

Michael Mauboussin – Research, Articles and Interviews (2015-2016)

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Capital Allocation Outside the U.S.

Evidence, Analytical Methods, and Assessment Guidance

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- Capital allocation is a senior management team's most fundamental responsibility. The problem is that many CEOs don't know how to allocate capital effectively. The objective of capital allocation is to build long-term value per share.
- In this report we examine the sources and uses of capital for Japan, Europe, Asia/Pacific excluding Japan, and Global Emerging Markets. This extends our analysis beyond the United States, which we discussed in a prior report.
- Countries or regions with a high return on invested capital (ROIC) can fund a substantial percentage of investment internally whereas those with low ROICs must rely more on external financing.
- Capital allocation is also determined by the largest sectors in a country's or a region's economy, the stage of economic development, cultural norms, and regulations.
- We provide a framework for assessing a company's capital allocation skills, which includes examining past behaviors, understanding incentives, and considering the five principles of capital allocation.

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Executive Summary

- We extend our analysis of capital allocation beyond the United States to other major world regions, including Japan, Europe, Asia/Pacific excluding Japan (APEJ), and Global Emerging Markets (GEM). For the prior report, see [Michael J. Mauboussin and Dan Callahan, "Capital Allocation: Evidence, Analytical Methods, and Assessment Guidance," *Credit Suisse Global Financial Strategies*, August 5, 2014.](#)
- Capital allocation is the most fundamental responsibility of a senior management team of a public corporation. The problem is that many CEOs, while almost universally well intentioned, generally don't know how to allocate capital effectively. The proper goal of capital allocation is to build long-term value per share. The emphasis is on building value and letting the stock market reflect that value. Companies that dwell on boosting their short-term stock price frequently make decisions that are at odds with building value.
- Regions and countries vary in the source of funding for capital. In general, high return on investment is associated with an ability to internally fund a substantial percentage of investments. Countries that largely finance investments internally include the U.S., the U.K., and Germany. Countries that require a higher proportion of external financing include France, Japan, and China.
- Academic research shows that rapid asset growth is associated with poor total shareholder returns in most regions of the world. Further, companies that contract their assets often create substantial value per share. But these findings are more robust in developed markets than in developing markets. Making investments that earn a return in excess of the opportunity cost is the key to creating value.
- Ultimately, the answer to all capital allocation questions is, "It depends." Most actions are either foolish or smart based on the price and value. Similar to investors, companies tend to buy when times are good and retreat when times are challenging, failing to take advantage of gaps between price and value.
- Past spending patterns are often a good starting point for assessing future spending plans. Once you know how a company spends money, you can dig deeper into management's decision-making process. Further, it is useful to calculate return on invested capital and return on incremental invested capital. These metrics can provide a sense of the absolute and relative effectiveness of management's spending.
- Understanding incentives for management is crucial. Assess the degree to which management is focused on building value and addressing agency costs.
- The five principles of capital allocation include: zero-based capital allocation; fund strategies, not projects; no capital rationing; zero tolerance for bad growth; and know the value of assets and be prepared to take action.

Summary of Global Capital Allocation

- Mergers and acquisitions (M&A), capital expenditures, research and development (R&D), and net working capital are the uses of capital for internal investment. How companies invest internally varies substantially by region. (See Exhibit 1.) Here are some of the main observations based on spending in recent decades:
 - M&A is the largest use of capital in the U.S., Europe, and GEM, the second largest use in APEJ, and the fourth largest use in Japan. The rarity of M&A in Japan is of particular note.
 - Capital expenditures are the largest use of capital in Japan and APEJ and the second largest use in the U.S., Europe, and GEM. The range in spending, measured as a percentage of sales, was twice as large for M&A as it was for capital expenditures.
 - R&D is the second largest use of capital in Japan, the third largest in the U.S. and Europe, and the fourth largest in APEJ and GEM. Developed markets spend substantially more on R&D than developing markets do.
 - Net working capital is the third largest use of capital in Japan, APEJ, and GEM, and the smallest use in the U.S. and Europe. This disparity likely reflects the differences in the businesses in the respective economies.
- Divestitures play a significant role in each of the regions, constituting roughly one-third to one-half the level of total M&A. They are also larger than dividends and share buybacks in all regions but Japan.
- Dividends substantially exceed share buybacks in all regions except the U.S., where they have been roughly equivalent on average. Buybacks are modest in Europe and fairly insignificant in Japan, APEJ, and GEM.
- Share buybacks have been meaningful in countries that embrace the Anglo-Saxon model and inconsequential in nearly all other regions. This pattern reflects cultural and regulatory constraints.

Exhibit 1: Capital Deployment – Historical Averages for U.S., Japan, Europe, APEJ, and GEM

	Uses of Capital (As a Percentage of Sales)							Economic Returns and Growth	
	M&A	Capex	R&D Expense	Net Working Capital	Gross Buybacks	Divestitures	Dividends	CFROI*	Real Asset Growth Rate
U.S.	10.4%	7.1%	2.2%	0.8%	2.1%	3.3%	2.2%	8.5%	5.6%
Japan	1.2%	4.6%	2.1%	1.2%	0.2%	0.4%	0.6%	3.0%	3.3%
Europe	9.7%	7.0%	2.0%	1.5%	0.6%	5.1%	2.2%	6.7%	3.9%
APEJ	10.2%	10.5%	0.8%	2.8%	0.4%	5.1%	2.6%	6.4%	9.8%
GEM	15.8%	12.1%	0.3%	3.7%	0.5%	6.5%	3.2%	6.3%	9.3%

Source: Credit Suisse HOLT.

Note: For uses of capital, historical averages are based on the following years: U.S. (1980-2013), Japan (1985-2013), Europe (1985-2013), APEJ (1992-2013), GEM (1992-2013). For CFROI® and Real Asset Growth Rates, historical averages are based on the years 1993-2013 for all regions.

* Cash Flow Return on Investment, or CFROI,® is a registered trademark in the United States and other countries (excluding the United Kingdom) of Credit Suisse Group AG or its affiliates.

Introduction

Capital allocation is the most fundamental responsibility of a senior management team of a public corporation. Successful capital allocation means converting inputs, including money, things, ideas, and people, into something more valuable than they would be otherwise. The net present value (NPV) test is a simple, appropriate, and classic way to determine whether management is living up to this responsibility. Passing the NPV test means that \$1 invested in the business is worth more than \$1 in the market. This occurs when the present value of the long-term cash flow from an investment exceeds the initial cost.

Why should value determine whether a management team is living up to its responsibility? There are two reasons. The first is that companies must compete. A company that is allocating its resources wisely will ultimately prevail over a competitor that is allocating its resources foolishly. The second is that inputs have an opportunity cost, or the value of the next best alternative. Unless an input is going to its best and highest use, it is underperforming relative to its opportunity cost.

The process of making inputs more valuable has a number of aspects. A logical starting point is a strategy. Properly conceived, a strategy requires a company to specify the trade-offs it will make to establish a position in the marketplace that creates value. A strategy also requires a company to align its activities with its positioning and to execute effectively.¹

Since a company's strategy is often already in place when a new chief executive officer (CEO) takes over, capital allocation generally becomes his or her main responsibility. While a proper and comprehensive discussion of capital allocation requires a consideration of intangible and human resources, our focus here is on how companies spend money.

The problem is that many CEOs, while almost universally well intentioned, don't know how to allocate capital effectively. Warren Buffett, chairman and CEO of Berkshire Hathaway, describes this reality in his 1987 letter to shareholders. He discusses the point of why it is beneficial for Berkshire Hathaway's corporate office to allocate the capital of the companies it controls. Buffett is worth quoting at length:²

This point can be important because the heads of many companies are not skilled in capital allocation. Their inadequacy is not surprising. Most bosses rise to the top because they have excelled in an area such as marketing, production, engineering, administration or, sometimes, institutional politics.

Once they become CEOs, they face new responsibilities. They now must make capital allocation decisions, a critical job that they may have never tackled and that is not easily mastered. To stretch the point, it's as if the final step for a highly-talented musician was not to perform at Carnegie Hall but, instead, to be named Chairman of the Federal Reserve.

The lack of skill that many CEOs have at capital allocation is no small matter: After ten years on the job, a CEO whose company annually retains earnings equal to 10% of net worth will have been responsible for the deployment of more than 60% of all the capital at work in the business.

CEOs who recognize their lack of capital-allocation skills (which not all do) will often try to compensate by turning to their staffs, management consultants, or investment bankers. Charlie [Munger] and I have frequently observed the consequences of such "help." On balance, we feel it is more likely to accentuate the capital-allocation problem than to solve it.

In the end, plenty of unintelligent capital allocation takes place in corporate America. (That's why you hear so much about "restructuring.")

Intelligent capital allocation requires understanding the long-term value of an array of opportunities and spending money accordingly. It also includes knowing the value of a firm's individual assets and being willing to sell them when they are worth more to others.

We believe that long-term growth in value per share should guide capital allocation decisions. A necessary corollary is that there is a time when shrinking the business is the most beneficial course for ongoing shareholders. In some cases, for instance, buying back shares is a wiser choice than expanding by means of capital expenditures or acquisition.

Capital allocation is a dynamic process, so the correct answer to most questions is, "It depends." Sometimes acquiring makes sense and other times divesting is the better alternative. There are times to issue equity and times to retire it. Because the components that determine price and value are changing constantly, so too must the assessments that a CEO makes. As Buffett says, "The first law of capital allocation—whether the money is slated for acquisitions or share repurchases—is that what is smart at one price is dumb at another."³

Buffett also discusses what he calls the "institutional imperative," a force that is also pertinent.⁴ The force has multiple aspects as he describes it, but a pair of them are relevant here. One is that subordinates will readily create spreadsheets and studies to support the business craving of the leader. Another is that companies will "mindlessly" imitate one another, whether in M&A or executive compensation.

The message here should be clear. A decision isn't good just because someone in the organization can justify it or because some other company is doing it. Proper capital allocation requires a sharp analytical framework and independence of mind.

In our experience, very few CEOs, and chief financial officers for that matter, have what we call the "North Star of value." The North Star is not the brightest star, but it doesn't move much throughout the night or year. As a result, it provides a reliable sense of direction. Likewise, companies that have a North Star of value have an unwavering view of value no matter what is going on. It is common for executives to solicit input from a range of stakeholders, hear varying points of view, and walk away confused and unsure about the proper course of action. This doesn't happen to executives with the North Star of value, especially since they may have better information about their company's prospects than the market does.

Incentives are another barrier to proper capital allocation. An executive who is paid to deliver a target based on short-term earnings per share may well act very differently than an executive who is focused on building long-term value per share. In assessing management, ask a fundamental question: If there is a conflict between maximizing a reward based on the incentive plan and creating long-term value per share, which route will the executive select?

William Thorndike's excellent book, *The Outsiders: Eight Unconventional CEOs and Their Radically Rational Blueprint for Success*, inspired our reports on capital allocation.⁵ Thorndike shares the stories of eight CEOs who created tremendous value per share during their tenures. One theme that comes out clearly in the book, and is explicit in the subtitle, is that these CEOs appeared out of step with conventional wisdom as they were building value. The North Star of value guided their decisions and they had the independence of mind to make the best choices.

This report has three parts:

1. **Groundwork.** This part starts by showing the sources of capital by region. We then specify a framework for considering the economic virtue of each form of capital allocation based on academic research.
2. **Capital allocation by region.** This section documents capital allocation by region, providing historical context, CFROIs and rates in asset growth, and the trends in capital allocation.
3. **Assessing a company's capital allocation skills.** This part discusses methods to assess past capital allocation choices, how to evaluate incentives, and the five principles of capital allocation.

Part I: Groundwork – Where Does the Money Come From and Where Has It Gone?

If the job of management is to deploy capital so as to add value, it makes sense to start with a discussion of where capital comes from and how management teams have spent it in the past. The sources of capital include the cash the business generates and access to the capital of claimholders, including debtors and shareholders. A company can also sell an asset, which is a one-time realization of the cash flow the asset is expected to generate over its life.

Businesses that grow rapidly generally require a sizeable amount of investment. For example, imagine a restaurant concept that is highly successful. To satiate demand that firm must build lots of restaurants and hence invest a substantial sum in order to expand. The rate of return on incremental capital is the maximum growth rate in operating profit a business can reach without external financing. By extension, a company with a return on invested capital (ROIC) higher than its growth rate will generate surplus capital.⁶

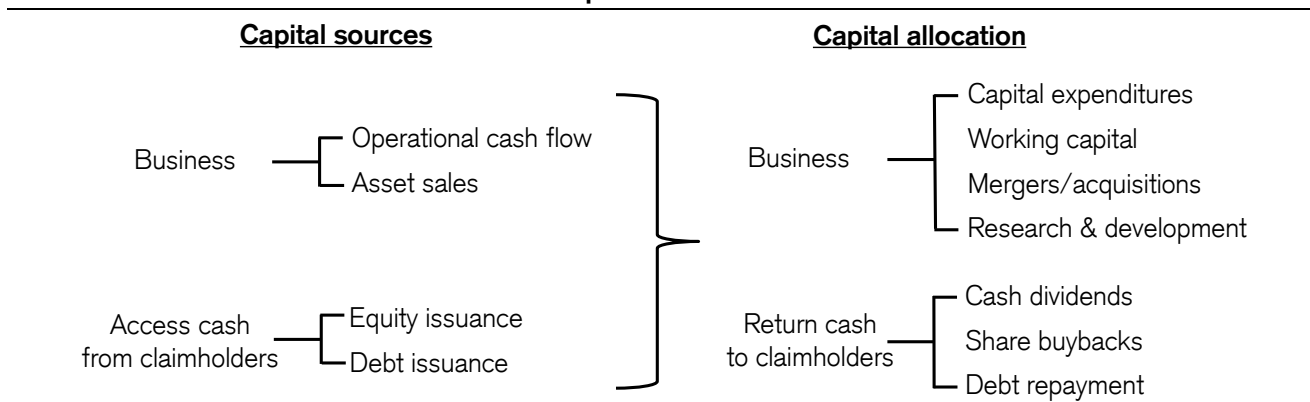
Companies that cannot fund their growth internally must access cash externally, either by borrowing or selling equity. The pecking order theory is an idea in corporate finance that says that managers of companies will typically choose to fund investments first with cash that the company generates internally, next with debt, and finally with equity.⁷ One essential tenet of thoughtful capital allocation is that all capital has an opportunity cost, whether the source is internal or external.

The uses of capital are where money goes. Executives can invest in the business through capital expenditures, increases in working capital, research and development, or mergers and acquisitions. These investments allow a company to grow. But growth, in and of itself, is never the goal of a thoughtful capital allocator. The proper metric of success is an increase in long-term value per share.

A company can also return cash to debt and equity holders. Debt repayment, a return of some or all principal and interest a company owes, is straightforward. A company can return cash to shareholders either by paying a dividend, where all holders receive the same amount, or by buying back stock. In a buyback, shareholders sort themselves. Those who want cash sell their shares and those who want to increase their stake in the company hold their shares. A dividend treats all shareholders the same no matter what the stock price.

In a buyback, selling shareholders benefit at the expense of ongoing shareholders if the stock is overvalued, and ongoing shareholders benefit at the expense of selling shareholders if the stock is undervalued. All shareholders are treated uniformly only if the stock price is at fair value.⁸

Exhibit 2 summarizes the sources and uses of financial capital. These follow closely the alternatives and choices that Thorndike specifies in *The Outsiders*.

Exhibit 2: Sources and Uses of Financial Capital

Source: Credit Suisse.

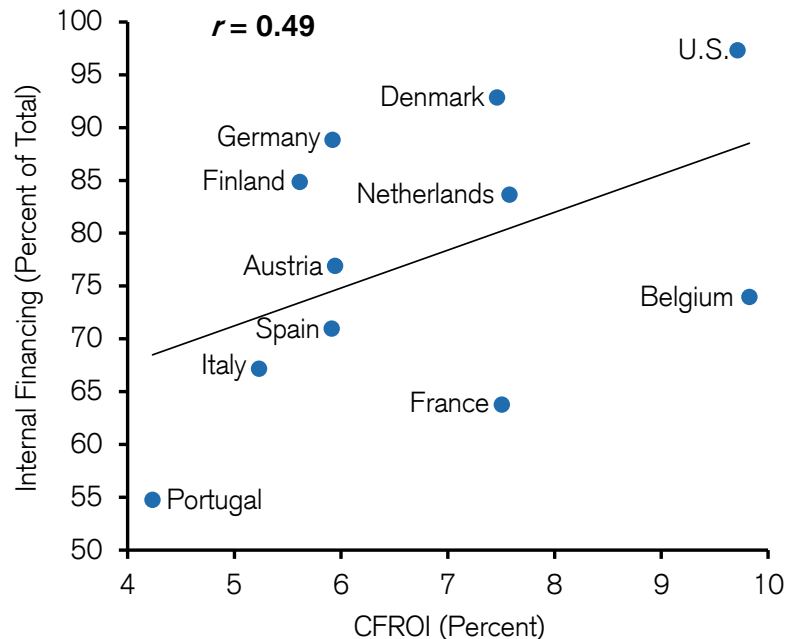
Sources of Capital

Internal financing, or the cash generated by the businesses, is the largest source of capital for most countries and regions and typically falls in the range of 60 to 90 percent. Issuance of new debt is the next most significant source of capital. The issuance of equity varies a great deal by region, and companies in developed economies commonly retire as much equity as they issue.

The ratio of internal financing to the total source of capital tends to correlate with the underlying return on invested capital for the country. A country with a high ROIC can fund a higher percentage of its investments with internally-generated cash than a country with a low ROIC. Exhibit 3 shows this correlation, using cash flow return on investment (CFROI) as a measure of return on investment. The data reflect the average of the ten years ended 2013.⁹

There are pros and cons to having internal financing represent a high percentage of investment funding. The pro is that companies are earning high returns on capital in general and need not rely on capital markets to fund their growth. The con is that companies can deploy internally-generated funds into value-destroying investments. The need to raise money from the capital markets creates a check on management's spending plans.

Indeed, Peter Bernstein, the renowned financial historian and economist, once suggested that all companies should be required to pay out 100 percent of their earnings and then appeal to the markets when they want funds for investment. He argued that markets are more effective than companies at allocating capital, and as a result the overall effectiveness of capital allocation would improve if left to the devices of the market.¹⁰

Exhibit 3: Relationship between CFROI and Internal Financing Capability (2004-2013 Average)

Source: Europe: Eurostat European Sector accounts; U.S.: Board of Governors of the Federal Reserve System, Division of Research and Statistics, Flow of Funds Accounts Table F.102; Credit Suisse.

Before delving into each of the specific uses of capital, it is worth considering what the academic research says about capital allocation. A key finding is that asset growth rates are strong predictors of future abnormal returns to shareholders in countries with developed financial markets. The effect is weaker, if present, in developing economies.¹¹

More specifically, developed markets firms with low asset growth rates earn substantially higher shareholder returns, after adjusting for risk, than firms with high asset growth rates. Further, companies that contract their assets tend to generate higher shareholder returns than companies that expand their assets.

High returns to shareholders tend to follow events such as spin-offs, dividend initiations, share repurchases, and debt prepayments, whereas low returns to shareholders generally follow events such as acquisitions and stock and debt issuance.

A global study of 40 countries reveals that from 1982-2010 the relationship between asset growth and shareholder results was strong in Europe, with 14 of the 17 countries in the study showing the relationship (Greece, Italy, and Portugal were the exceptions). The economies in APEJ also overwhelmingly exhibit the asset growth effect, including 10 of the 13 countries in the study (the result didn't hold for China, Taiwan, or the Philippines).

Unlike most developed countries, developing economies do not demonstrate a significant asset growth effect. Of the 14 developing economies in the study, only 2 exhibited a strong asset growth effect.

The academic research also supports the point that growth is not inherently good. We must recognize that context is very important. The correct answer to almost every capital allocation question is, "It depends." We need to look beyond base rates, as informative as they are, to understand what truly drives or impedes value creation.

Uses of Capital

We now turn to the details of the major uses of capital. We discuss how to assess each alternative from an economic standpoint and summarize the findings of the empirical research. The subsequent part reviews the details of the historical trends for the uses of capital in each region.

Mergers and Acquisitions. M&A is a major source of redistribution of corporate resources. For many companies, M&A is the most significant means to pursue strategic goals and the most costly way to do so. Nearly all companies and investment portfolios will feel the effect of M&A at some point. Consider that over the past twenty years, M&A volume as a fraction of the total equity market capitalization has averaged 12 percent in Europe, 9 percent in the U.S., 8 percent in GEM, 7 percent in APEJ, and 3 percent in Japan.

M&A tends to follow the stock market closely, with more M&A activity when the stock market is up. It comes as no surprise that companies that act early in an M&A cycle tend to generate higher returns than those that act later. The first movers in an M&A wave enjoy the benefits of a larger pool of acquisition targets and cheaper valuations than companies that acquire later in the cycle. Later acquirers are encouraged to act based on bandwagon effects, or what Buffett calls the institutional imperative, and an accommodating environment for financing.¹²

One of the most effective ways to assess the merit of a deal is to compare the present value of incremental cash flow, the result of synergy, to the premium the acquirer agrees to pay.¹³ If the synergy exceeds the premium, the deal will add value for the buyer. If the synergy is less than the premium, the buyer will see its shares decline. The relationship between synergy and premium is more explanatory than the measures that companies and investors commonly use, including earnings accretion or dilution.¹⁴

Here's an example. Assume that the market capitalization is \$2,000 for the buyer and \$800 for the seller. The buyer bids \$1,000 for the seller, representing a \$200 premium. If the synergy is only \$100, the market capitalization of the buyer will slump to \$1,900 and the seller will receive \$1,000. If, on the other hand, the synergy is \$300, the market capitalization of the buyer will rise to \$2,100 as the seller receives \$1,000.

Although the key factors in judging M&A are the synergy and the premium, only the premium is explicit. While companies today generally provide some guidance for expected synergy, the investor must still assess the likelihood that the company will achieve the objective. M&A creates value in the aggregate as the combined value of the buyer and target is almost always higher after a deal is announced than before. But buyers commonly overpay, which means the seller's shareholders often capture the value of the synergy.

Capital Expenditures. Capital expenditures have been the largest source of investment in Japan and APEJ, and are a large percentage of spending in GEM. As a broad rule of thumb, spending on capital expenditures, measured as a percentage of sales, is larger in developing countries than in developed countries. Further, the growth in capital expenditures tends to come with low variance, which means that executives want to keep the spending steady.

Executives and investors frequently distinguish between "maintenance" capital expenditures and total capital expenditures. Maintenance spending is the minimum required to maintain or replace the long-term assets in place. We can assume that capital expenditures beyond the maintenance level are in pursuit of growth.

Depreciation expense serves as a rough proxy for maintenance capital spending.¹⁵ Measured as a percentage of sales, growth capital expenditures range from one-fifth to one-half of overall capital expenditures across the different regions. That maintenance capital expenditures are essential explains a good deal of the stability of

spending. Further, it suggests that in assessing the value creation prospects of capital expenditures, you are best served to focus on the component that supports growth.

The stock market tends to favorably greet increases in capital expenditures for companies that have attractive returns on invested capital and a good record of past spending. The market expresses skepticism at increases for low return on capital businesses or businesses that are at or near a cyclical peak.¹⁶

Research and Development. Unlike M&A and capital expenditures, R&D is an expense on the income statement rather than invested capital on the balance sheet. Accountants expense R&D in the period the company incurs it, notwithstanding the potential long-term benefits, because they deem the outcomes too uncertain and difficult to quantify. We can define R&D as a set of activities that seeks to develop new products or the tools to create new products.

In the U.S., businesses account for about 70-75 percent of total R&D spending, with the government and academia splitting the other 25-30 percent. The industries that spend the most include information technology, healthcare, materials, and aerospace and defense. Technology and healthcare combined represent more than two-thirds of all R&D spending in the U.S., and technology R&D spending is roughly 1.5 times that of healthcare.

R&D spending averages about two percent of revenues in developed economies including the U.S., Japan, and Europe. That ratio is less than one percent in APEJ and GEM. The U.S., China, and Japan together represent more than half of global R&D spending, and ten countries account for about 80 percent of the total. At current rates of funding and growth, China will surpass the U.S. as the largest spender on R&D in the year 2022.¹⁷

The academic research on the effectiveness of R&D spending is somewhat equivocal, in part because of the measurement challenges and the decline in R&D productivity in the pharmaceutical industry. One of the best ways to study the market's reaction to any form of investment is to examine unexpected changes. In one such study, finance professors studied more than 8,000 unexpected increases in R&D spending over a 50-year period ended in 2001 and found that the stocks of those companies rose.¹⁸ Other researchers conclude that the returns to R&D are positive and higher than other capital investments.¹⁹

A reasonable question is whether the stock market effectively reflects R&D spending. One large study found that the market does it well. This means that companies that spend a large percentage of sales on R&D realize similar stock market returns as companies that spend a small percentage of sales on R&D. The researchers came to similar conclusions for advertising expenses, which are about one-half as large as R&D expenses in the aggregate.²⁰

Academics have also found that larger companies that acquire their R&D by buying businesses that are R&D intensive tend to fare poorly in the stock market.²¹ This is consistent with the view that the value of R&D in an acquisition ultimately accrues to the seller, not the buyer. That said, companies with strong execution capabilities can create value by enhancing R&D effectiveness.²²

One study focused specifically on Japan found that the stock market properly reflected R&D spending. Specifically, it showed that companies that spent a large percentage of sales on R&D realized similar total shareholder returns as companies that spent a small percentage.²³

Some recent research suggests that the technology companies in the U.S. that are in the bottom one-third of R&D spending as a percentage of sales deliver higher returns to shareholders than those in the top third.²⁴

This finding underscores how tricky it is to assess R&D spending because a number of technology companies have benefitted from R&D that was funded by the government.

Mariana Mazzucato, a professor of economics at the University of Sussex, addresses this issue in her provocative book, *The Entrepreneurial State*.²⁵ Her thesis is that the government funds a great deal of high-risk R&D that companies go on to exploit commercially.

She uses the vivid example of the iPhone from Apple Inc., a company that has created a huge amount of shareholder value in the past decade. Four of the main technologies inside the iPhone, including the Global Positioning System (GPS), the Internet, touch screen, and voice recognition software, were developed by the U.S. government. As Mazzucato notes, Apple did a brilliant job of integrating these technologies, designing an attractive and intuitive product, and marketing effectively. But it did not develop some of the key technologies inside the phone, which means the company's shareholders did not have to shoulder those expenses.

Net Working Capital. Net working capital is the capital a company requires to run its day-to-day operations. It is defined as current assets minus non-interest-bearing current liabilities. The primary components of net working capital include inventory, accounts receivable, and accounts payable. Interest-bearing current liabilities, which include short-term debt and the current maturities of long-term debt, are a form of financing and are therefore not part of net working capital.

For the purpose of capital allocation, we analyze the change in net working capital. Net working capital is a substantially larger use of capital in developing markets than in developed markets. For instance, changes in net working capital were 3.7 percent of sales in GEM and 2.8 percent in APEJ compared to 1.5 percent of sales or less in Europe, Japan, and the U.S.

Divestitures. Companies use divestitures to adjust their business portfolio. Actions include the sale of divisions, spin-offs, and equity carve-outs. A company will divest an operation when it perceives the value to another owner to be higher, or if the divestiture adds focus to the parent and hence improves results.

There are a few considerations in assessing divestitures. First, research has established that most of the value creation for a typical company comes from a relatively small percentage of its assets.²⁶ This means that most companies have businesses or assets that do not earn the cost of capital and that may be more valuable to another owner.

Divestitures can lead to "addition by subtraction" when a company that divests an operation with a low return on invested capital receives more than what the business is worth as an ongoing part of the firm. So there's an addition of value to the company even as there's a subtraction in the size of the firm.

Second, we have already reviewed the evidence showing that M&A creates value in the aggregate but that acquirers struggle to capture much, if any, of that value. This suggests that it is better to be a seller than a buyer on average. This point is particularly relevant when there are multiple bidders for an asset. Contested deals frequently lead to what economists call the "winner's curse."²⁷ When this occurs, the "winner" of the bidding pays too much for the asset, hence the "curse." The winner's curse means that there is a wealth transfer, above and beyond the value of the asset, from the buyer to the seller.

Finally, most companies have a natural tendency to want to grow rather than shrink. As companies grow and diversify, capital allocation and strategic control can become more challenging. When a CEO who understands capital allocation takes the helm of a company with underperforming assets, there is a great opportunity to create value through divestitures.²⁸

Notwithstanding their significance in capital allocation, divestitures have received substantially less attention than M&A in the academic literature. Research for the most part concludes that divestitures create value. A meta-analysis of nearly 100 studies on divestitures concludes: "In the broadest possible terms, our results suggest that on average, divestiture actions are associated with positive performance outcomes for the divesting parent firm."²⁹

Analysis also shows that spin-offs create value for the spin-offs themselves as well as the corporate parents.³⁰ Researchers who did a meta-analysis of more than 25 papers in the spin-off literature summed up their findings this way: "The main conclusion is consistent: spin-offs are associated with strongly significant abnormal returns."³¹ They suggest the factors that explain these wealth effects include sharpened focus, better information, and in some cases tax treatment.

Dividends. A dividend is a cash payment to a shareholder that is generally paid from profits. Dividends and share buybacks are the main ways companies return cash to shareholders. Companies can also return cash to shareholders by selling the company for cash.

The most profound difference between buybacks and dividends may be the attitude of executives. Most executives believe that once a dividend is established, paying it is on par with investment decisions such as capital spending. In contrast, they tend to view buybacks as something to do with residual cash flow after the company has made all investments that are appropriate.³²

There are a couple of consequences of this difference in attitude. The first is that dividend payments are vastly less volatile than buybacks. Indeed, of all the capital allocation options, dividends have among the lowest standard deviation in growth.

How should investors assess dividends? First, dividends are useful to consider in the context of cash flow. To sustain a cash dividend, a company has to generate cash flow beyond the basic needs to maintain the business and support its growth. So an investor should gauge a company's cash flow prospects in order to anticipate a company's ability to pay dividends.³³

Second, dividends can play an important role in the capital accumulation rate, also known as total shareholder return (TSR). From time to time you hear that dividends provide the bulk of shareholder returns for equities in the long run. That assertion is wrong if you assume the goal of an investor is to accumulate capital. In fact, price appreciation is the only source of investment return that increases accumulated capital over time.³⁴

The equity rate of return is a one-period measure and is simply the sum of stock price appreciation and the dividend. The capital accumulation rate, or TSR, is a multi-period measure that assumes all dividends are reinvested in the stock. Knowing price appreciation and dividend yield, the following equation allows you to calculate TSR:

Total shareholder return (TSR) = Price appreciation + [(1 + price appreciation) * dividend yield]

The value of the compounding reinvested dividends means that the equity rate of return is always lower than the TSR as long as price appreciation is positive. For example, assume price appreciation of 7 percent and a dividend yield of 2 percent. The equity rate of return is 9 percent (.07 + .02) and the TSR is 9.14 percent (.07 + [(1 + .07)*.02]).

The key is that for an investor to actually earn the TSR, all of the dividends they receive must be reinvested back into the stock. That's why price appreciation only determines the TSR.

It's crucial to acknowledge that almost no one earns the full TSR because most individuals do not reinvest the dividends they receive, and dividends are generally taxable. While there are no clear-cut data on the topic, it appears that only one-tenth of all dividend proceeds are reinvested. Naturally, investors can use dividends to consume. But if they do, they can't earn the TSR.

Further, most investors must pay taxes on the dividends they receive. The TSR declines when you assume that only a fraction is reinvested in the stock. Academic research supports the view that the tax rate on payouts affects shareholder returns.³⁵

Academic research on dividends supports a few points. To begin, older companies are more likely to pay dividends than younger companies. So any analysis of dividend yields must take into account the maturity of the population of companies under consideration.³⁶

Second, dividends provide a strong signal about management's commitment to distribute cash to shareholders and its confidence in the future earnings of the business. This is consistent with the managerial attitude that dividends are sacrosanct once declared. For this reason, companies are very deliberate about the decision to initiate a dividend.³⁷

Dividend payouts are generally more generous in developing markets than in developed markets. Dividends as a percentage of sales averaged 3.2 percent in GEM and 2.6 percent in APEJ in the past couple of decades, higher than the 2.2 percent in the U.S. and Europe. Japan's payout rate has been consistently below the average of other regions of the world, with dividends as a percentage of sales of 0.6 percent in the past 30 years.

Share Buybacks. A share buyback is the second way that a company can return cash to its shareholders. Whereas all shareholders are treated equally with a dividend, only shareholders who sell to the company receive cash. This means that shareholders realize very different outcomes based on whether they choose to sell or hold the stock when they deem it to be overvalued, fairly valued, or undervalued.

When assessing a repurchase program, investors and executives should consider the golden rule of share buybacks, which states: A company should repurchase its shares only when its stock is trading below its expected value and when no better investment opportunities are available.³⁸

The golden rule addresses both absolute and relative value. Companies should only invest where they anticipate a payoff that has a positive net present value. This is a fancy way of saying "you will get more than what you pay for." This absolute benchmark applies to all of a company's capital allocation decisions, including M&A, capital expenditures, and R&D.

The rule also addresses relative value when it emphasizes that companies should prioritize higher return internal investment opportunities over buybacks. Ideally, executives should rank their investment opportunities by expected return and fund them from highest to lowest. A company should expect that all of the investments it funds will earn above the cost of capital. There can be cases when buybacks are more attractive than investing in the business.³⁹

The second aspect of assessing a buyback is its impact on various shareholders under different conditions. Only if a stock trades exactly at intrinsic value do buybacks and dividends treat all shareholders the same. If a stock is overvalued or undervalued, the effect of a buyback is different for selling shareholders than it is for those who continue to hold.

From the company's standpoint, corporate value is conserved no matter how the company chooses to pay out cash. What differs is who wins and who loses as the result of buying stock below or above intrinsic value. Since management should focus on building value per share for continuing shareholders, it should always try to buy back shares that are undervalued.

To be more concrete, if a company buys back shares that are overvalued the selling shareholders gain at the expense of ongoing shareholders. The premium to intrinsic value accrues to the sellers and the value per share for the ongoing holders goes down accordingly.

If a company buys back shares that are undervalued the selling shareholders lose at the expense of ongoing shareholders. The discount to intrinsic value accrues to the ongoing shareholders and the selling shareholders fail to realize value.

This analysis suggests a couple of points that investors commonly overlook. First, if you are the shareholder of a company that is buying back stock, doing nothing is doing something. By choosing to hold the shares instead of selling a pro-rated amount, you are effectively increasing your percentage ownership in the company. One alternative is to sell shares in proportion to your stake, creating a homemade dividend and maintaining a steady percentage ownership in the business.

Second, it is logical that you would prefer that the companies you hold in your portfolio buy back stock rather than pay a dividend. If you own shares of companies that you think are undervalued, buybacks will increase value per share by definition. The only instance where this may not be true is if you believe that a dividend would provide a more powerful signal to the market, hence creating more value than a buyback.

Tying together these thoughts, there are basically three schools of thought regarding buybacks: fair value, intrinsic value, and accounting-motivated. The intrinsic value school is where you want to be if possible.

The fair value school takes a steady and consistent approach to buybacks. Management believes that over time it will buy back shares when they are both overvalued and undervalued, but for the most part when they are about fairly priced. This approach offers shareholders substantial flexibility as it allows them to hold shares and defer tax liabilities or create homemade dividends by selling a pro-rated number of shares.

The fair value school is consistent with the free cash flow hypothesis, which says that managers who have excess cash will invest it in projects with a negative net present value. By disbursing cash, a company buying back its shares reduces the risk of doing something foolish with the funds.⁴⁰ Research suggests that most companies would have been better off buying back stock consistently versus their actual behavior of buying heavily in some periods and lightly, or not at all, in others.⁴¹

The intrinsic value school believes a company should only buy back shares when it deems them to be undervalued. A company must have asymmetric information or beliefs, as well as analytical prowess, to profitably pursue this approach. Asymmetric information means that company management has information that the stock price fails to reflect. Differing beliefs occur when management has the same information as the market but comes to different conclusions about what that information means.

Analytical prowess means that the executives at the company know how to translate their differential view into an estimate of the relationship between the stock price and intrinsic value. Investors should not assume that management has this ability. Indeed, surveys consistently show that executives believe their stock to be cheap.

Management can act on its conviction by being bold with its buyback program, buying back a substantial percentage of the shares or even buying them at a premium to the prevailing price through a tender offer.⁴² This school fits the signaling hypothesis, which suggests that companies buy back shares when they deem them to trade below intrinsic value. Further, it is important to focus on actual share buybacks versus buyback announcements. The evidence supporting the signaling hypothesis is mixed, but 85 percent of CFOs believe that their buyback decision conveys information.⁴³

Boosting short-term accounting results, especially earnings per share (EPS), is what motivates the final school.⁴⁴ When surveyed, three-fourths of CFOs cite increasing EPS as an important or very important factor in the decision to buy back shares. Two-thirds of CFOs say that offsetting the dilution from option or other stock-based programs is important. This underscores another essential point: you should consider buybacks net of equity issuance.

The problem with the accounting-motivated school is that its actions are not necessarily aligned with the principle of value creation.⁴⁵ For example, there may be a case where buying back overvalued stock boosts EPS and helps management reach a financial objective that prompts a bonus. In this case the motivation is impure because management's proper goal is to allocate capital in an economically sound fashion for shareholders.

Investors assessing companies buying back stock should make an effort to determine which school the management is in. It can be the case that management buys back stock for the right reason and realizes accounting benefits as a result. That's fine. But investors should be on the lookout for companies that make decisions based on the accounting results without sufficient regard for the economic merits.

A couple of findings from the academic research are worth highlighting. The first is that it appears companies are increasingly using buybacks as a substitute for dividends.⁴⁶ As a result, total shareholder yield (sum of dividends and buybacks divided by equity market capitalization) may be a better indicator of a company's proclivity to pay out than a simple dividend yield.

Second, a global study found that share buybacks generate positive excess returns on balance, but that the results differed across regions. Buybacks led to positive excess returns in Japan, APEJ, and several prominent GEM countries, but did not do so in Europe. The researchers suggest the source of the positive returns is the ability of management teams to take advantage of undervalued stock prices.⁴⁷

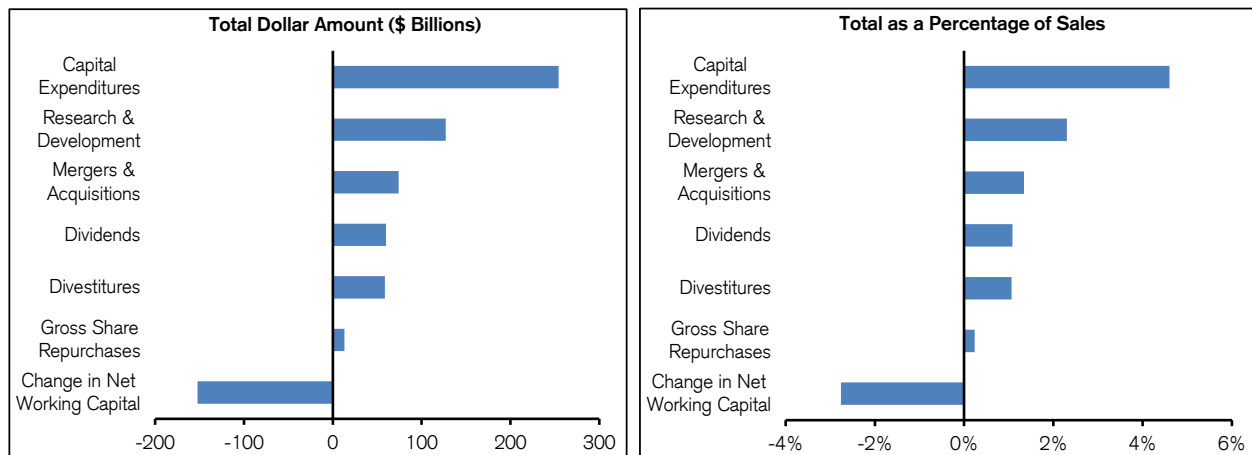
We now turn to capital allocation by region. Before we do, here's a quick comment on currency. Credit Suisse HOLT® converts the numbers based on local currencies into U.S. dollars using year-end exchange rates. This applies to R&D, capital expenditures, buybacks, dividends, and net working capital data. For M&A and divestitures, Thomson Reuters Datastream converts values in local currencies into U.S. dollars as of the effective date of the deal.

Part II: Capital Allocation by Region

Japan

Uses of Capital. Exhibit 4 shows how the top 1,000 companies in Japan, excluding companies in the financial services and regulated utility industries, deployed capital in 2013. While just a snapshot for a particular year, the ranking reasonably reflects how companies in Japan have allocated capital over time.

Exhibit 4: Japan Capital Deployment, 2013

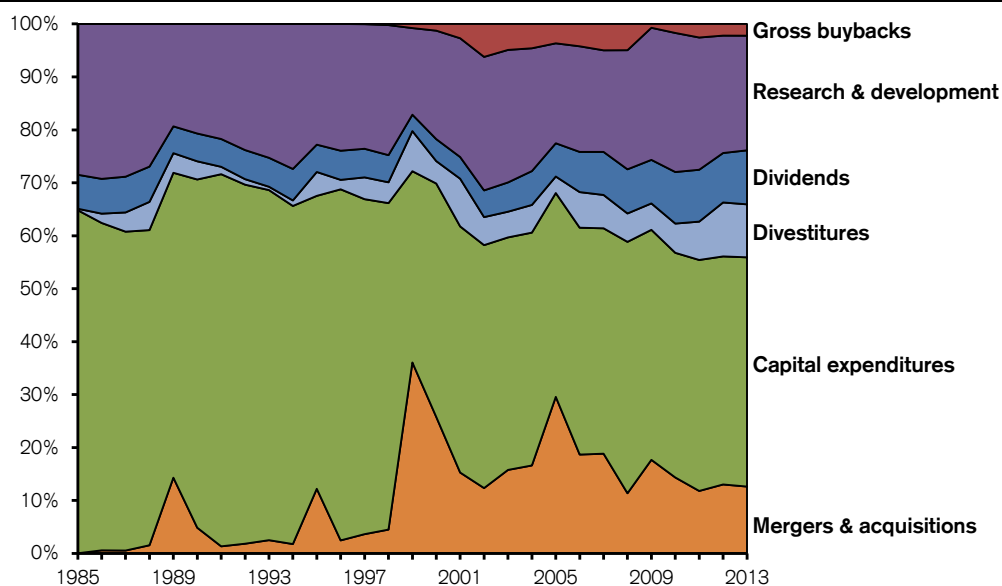


Source: Credit Suisse HOLT, Thomson Reuters Datastream.

Note: Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Exhibit 5 shows the breakdown of spending by source from 1985-2013. This graph excludes changes in net working capital because those values are negative in many years.

Exhibit 5: Japan Capital Deployment, 1985-2013



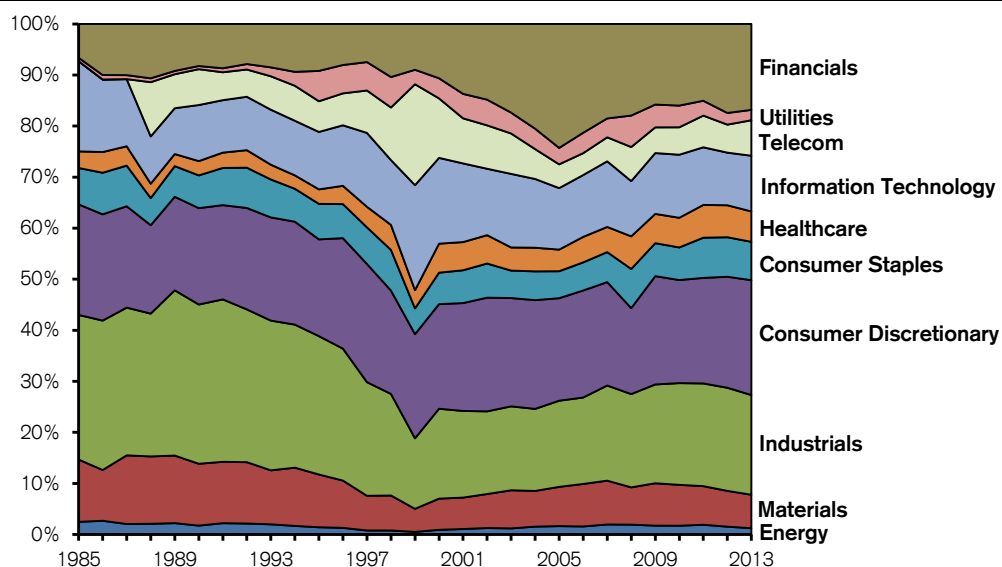
Source: Credit Suisse HOLT, Thomson Reuters Datastream.

Note: Data for R&D, capital expenditures, buybacks, and dividends exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Similar to 2013, capital expenditures and research and development (R&D) are the largest uses of capital over time. An examination of the changes from 1985 through 2013 reveals some noteworthy patterns:

- Capital expenditures are by far the largest use of capital. Historically, capital expenditures have been more than double the level of R&D spending and nearly four times that of M&A. Capital expenditures have been fairly steady over time. In 2013, they were 4.6 percent of total sales, in line with the long-term average. But the fraction of capital expenditures to the total sum that companies allocate has declined over the decades. This reflects a change in the composition of the economy, with businesses that require less capital investment replacing those that require more. (See Exhibit 6.) For example, the energy, materials, and industrial sectors represented 43 percent of the market capitalization of the top 1,000 companies in the Japanese market in 1985 but just 27 percent in 2013.
- R&D spending has shown a gradual rise from 1.6 percent of sales in 1985 to 2.3 percent in 2013. These levels make Japan one of the world's leaders in R&D spending, and the ratio has been steady over the years. Japan's large presence in R&D-intensive sectors explains its level of spending.
- M&A plays a much smaller role in Japan than it does in other major countries and regions. M&A volume was only 1.3 percent of sales in 2013, slightly above its long-term average. Legal and cultural factors explain why M&A was negligible until the late 1990s. For much of Japan's history, society frowned on M&A and gaining approval for deals was difficult because of the interlocking and diffuse ownership structure of corporations. M&A activity picked up when Japan instituted new laws to increase investor protection and as the legacy corporate ownership structure began to change.
- The return of cash to shareholders through dividends and buybacks was paltry before Japan adopted a series of regulatory reforms in the 1990s. The government first made buybacks legal in 1994 and then made their tax treatment less punitive a few years later. Further, corporate governance reforms that were friendly to investors spurred more M&A activity and boosted corporate payouts overall. The buyback yield (buybacks as a percentage of total market capitalization) went from zero in 1985-1999 to 0.7 percent in 2000-2013, while the dividend yield rose from 0.8 percent to 1.5 percent.

Exhibit 6: Japan Sector Composition, 1985-2013



Source: Credit Suisse HOLT.

Note: Data for telecom sector not available for 1985-1987.

Exhibit 7 shows a detailed history of capital deployment from 1985-2013. It is worth noting that the standard deviations of the growth rates, which appear in the bottom row, are small for R&D, capital spending, and dividends, relative to those of M&A, buybacks, and divestitures. Standard deviation is a measure of how much something varies from an average. These standard deviations provide a glimpse into how managers think about each use of capital. The lower the standard deviation, the more sacrosanct management deems that investment. Exhibit 8 represents the same deployment numbers as a percentage of sales.

Exhibit 7: Japan Capital Deployment, 1985-2013

	Total Amount (in Millions of U.S. Dollars, Nominal)						
	M&A	Capex	R&D Expense	Net Working Capital	Gross Buybacks	Divestitures	Dividends
1985	16	44,556	19,587		0	195	4,410
1986	490	52,818	24,989	88,196	0	1,506	5,610
1987	641	71,607	34,297	176,415	0	4,317	8,027
1988	2,318	89,859	40,667	84,746	0	8,050	10,056
1989	29,187	117,537	39,471	59,385	0	7,563	10,340
1990	10,796	146,516	46,093	94,765	0	7,656	11,691
1991	3,333	175,620	54,291	79,912	0	3,490	13,117
1992	4,235	156,984	55,134	-9,894	0	2,407	12,721
1993	6,091	161,217	61,629	59,731	0	1,541	13,320
1994	4,544	164,543	70,556	105,540	0	2,690	15,323
1995	38,939	176,516	72,727	32,170	0	14,400	16,471
1996	7,018	189,588	68,429	-94,761	12	5,117	15,742
1997	9,858	171,616	63,842	-80,287	99	11,177	14,646
1998	14,046	192,795	76,786	84,146	657	12,286	16,058
1999	199,963	200,309	90,712	46,405	4,293	42,061	17,170
2000	108,727	186,093	86,484	-172,521	5,331	17,875	17,506
2001	53,169	161,875	78,119	-122,453	9,406	31,392	14,263
2002	43,187	160,612	88,275	43,165	21,763	18,533	17,659
2003	64,538	179,768	102,443	99,918	20,062	19,881	22,624
2004	79,910	211,615	111,609	79,118	22,091	25,151	30,788
2005	161,370	210,119	103,010	-66,505	19,943	17,011	34,298
2006	100,628	231,025	107,552	48,028	22,736	36,246	40,930
2007	117,557	265,739	119,782	76,740	31,077	39,308	50,749
2008	74,231	310,337	147,072	231,476	32,375	35,061	54,492
2009	92,125	226,488	130,087	-10,492	3,754	26,033	42,854
2010	83,900	248,281	153,694	206,884	9,931	32,351	56,961
2011	76,818	284,180	162,703	117,679	16,676	47,187	63,800
2012	85,784	283,860	146,160	-72,466	14,477	67,142	61,536
2013	74,102	254,230	127,127	-152,247	13,002	58,761	59,875
CAGR	35.3%	6.4%	6.9%	-202.0%	NA	22.6%	9.8%
St. Dev.	650.1%	14.4%	13.3%	428.0%	243.1%	159.5%	15.7%

Source: Credit Suisse HOLT, Thomson Reuters Datastream, and Credit Suisse.

Note: Dollar amounts not inflated. Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries. The standard deviation for buybacks covers 1996-2013.

Exhibit 8: Japan Capital Deployment, 1985-2013

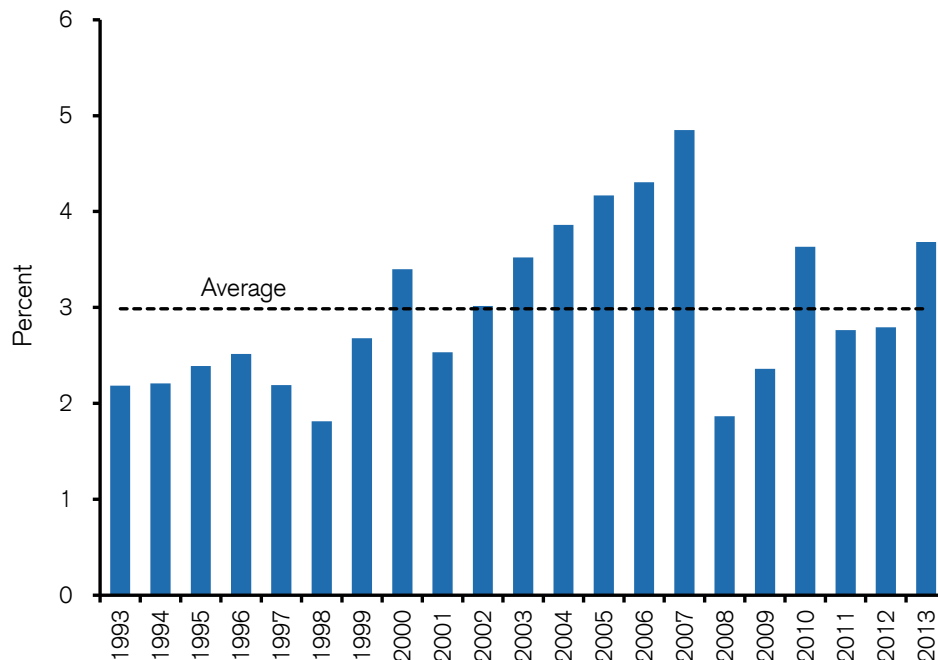
	As a Percentage of Sales						
	M&A	Capex	R&D Expense	Net Working Capital	Gross Buybacks	Divestitures	Dividends
1985	0.0%	3.7%	1.6%		0.0%	0.0%	0.4%
1986	0.0%	3.9%	1.8%	6.4%	0.0%	0.1%	0.4%
1987	0.0%	3.7%	1.8%	9.2%	0.0%	0.2%	0.4%
1988	0.1%	4.1%	1.9%	3.9%	0.0%	0.4%	0.5%
1989	1.3%	5.1%	1.7%	2.6%	0.0%	0.3%	0.4%
1990	0.4%	5.4%	1.7%	3.5%	0.0%	0.3%	0.4%
1991	0.1%	5.8%	1.8%	2.6%	0.0%	0.1%	0.4%
1992	0.1%	5.3%	1.8%	-0.3%	0.0%	0.1%	0.4%
1993	0.2%	5.0%	1.9%	1.8%	0.0%	0.0%	0.4%
1994	0.1%	4.4%	1.9%	2.8%	0.0%	0.1%	0.4%
1995	1.0%	4.6%	1.9%	0.8%	0.0%	0.4%	0.4%
1996	0.2%	5.3%	1.9%	-2.6%	0.0%	0.1%	0.4%
1997	0.3%	5.2%	1.9%	-2.5%	0.0%	0.3%	0.4%
1998	0.4%	5.3%	2.1%	2.3%	0.0%	0.3%	0.4%
1999	5.0%	5.0%	2.3%	1.2%	0.1%	1.1%	0.4%
2000	2.9%	4.9%	2.3%	-4.5%	0.1%	0.5%	0.5%
2001	1.6%	4.9%	2.4%	-3.7%	0.3%	1.0%	0.4%
2002	1.2%	4.3%	2.4%	1.2%	0.6%	0.5%	0.5%
2003	1.5%	4.2%	2.4%	2.3%	0.5%	0.5%	0.5%
2004	1.7%	4.4%	2.3%	1.6%	0.5%	0.5%	0.6%
2005	3.6%	4.6%	2.3%	-1.5%	0.4%	0.4%	0.8%
2006	2.0%	4.7%	2.2%	1.0%	0.5%	0.7%	0.8%
2007	2.1%	4.7%	2.1%	1.4%	0.6%	0.7%	0.9%
2008	1.2%	4.8%	2.3%	3.6%	0.5%	0.5%	0.9%
2009	1.7%	4.2%	2.4%	-0.2%	0.1%	0.5%	0.8%
2010	1.3%	3.9%	2.4%	3.2%	0.2%	0.5%	0.9%
2011	1.1%	4.1%	2.4%	1.7%	0.2%	0.7%	0.9%
2012	1.4%	4.6%	2.3%	-1.2%	0.2%	1.1%	1.0%
2013	1.3%	4.6%	2.3%	-2.8%	0.2%	1.1%	1.1%

Source: Credit Suisse HOLT, Thomson Reuters Datastream, and Credit Suisse.

Note: Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Recent Trends in Cash Flow Return on Investment and Asset Growth. The maximum earnings growth rate a company can achieve through internal funding is a function of its ROIC and payout ratio. High ROICs and low payout ratios allow for higher achievable growth rates than low ROICs and high payout ratios. Low ROIC or high payout businesses can certainly grow but need to access debt or equity capital to do so.

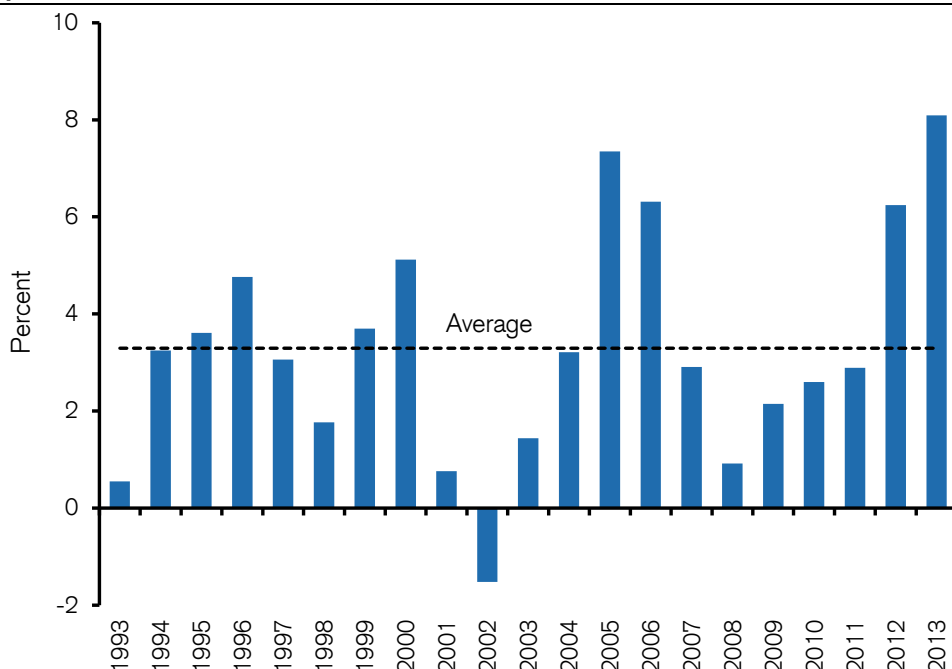
Part of the explanation for Japan's low payout ratio is the country's low CFROI. CFROI measures the cash return a business earns on the investments it makes. Since CFROI is also adjusted for inflation, it is an ideal tool for comparing results over time. Exhibit 9 shows that today's CFROI of 3.7 percent is above the twenty-year average of 3.0 percent. But Japan's CFROI is well below the U.S. level of nearly 10 percent and an average of more than 6 percent in Europe. Further, Japan's current CFROI remains below the peak years of the mid-2000s.

Exhibit 9: Japan CFROI, 1993-2013

Source: Credit Suisse HOLT.

Note: Weighted aggregate of Japanese firms excluding financials and regulated utilities.

Exhibit 10 shows the annual rate of asset growth, adjusted for inflation, over the past twenty years. In recent years, some easing of regulatory burdens for companies along with stimulative fiscal and monetary policy have encouraged companies to grow.

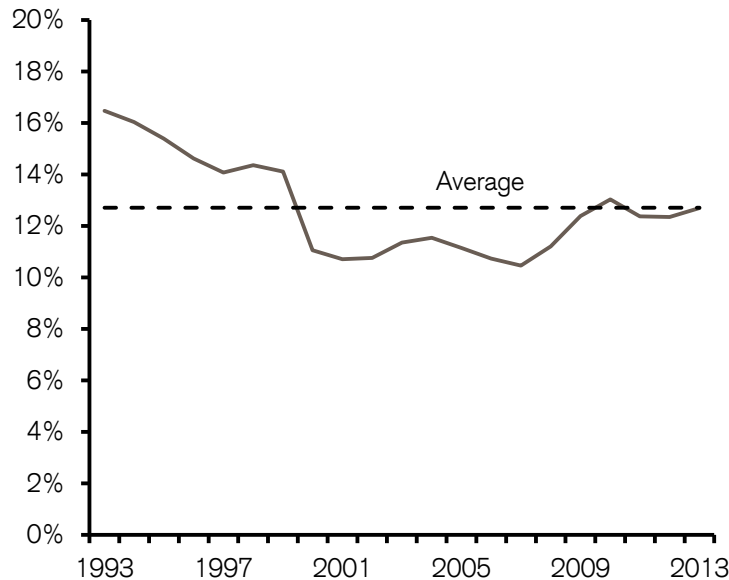
Exhibit 10: Japan Real Asset Growth Rate, 1993-2013

Source: Credit Suisse HOLT.

Note: Weighted aggregate of Japanese firms excluding financials and regulated utilities.

Exhibit 11 shows that at 13 percent, today's cash as a percentage of assets is exactly at the long-term average, but below the peak of 16 percent in 1993.

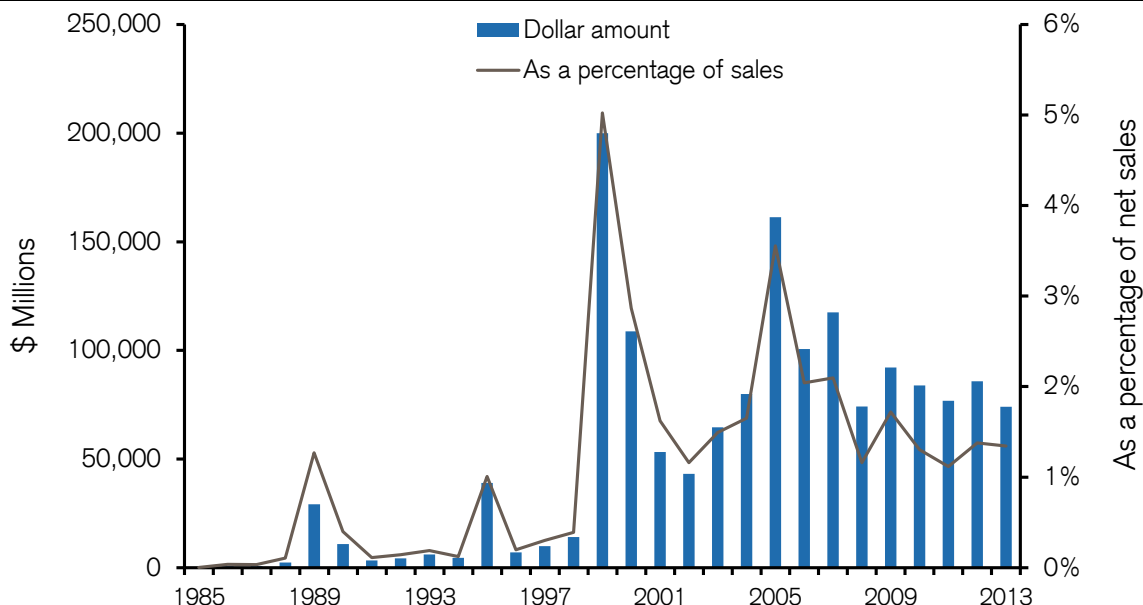
Exhibit 11: Japan Cash as a Percentage of Total Assets, 1993-2013



Source: Credit Suisse HOLT.
Note: Top 1,000 industrial firms.

Mergers and Acquisitions. Exhibit 12 shows the dollar amount of M&A as well as M&A as a percentage of sales from 1985 to 2013. M&A volume was only 1.3 percent of total sales in 2013, slightly above its long-term average of 1.2 percent. M&A plays a much smaller role in Japan than it does in other regions. For example, M&A averaged 11 percent of sales in the U.S. and 10 percent of sales in Europe over the same period. A look at the relative dollar amounts is also revealing. In 2013, M&A volume in Japan was just one-tenth the level of the U.S. and one-seventh that of Europe.

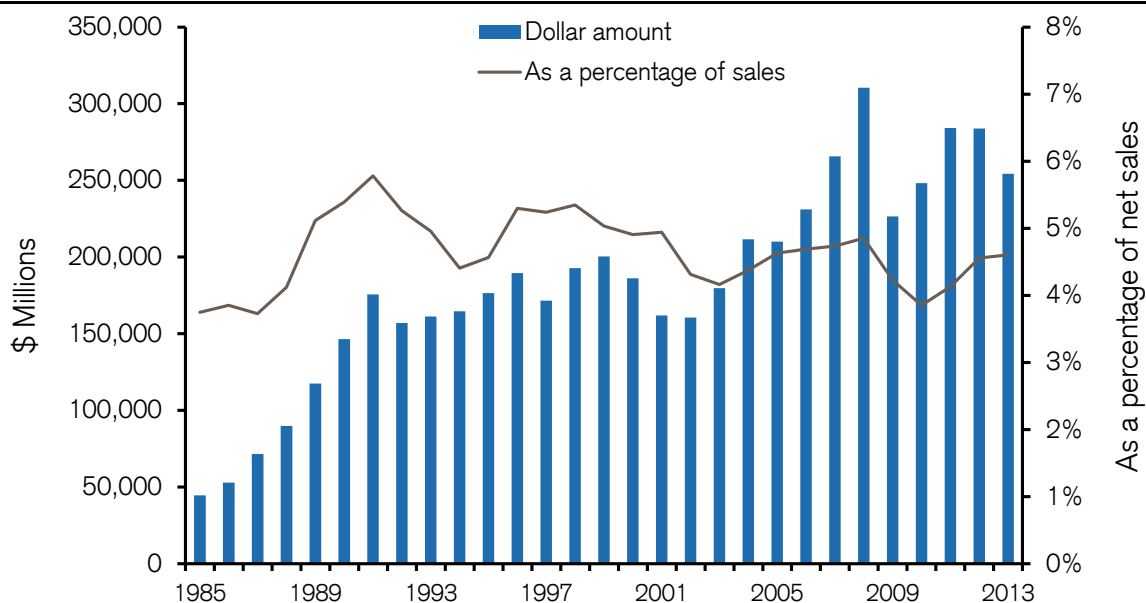
In Japan, M&A displays cyclical activity at times—note the peaks in 1999 and 2005, two strong years for the Nikkei. But legal and cultural factors have played a larger role in explaining the country's M&A activity.⁴⁸ M&A was negligible until the late 1990s because it was not societally accepted. The interlocking and diffuse ownership structure of corporations, known as *keiretsu*, made it difficult to get approval for deals. Spurred in part by a sputtering economy and a declining stock market, Japan instituted new laws to increase investor protection and to finance deals. At the same time, the *keiretsu* system eroded and banks began to restructure, paving the way for more M&A activity.

Exhibit 12: Japan Mergers and Acquisitions, 1985-2013

Note: Dollar amounts not inflated. Japan announced domestic mergers; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases.

Source: Thomson Reuters Datastream, Credit Suisse HOLT, Credit Suisse.

Capital Expenditures. Exhibit 13 shows capital expenditures, as well as capital expenditures as a percentage of sales, in Japan from 1985 to 2013. Capital expenditures have been fairly steady over time. In 2013, they were consistent with the long-term average of 4.6 percent of sales. Notwithstanding the recent rise in M&A, spending on capital expenditures in 2013 was nearly four times that of M&A. Even though capital expenditures are Japan's largest use of capital, that form of investment still lags other regions when measured as a percentage of sales.

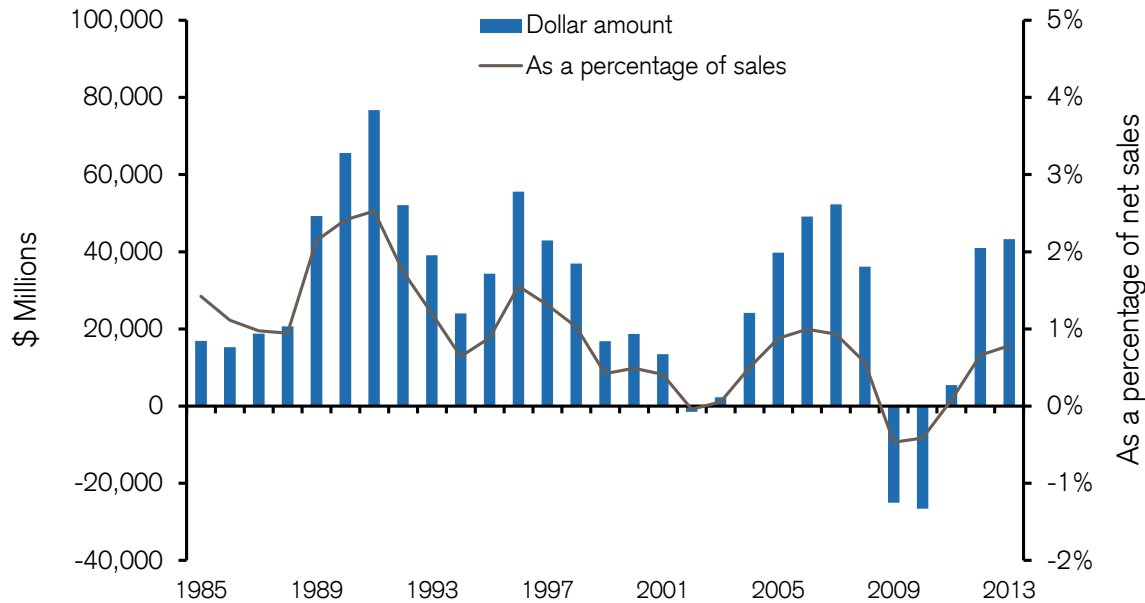
Exhibit 13: Japan Capital Expenditures, 1985-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Exhibit 14 shows capital expenditures net of depreciation. Measured as a percentage of sales, growth capital expenditures have averaged roughly one-fifth of overall capital expenditures.

Exhibit 14: Japan Capital Expenditures Net of Depreciation, 1985-2013



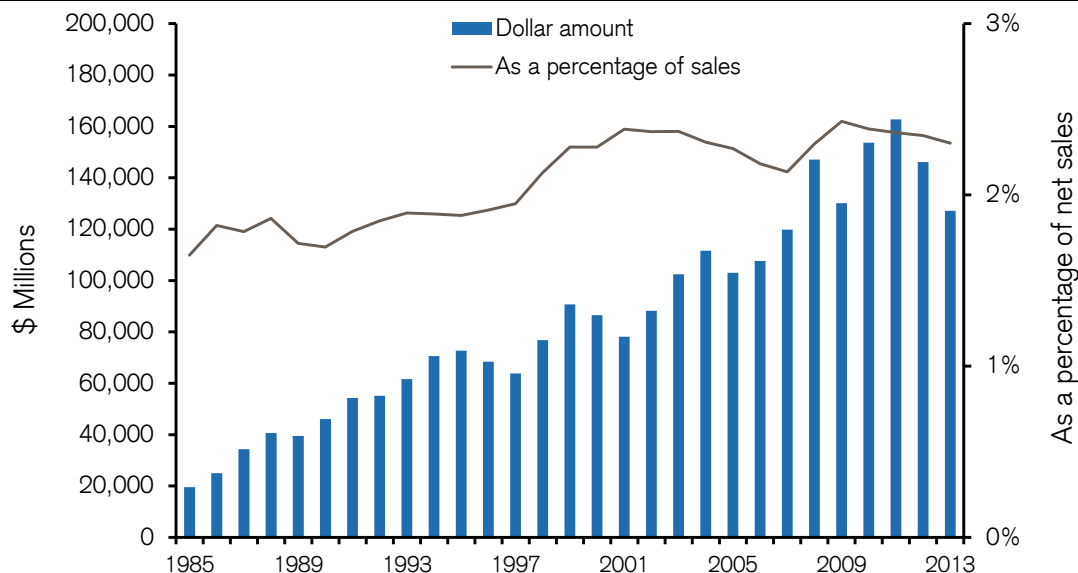
Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Research and Development. Exhibit 15 shows the dollar amount of R&D since 1985 as well as R&D as a percentage of sales. R&D doesn't typically shift much from year to year in Japan, but shows a gradual rise from 1.6 percent of sales in 1985 to a peak of 2.4 percent of sales in 2009, only to settle slightly lower at 2.3 percent in 2013.

Japan is one of the world leaders in R&D spending. In Japan, businesses account for 77 percent of total R&D spending, with the government, academia, and private nonprofit companies accounting for the other 23 percent. Its R&D spending as a percentage of sales is comparable to that of the U.S. at 2.3 percent, but well above Europe at 1.7 percent, APEJ at 0.9 percent, and GEM at 0.4 percent.

Japan's large presence in sectors that are R&D intensive, such as automobiles and electronics, explains these levels of spending. Japan's R&D spending has been stable in recent years despite the fact that information technology, the country's most R&D-intensive sector, went from roughly 20 percent of the country's market capitalization in 1999 to half that amount about a dozen years later.

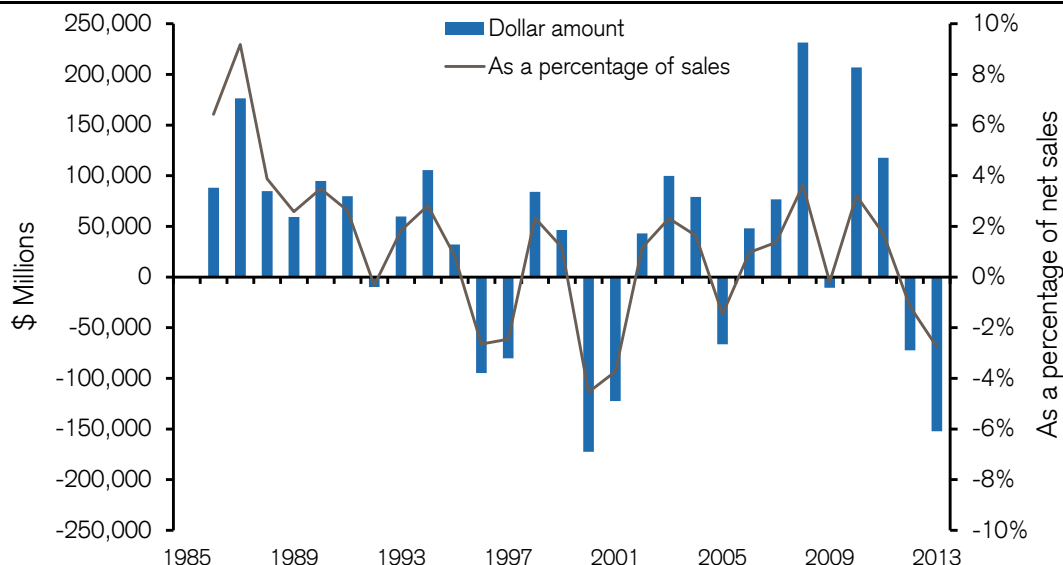
Exhibit 15: Japan Research and Development, 1985-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Net Working Capital. Net working capital, current assets minus non-interest-bearing current liabilities, is the capital a company requires to run its day-to-day operations. Net working capital equals about one-quarter of assets, on average, for companies in Japan.

Exhibit 16 shows the annual change in net working capital from 1985 through 2013. At year-end 2013, net working capital stood at \$1.3 trillion for the top 1,000 public firms in Japan. We consider changes in net working capital as opposed to the absolute amount, because changes are what you should consider to be an incremental investment. Net working capital investments are highly volatile in Japan, albeit smaller in absolute size than capital expenditures and R&D.

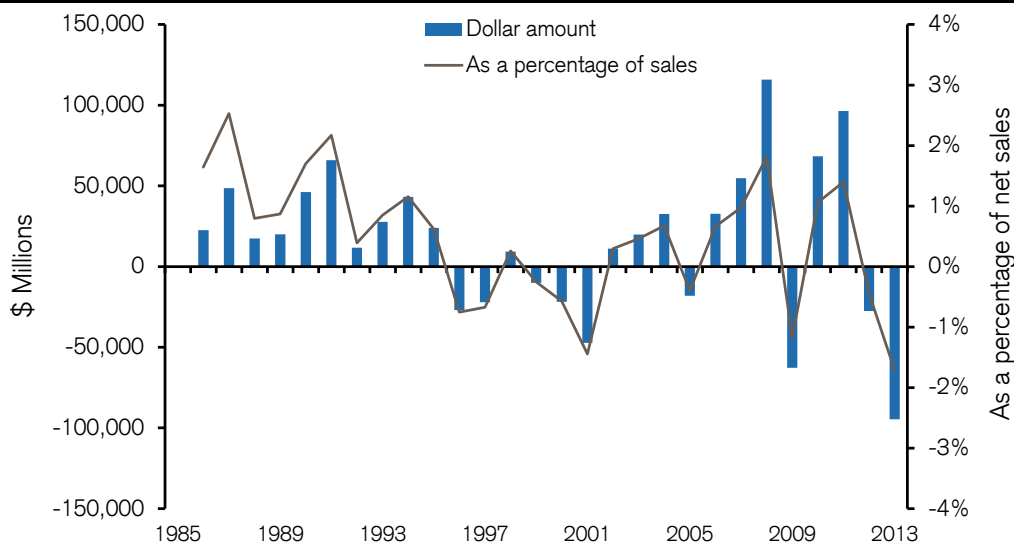
Exhibit 16: Japan Change in Net Working Capital, 1985-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Our definition of net working capital includes cash. The picture changes dramatically if we exclude cash. At the end of 2013, net working capital excluding cash was about \$535 billion for the top 1,000 Japanese industrial companies, roughly two-fifths of the total net working capital sum. Exhibit 17 shows the change in net working capital excluding cash.

Exhibit 17: Japan Change in Net Working Capital Excluding Cash, 1985-2013

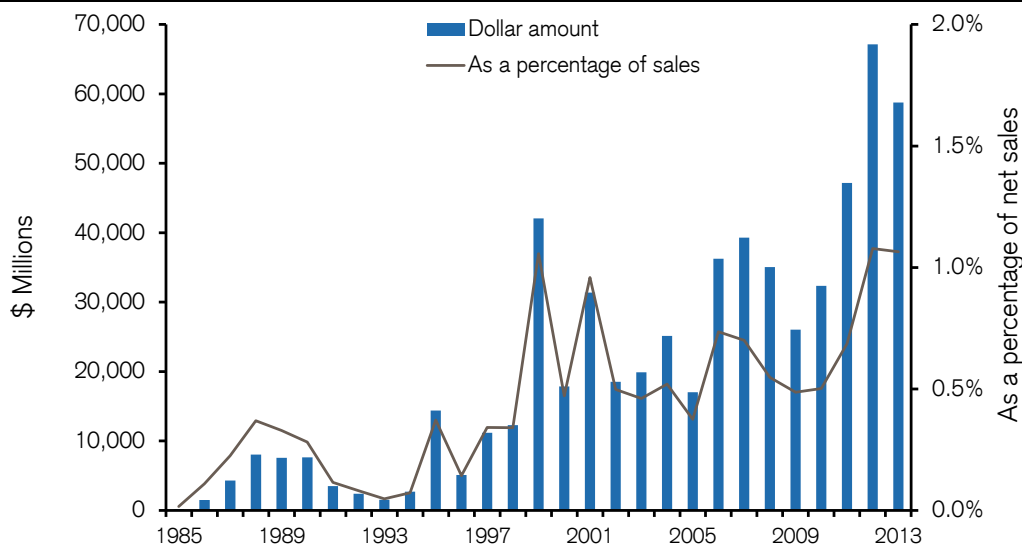


Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Divestitures. Exhibit 18 shows the magnitude of divestitures from 1985-2013. Similar to M&A, divestiture activity varies a lot from year to year, ranging from none in 1985 to a high of 1.1 percent of sales in 2013. Overall, divestitures have averaged 0.4 percent of sales, which is below all other alternatives except buybacks. These low levels are not surprising considering Japan's modest M&A activity. Since divestitures are correlated with M&A, many of the same legal and cultural factors that constrained M&A also limited divestitures.

Exhibit 18: Japan Divestitures, 1985-2013



Note: Announced divestitures; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases; Dollar amounts not inflated.

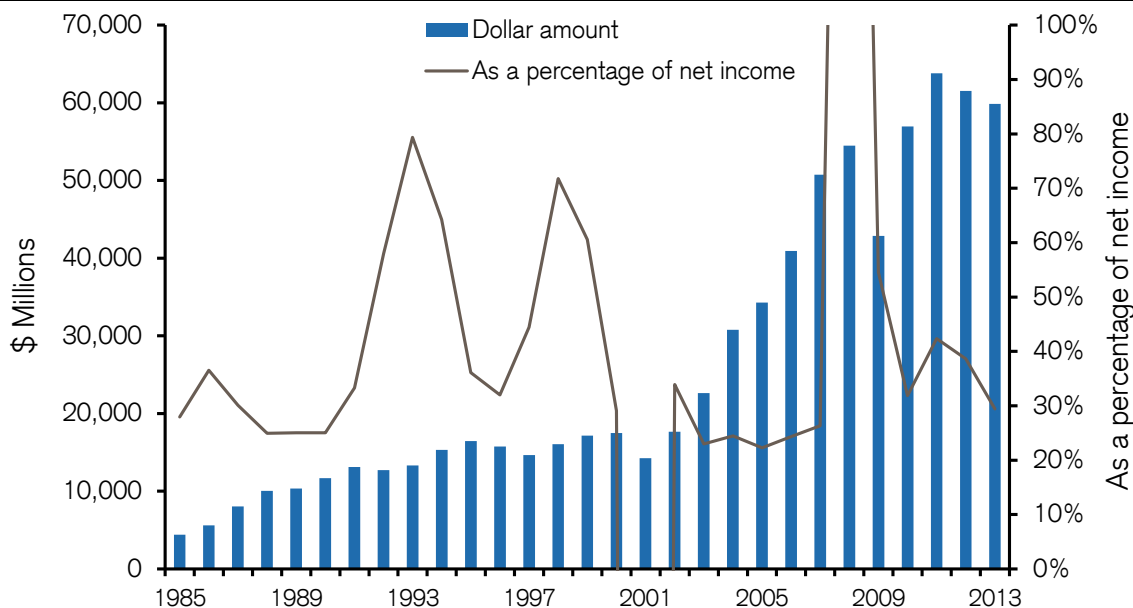
Source: Thomson Reuters Datastream, Credit Suisse HOLT, Credit Suisse.

Dividends. Exhibit 19 shows the annual amount of dividends on common and preferred stock for the top 1,000 companies in Japan, excluding the financial services and regulated utility industries, from 1985 to 2013. The average dividend payout ratio, or dividends as a percentage of net income, was roughly 35 percent. The average dividend yield, or dividend payment as a percentage of total market capitalization, was 1.1 percent.

In general, dividends do not move around too much from year to year in Japan, but they do show a notable uptick beginning in the early 2000s. From 1985-1999, the average dividend yield was only 0.8 percent. From 2000-2013, that figure almost doubled to 1.5 percent.

The corporate governance reform that led to greater M&A activity also unleashed a surge in corporate payout.⁴⁹ These legislative reforms, which gained momentum in 1999, created a better environment for companies and shareholders, including new laws that increase investor protection. The result has been more generous dividends and buybacks across the board. However, *keiretsu* firms still continue to favor dividends over buybacks, and their payouts remain more sensitive to fluctuations than those of non-*keiretsu* companies.

Exhibit 19: Japan Common and Preferred Dividends, 1985-2013



Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Share Buybacks. Exhibit 20 shows the annual amount of gross buybacks for the top 1,000 companies in Japan from 1985 to 2013. Buybacks totaled roughly 10 percent of net income over the full period. The average buyback yield, or buybacks as a percentage of total market capitalization, was 0.3 percent, well below the 1.1 percent dividend yield.

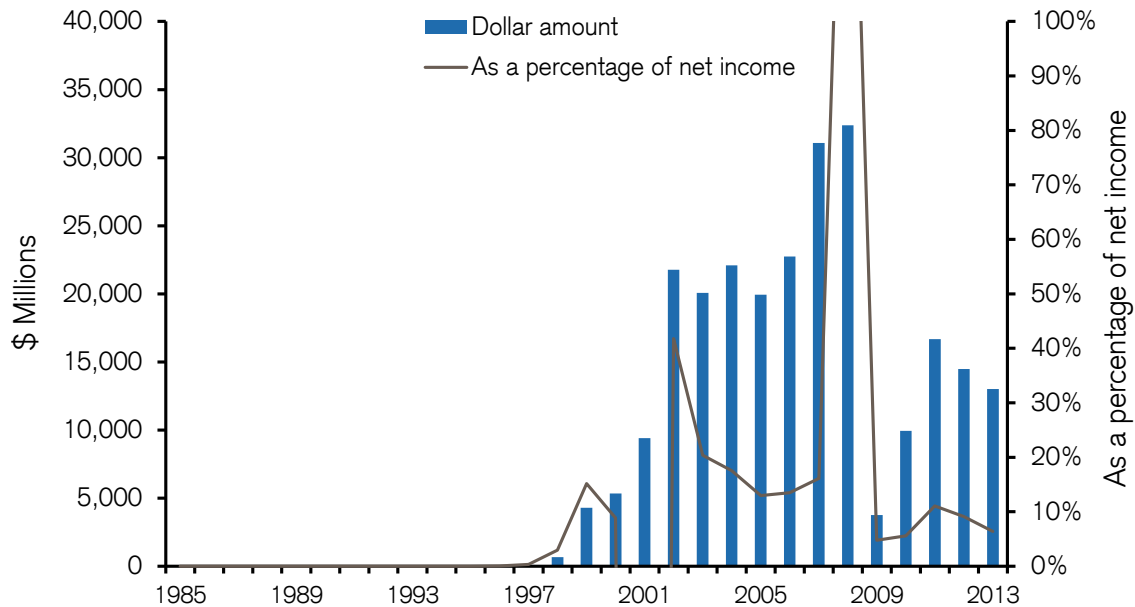
But the average belies the fact that buybacks were virtually nonexistent until the late 1990s because they were illegal until 1994. Even after the government legalized buybacks, significant tax disadvantages and regulatory hurdles remained for several years. Only the removal of these limitations and a wave of shareholder-friendly corporate governance reforms led to the recent surge in buybacks.

The numbers tell the story. From 1985-1999, the average buyback yield was zero. From 2000-2013, it was 0.7 percent. This yield is less than one half the 1.5 percent dividend yield during the same period, but the

disparity is far less. The balance remains in favor of dividends because the *keiretsu* firms are reluctant to embrace buybacks.

The rise in buybacks also appears tentative. As exhibit 20 demonstrates, buybacks rose considerably through the early 2000s but plummeted when Japan fell into a recession in 2008. Buybacks are also much more cyclical than dividends, consistent with the attitude many executives adopt that a company should fund a buyback only with cash that's left over after the company has exhausted all other uses, including dividends.

Exhibit 20: Japan Gross Share Buybacks, 1985-2013



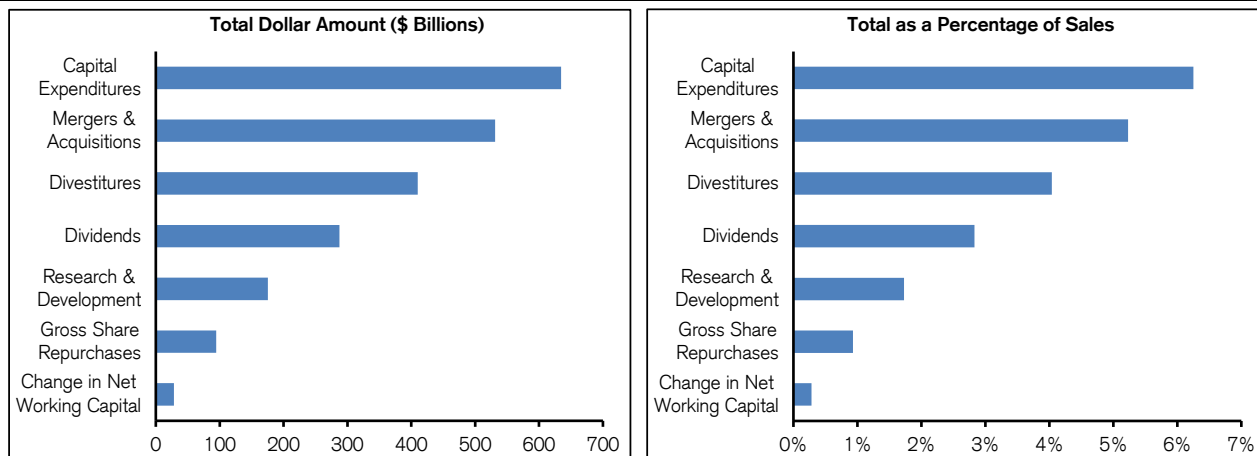
Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Europe

Uses of Capital. Exhibit 21 shows how the top 1,000 companies in Europe, excluding companies in the financial services and regulated utility industries, deployed capital in 2013. While just a snapshot for a particular year, the ranking reasonably reflects how companies in Europe have allocated capital over time.

Exhibit 21: Europe Capital Deployment, 2013

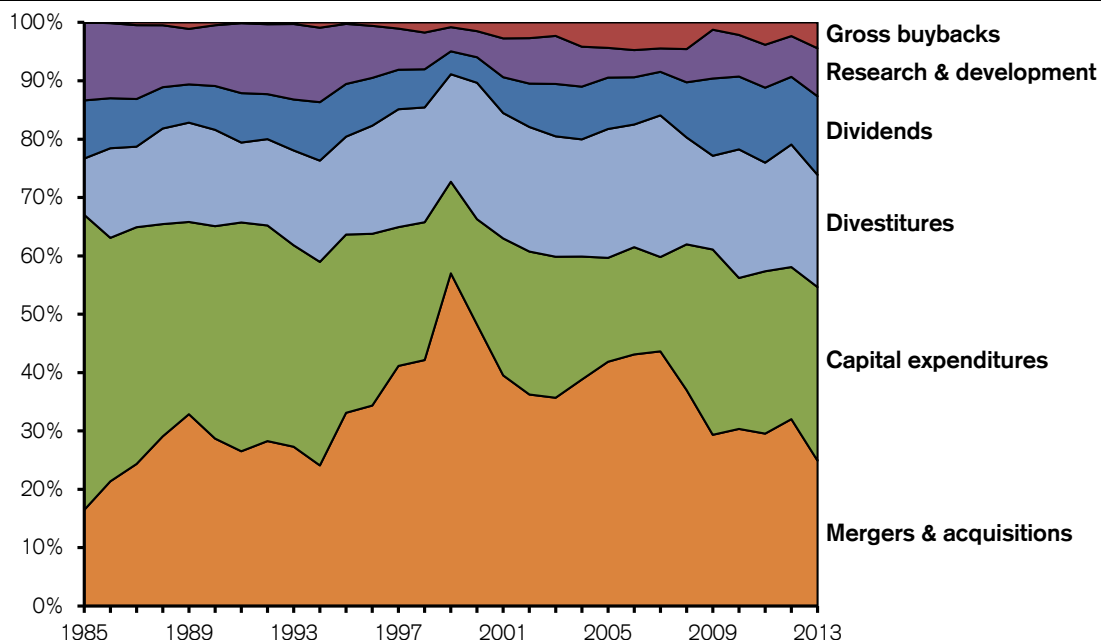


Source: Credit Suisse HOLT, Thomson Reuters Datastream.

Note: Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Exhibit 22 shows the breakdown of spending by source from 1985-2013. Again, we exclude changes in net working capital.

Exhibit 22: Europe Capital Deployment, 1985-2013



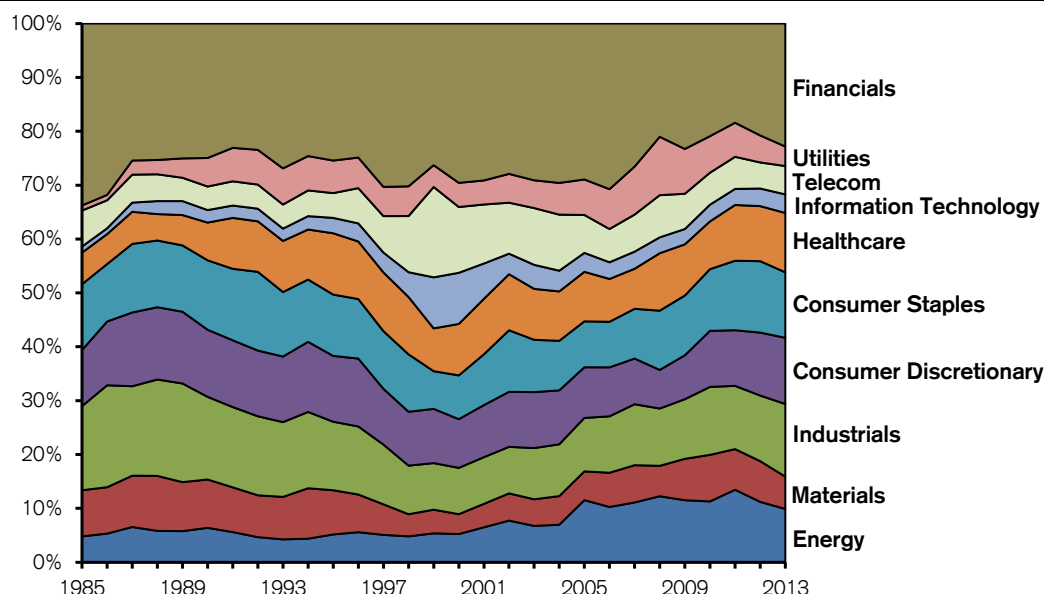
Source: Credit Suisse HOLT, Thomson Reuters Datastream.

Note: Data for R&D, capital expenditures, buybacks, and dividends exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

M&A has been the biggest use of capital over time but capital expenditures are not far behind. An examination of the results from 1985 through 2013 reveals some noteworthy patterns:

- M&A has been the largest use of capital, but it is very cyclical. M&A has been in a range of 2 percent of sales in 1985 to 31 percent at the peak in the late 1990s. M&A activity in Europe substantially lagged that of the U.S. in the late 1980s, but has since closed the gap as the result of political and economic factors. The introduction of the euro, globalization, and privatization stimulated M&A activity, especially for cross-border deals within the region. Greater participation from countries in Continental Europe also pushed volumes higher.
- Capital expenditures have been in a tight range of roughly 6 percent to 9 percent over the period. In 2013, they were 6.3 percent of total sales, modestly below the long-term average of 7 percent. One explanation for this stability is that the composition of the economy has been steady over time. (See Exhibit 23.) For example, the energy, materials, and industrial sectors, which tend to require more capital investment, represented 29 percent of the market capitalization in 1985 and 2013.
- Share buybacks were extremely rare until the mid-1990s as the result of legal bans and strict regulations on implementation and disclosure. European governments have largely overturned these bans and loosened the constraints, although many restrictions remain in place regarding the timing, price, and allowed amounts of buybacks. Companies have shifted their method of payouts following these changes, but they still heavily favor dividends. The volume of buybacks reached 60 percent of dividends in 2007, but has since retreated to one-third in 2013.
- R&D expenditures have been between 1.6 percent and 2.4 percent of sales, and have averaged 2.0 percent of sales over the full period. This level is below both the U.S. and Japan. Europe's small information technology sector contributes to the gap. Historically, IT has constituted just 3 percent of Europe's economy, compared to 14 percent in the U.S. and 13 percent in Japan. European corporations only account for about 60 percent of the overall R&D spending for their economy, well below the roughly 70 percent in the U.S. and 80 percent in Japan.

Exhibit 23: Europe Sector Composition, 1985-2013



Source: Credit Suisse HOLT.

Exhibit 24 shows a detailed history of capital deployment from 1985-2013. Again we see that the standard deviations of the growth rates are small for R&D, dividends, and capital spending relative to those of buybacks, M&A, and divestitures. Exhibit 25 represents the same deployment numbers as a percentage of sales.

Exhibit 24: Europe Capital Deployment, 1985-2013

	Total Amount (in Millions of U.S. Dollars, Nominal)						
	M&A	Capex	R&D Expense	Net Working Capital	Gross Buybacks	Divestitures	Dividends
1985	16,662	51,286	13,540		2	9,754	10,103
1986	33,808	66,049	20,370	56,907	188	24,306	13,568
1987	65,232	108,804	33,930	150,509	1,261	37,010	21,894
1988	104,214	130,444	38,050	66,845	1,734	58,737	25,402
1989	159,389	159,799	46,145	102,709	5,351	82,534	31,797
1990	165,507	210,080	60,093	136,681	2,770	95,289	43,336
1991	141,941	209,937	64,151	33,390	725	73,348	45,345
1992	139,517	182,456	59,179	-67,322	1,525	73,066	38,054
1993	127,405	161,220	60,405	19,108	1,254	75,881	40,807
1994	129,602	187,691	68,685	85,552	4,859	93,363	53,916
1995	249,526	230,266	77,609	83,135	1,887	126,487	68,023
1996	302,555	259,345	78,576	-40,401	5,149	163,244	72,164
1997	443,296	256,254	75,946	-84,396	11,376	217,727	72,964
1998	571,964	320,591	85,395	58,656	23,530	267,060	88,764
1999	1,165,024	320,920	84,589	-42,031	16,611	376,348	80,168
2000	971,338	363,695	90,102	16,017	30,101	470,985	88,117
2001	527,989	313,690	88,971	-45,598	36,526	287,118	82,101
2002	457,954	309,651	98,425	67,776	34,021	269,803	94,044
2003	490,203	332,044	113,180	162,717	31,686	283,514	123,303
2004	690,606	375,213	121,836	49,921	73,992	357,431	160,875
2005	937,001	398,555	114,072	-33,752	97,564	494,403	197,212
2006	1,239,207	528,434	133,941	118,522	136,203	604,354	232,726
2007	1,658,002	614,093	152,457	139,103	169,172	922,557	283,643
2008	971,147	655,218	149,474	-145,110	119,885	480,884	247,826
2009	529,237	573,017	150,895	66,956	22,493	289,887	238,879
2010	649,398	553,678	152,652	27,551	45,831	471,599	267,178
2011	632,749	596,082	157,612	17,111	81,896	398,718	275,373
2012	782,491	636,980	170,750	98,972	57,120	513,360	283,421
2013	531,122	634,553	175,596	28,530	94,538	410,119	287,387
CAGR	13.2%	9.4%	9.6%	-2.5%	47.2%	14.3%	12.7%
St. Dev.	43.1%	17.1%	16.2%	200.2%	1877.6%	39.4%	17.5%

Source: Credit Suisse HOLT, Thomson Reuters Datastream, and Credit Suisse.

Note: Dollar amounts not inflated. Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Exhibit 25: Europe Capital Deployment, 1985-2013

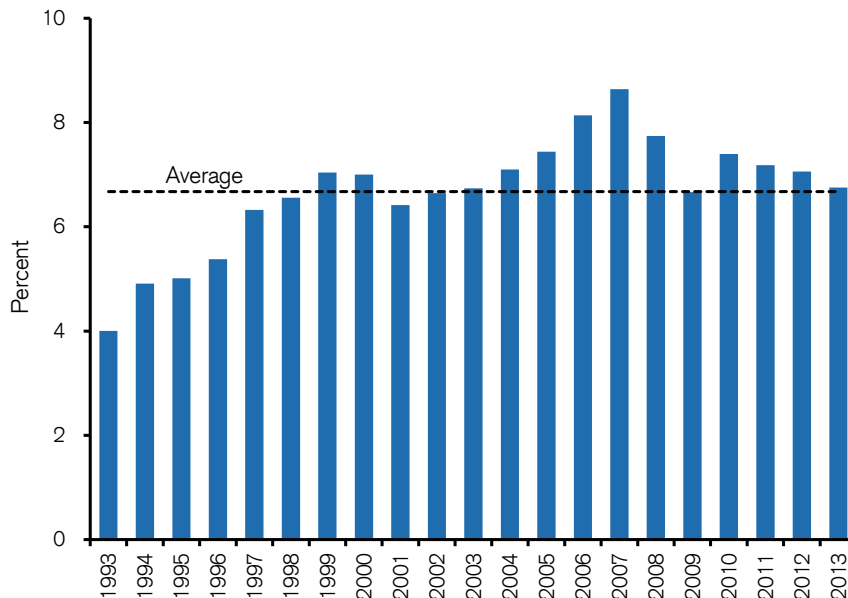
	As a Percentage of Sales						
	M&A	Capex	R&D Expense	Net Working Capital	Gross Buybacks	Divestitures	Dividends
1985	2.2%	6.8%	1.8%		0.0%	1.3%	1.3%
1986	3.8%	7.4%	2.3%	6.4%	0.0%	2.7%	1.5%
1987	4.7%	7.8%	2.4%	10.7%	0.1%	2.6%	1.6%
1988	6.5%	8.2%	2.4%	4.2%	0.1%	3.7%	1.6%
1989	8.0%	8.0%	2.3%	5.1%	0.3%	4.1%	1.6%
1990	6.5%	8.2%	2.3%	5.3%	0.1%	3.7%	1.7%
1991	5.1%	7.6%	2.3%	1.2%	0.0%	2.7%	1.6%
1992	5.4%	7.1%	2.3%	-2.6%	0.1%	2.9%	1.5%
1993	5.0%	6.3%	2.4%	0.7%	0.0%	3.0%	1.6%
1994	4.3%	6.2%	2.3%	2.8%	0.2%	3.1%	1.8%
1995	7.2%	6.7%	2.2%	2.4%	0.1%	3.7%	2.0%
1996	8.4%	7.2%	2.2%	-1.1%	0.1%	4.5%	2.0%
1997	12.9%	7.4%	2.2%	-2.5%	0.3%	6.3%	2.1%
1998	14.7%	8.2%	2.2%	1.5%	0.6%	6.9%	2.3%
1999	31.3%	8.6%	2.3%	-1.1%	0.4%	10.1%	2.2%
2000	23.7%	8.9%	2.2%	0.4%	0.7%	11.5%	2.1%
2001	12.4%	7.4%	2.1%	-1.1%	0.9%	6.7%	1.9%
2002	9.4%	6.3%	2.0%	1.4%	0.7%	5.5%	1.9%
2003	8.5%	5.8%	2.0%	2.8%	0.6%	4.9%	2.1%
2004	11.0%	6.0%	1.9%	0.8%	1.2%	5.7%	2.6%
2005	14.0%	6.0%	1.7%	-0.5%	1.5%	7.4%	3.0%
2006	15.3%	6.5%	1.7%	1.5%	1.7%	7.5%	2.9%
2007	18.0%	6.7%	1.7%	1.5%	1.8%	10.0%	3.1%
2008	10.4%	7.0%	1.6%	-1.6%	1.3%	5.2%	2.7%
2009	6.3%	6.8%	1.8%	0.8%	0.3%	3.5%	2.8%
2010	7.3%	6.2%	1.7%	0.3%	0.5%	5.3%	3.0%
2011	6.6%	6.2%	1.6%	0.2%	0.9%	4.1%	2.9%
2012	7.7%	6.3%	1.7%	1.0%	0.6%	5.0%	2.8%
2013	5.2%	6.3%	1.7%	0.3%	0.9%	4.0%	2.8%

Source: Credit Suisse HOLT, Thomson Reuters Datastream, and Credit Suisse.

Note: Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Recent Trends in Cash Flow Return on Investment and Asset Growth. Today's CFROI is in line with the long-term average of 7 percent, but below the peak years of the mid-2000s. (See Exhibit 26.)

Exhibit 26: Europe CFROI, 1993-2013

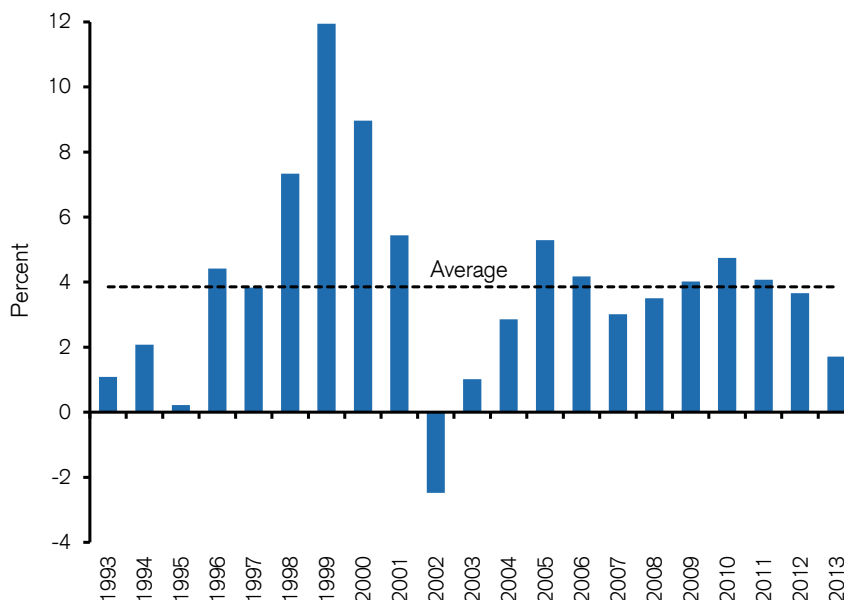


Source: Credit Suisse HOLT.

Note: Weighted aggregate of European firms excluding financials and regulated utilities.

Exhibit 27 shows the annual rate of asset growth, adjusted for inflation, over the past twenty years. Asset growth was very low in 2013, reflecting the reluctance of companies to invest. Asset growth in 2013, at 1.7 percent, was well below the long-term average of 3.9 percent, and asset growth in the past decade is also below average.

Exhibit 27: Europe Real Asset Growth Rate, 1993-2013

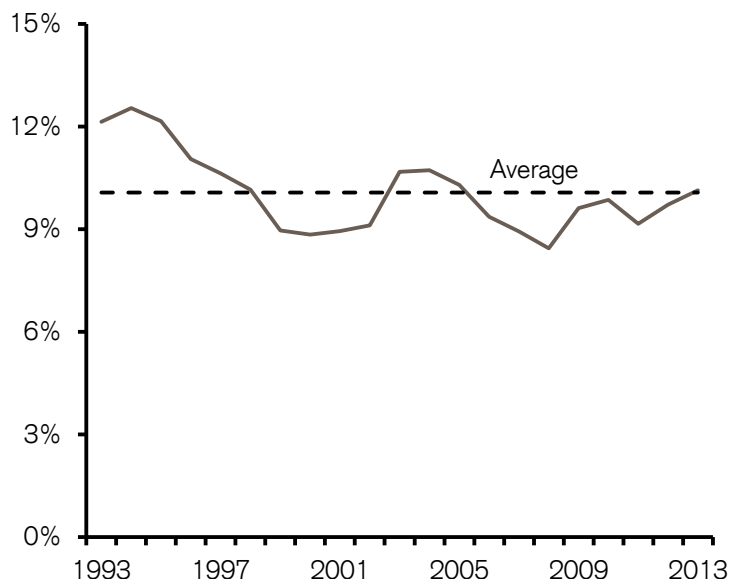


Source: Credit Suisse HOLT.

Note: Weighted aggregate of European firms excluding financials and regulated utilities.

Exhibit 28 shows that at 10 percent, today's cash as a percentage of assets is exactly at the long-term average, but below the peak of 13 percent in 1994.

Exhibit 28: Europe Cash as a Percentage of Total Assets, 1993-2013



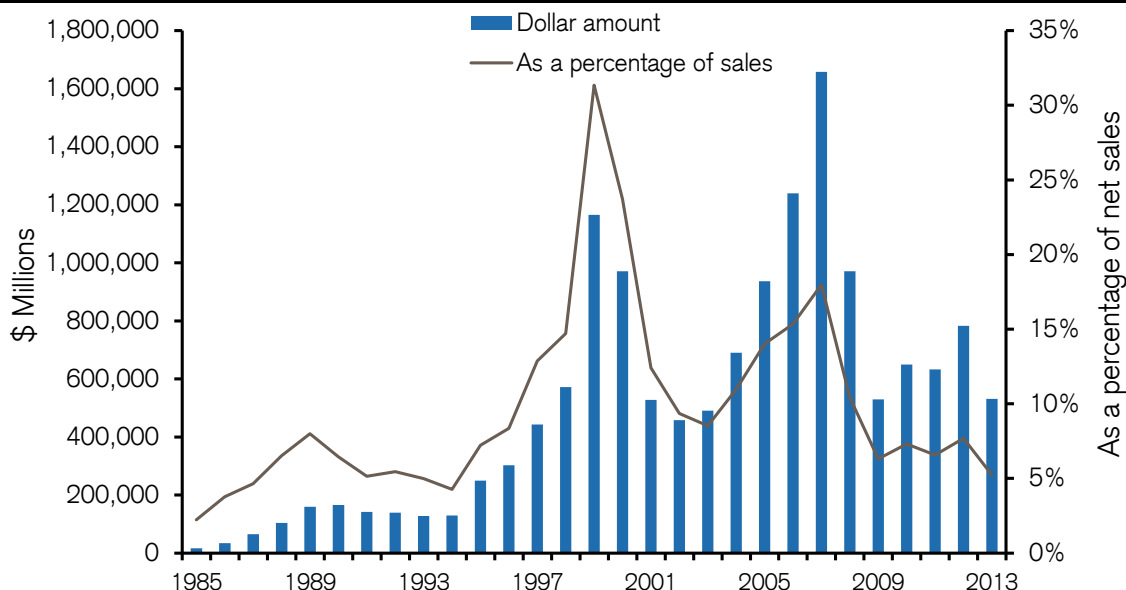
Source: Credit Suisse HOLT.
Note: Top 1,000 industrial firms.

Mergers and Acquisitions. Exhibit 29 shows the dollar amount of M&A as well as M&A as a percentage of sales from 1985 to 2013. M&A volume was 5.2 percent of total sales in 2013, well below its long-term average of roughly 10 percent. Over the full period, M&A in Europe and the U.S. has been equivalent as a percentage of sales.

While comparable as a fraction of sales, the absolute level of M&A in Europe still lags that of the U.S. From 1985 to 1989, M&A volume in Europe was less than one-third the level of the U.S., but has since risen to nearly three-fourths the level of the U.S. in recent years.

M&A in Europe has followed the stock market but research shows that several factors, including the introduction of the euro, globalization, deregulation, and privatization, have stoked the general rise since the late 1980s. In particular, these factors helped drive cross-border deals within Europe.⁵⁰

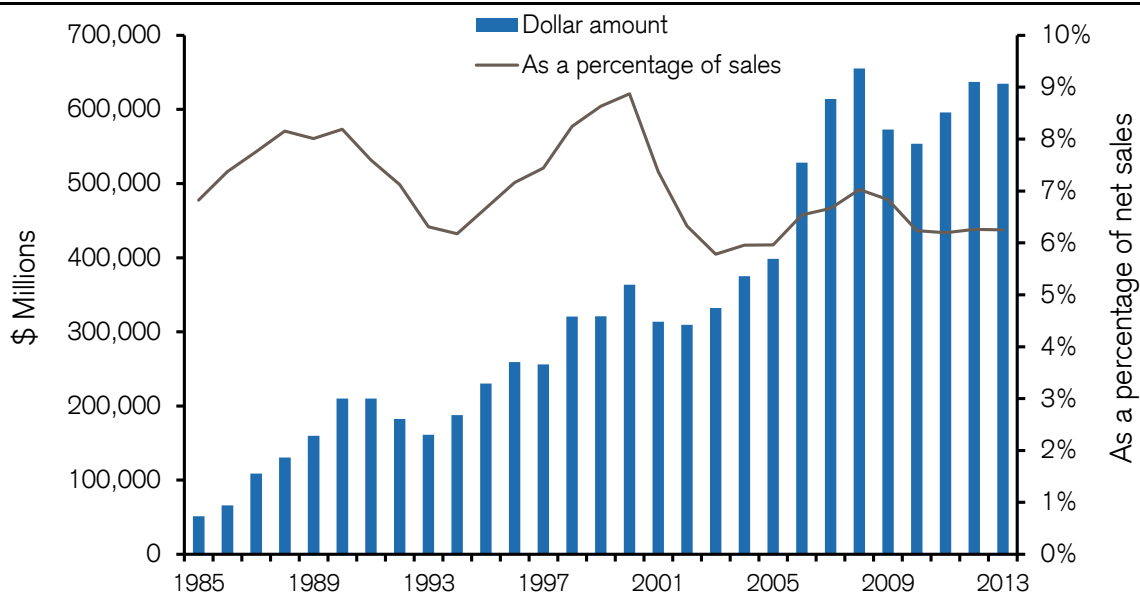
Greater participation from countries in Continental Europe also drove the increased deal activity. The U.K. once dominated total European M&A volume, accounting for roughly two-thirds of the total volume in the late 1980s. But in recent years (2010-2013), the U.K. accounted for just one-fifth of the total volume in Europe. Countries on the continent with the largest M&A activity in 2013 included Germany at 18 percent of the total, Russia at 11 percent, France at 10 percent, and the Netherlands at 9 percent.

Exhibit 29: Europe Mergers and Acquisitions, 1985-2013

Note: Dollar amounts not inflated. Europe announced domestic mergers; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases.

Source: Thomson Reuters Datastream, Credit Suisse HOLT, Credit Suisse.

Capital Expenditures. Exhibit 30 shows the dollar amount of capital expenditures, as well as capital expenditures as a percentage of sales, from 1985 to 2013. Capital expenditures were 6.3 percent of total sales in 2013, below the long-term average of 7.0 percent. In 2013, capital expenditures were the largest use of capital in Europe. M&A is usually the largest use of capital, but M&A volume in Europe was unusually low. Measured as a ratio of sales, Europe's capital expenditure spending exceeds that of Japan, is roughly in line with the U.S., and is well below that of APEJ and GEM. The exhibit reveals that capital expenditures are fairly steady from year to year.

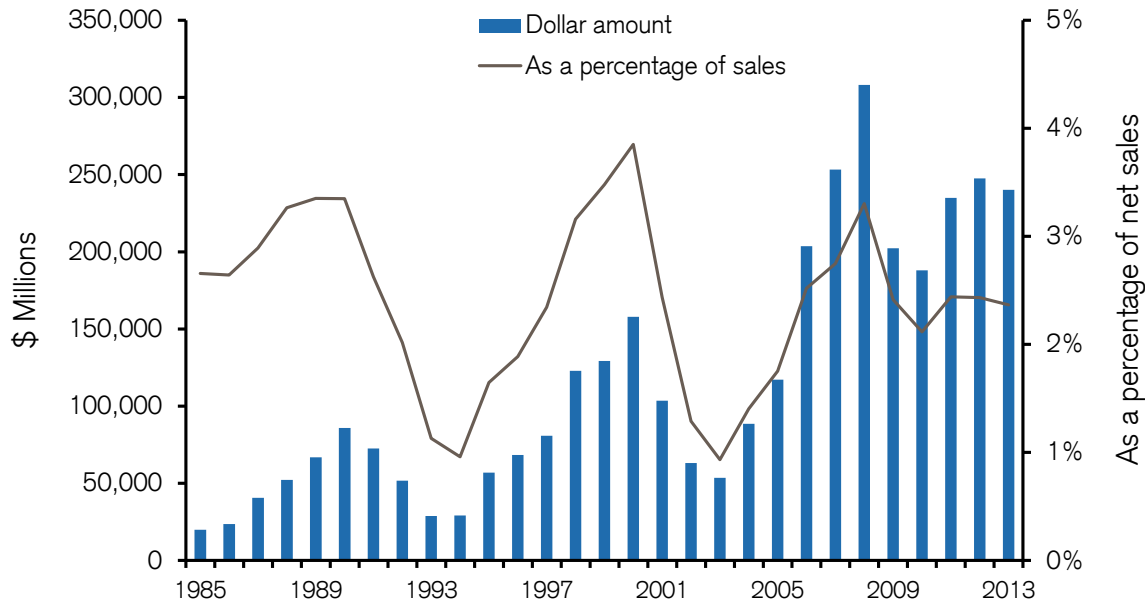
Exhibit 30: Europe Capital Expenditures, 1985-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Exhibit 31 shows capital expenditures net of depreciation. Measured as a percentage of sales, growth capital expenditures have averaged roughly one-third of overall capital expenditures.

Exhibit 31: Europe Capital Expenditures Net of Depreciation, 1985-2013



Note: Top 1,000 industrial firms. Dollar amounts not inflated.

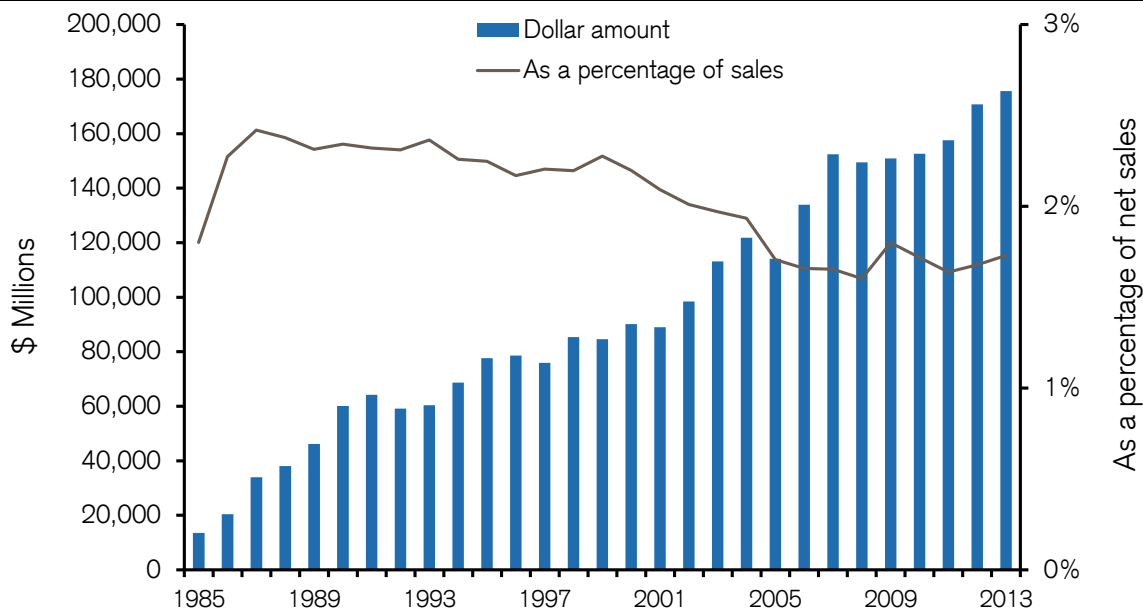
Source: Credit Suisse HOLT.

Research and Development. Exhibit 32 shows the dollar amount of R&D since 1985 as well as R&D as a percentage of sales. The ratio jumped to a peak of 2.4 percent of sales in 1987 only to steadily decline to 1.7 percent of sales in 2005, where it has remained. This level is well below both that of the U.S. and Japan at 2.3 percent. Sector composition largely explains the difference. Europe has a very low concentration in IT, the most R&D-intensive sector, and a higher concentration in industries that rely more heavily on capital investments. Academic research supports this conclusion.⁵¹

Yet, sector composition isn't the whole story. R&D as a percentage of sales has fallen since the late 1980s despite a modest rise in R&D-intensive sectors. For example, healthcare, one of the most R&D-intensive sectors, grew considerably during the period, while IT expanded to a lesser extent.

Based on 2013 figures, European countries with companies that spent the most on R&D as a percentage of sales included Switzerland at 5.1 percent (heavily influenced by the pharmaceutical industry), Sweden at 3.1 percent, and Germany at 2.5 percent. Notable laggards included the U.K. and Italy at 0.8 percent of sales and Spain at 0.6 percent.

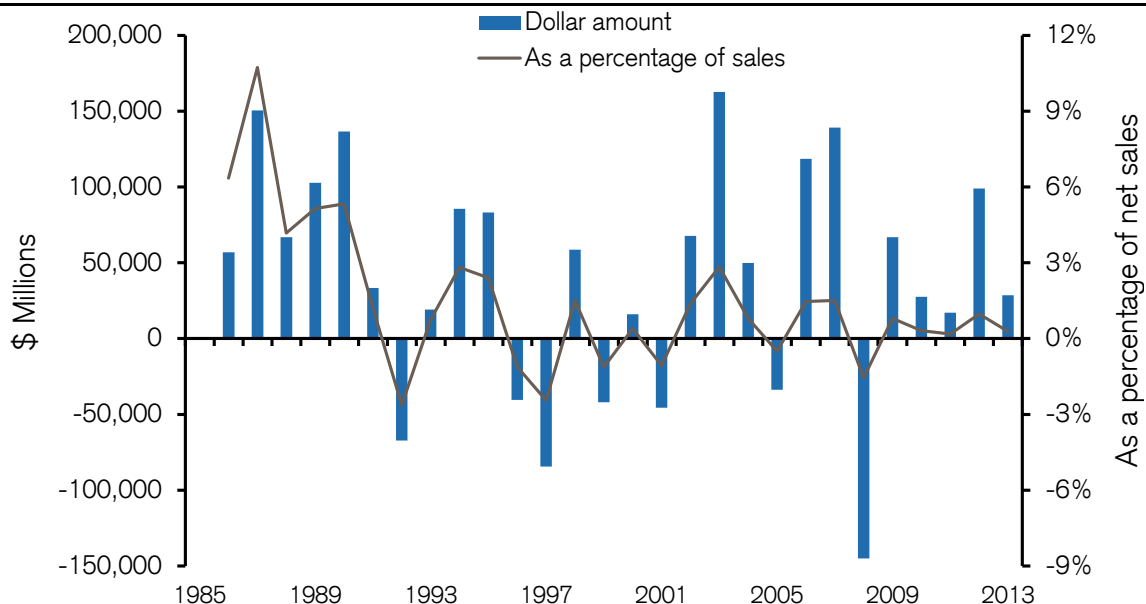
In European countries, businesses account for just under two-thirds of total R&D spending on average, with the government, academia, and private nonprofit companies sharing the balance.⁵² Corporations in Europe account for a smaller share of the total R&D spending than they do in the U.S. and Japan, where businesses spend around 70-75 percent. The business share of total R&D spending ranges from a low of 34 percent in Greece to a high of 74 percent in Switzerland. Among larger European economies, the business share of R&D spending is 63 percent in the U.K., 64 percent in France, and 67 percent in Germany.

Exhibit 32: Europe Research and Development, 1985-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Net Working Capital. Net working capital is about 15 percent of assets, on average, for companies in Europe. Exhibit 33 shows the annual change in net working capital from 1985 through 2013. At year-end 2013, net working capital stood at \$1.2 trillion for the top 1,000 public firms in Europe. We consider changes in net working capital as opposed to the absolute amount, because changes are what you should consider to be an incremental investment. Net working capital investments are highly volatile in Europe and are a smaller sum than M&A, capital expenditures, or R&D.

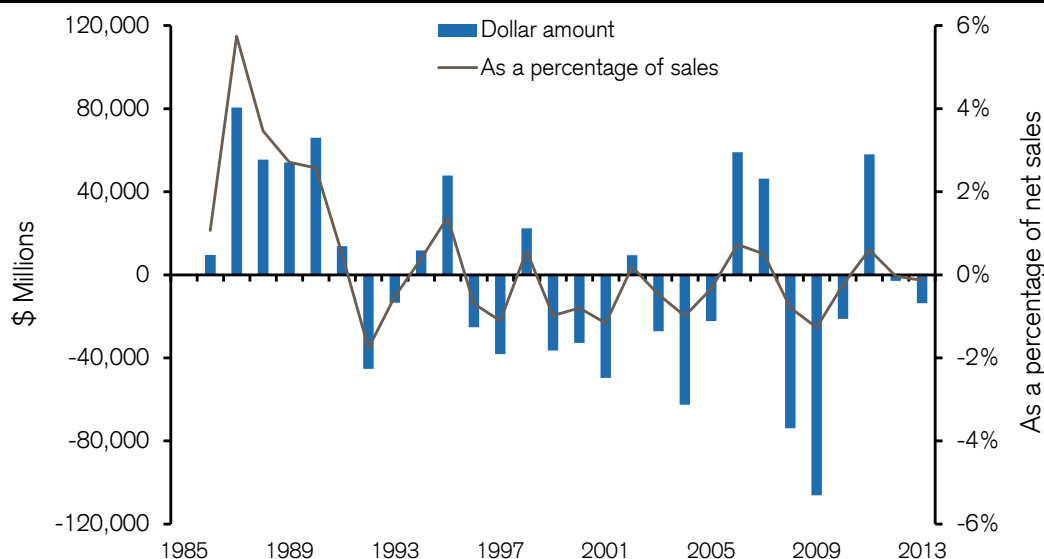
Exhibit 33: Europe Change in Net Working Capital, 1985-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

The situation changes significantly if we exclude cash. At the end of 2013, net working capital excluding cash was only \$7 billion for the top 1,000 European industrial companies, less than 1 percent of total net working capital. Exhibit 34 shows the change in net working capital excluding cash.

Exhibit 34: Europe Change in Net Working Capital Excluding Cash, 1985-2013

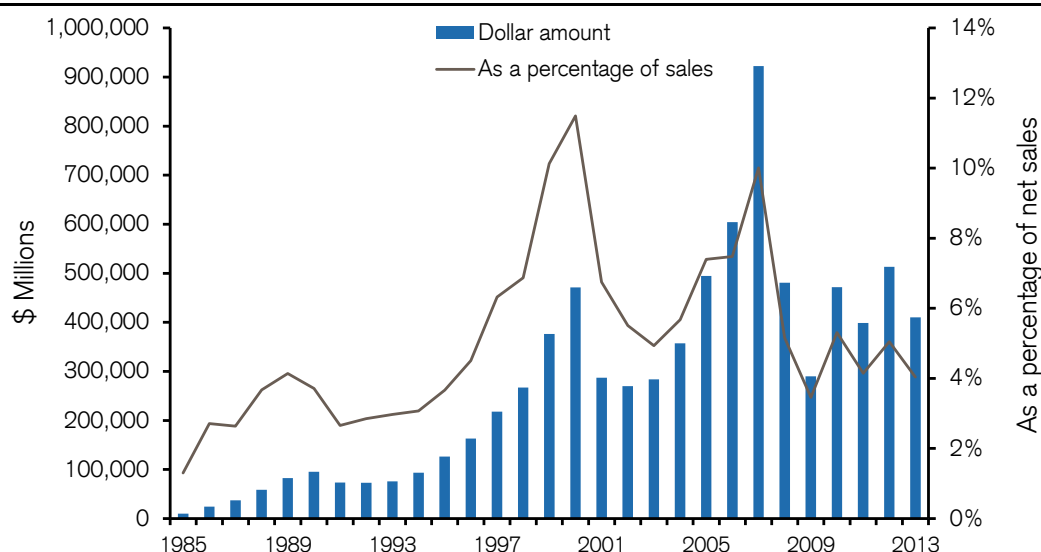


Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Divestitures. Exhibit 35 shows divestitures from 1985-2013. Similar to M&A, divestiture activity varies a great deal from year to year, ranging from a low of 1 percent of sales in 1985 to a high of 11 percent in 2000. While divestitures generally draw less attention than M&A, they represent a substantial component of capital allocation. Overall, divestitures have averaged 5.1 percent of sales over time, which is slightly more than one half the level of M&A and much higher than gross buybacks, dividends, and R&D spending.

Exhibit 35: Europe Divestitures, 1985-2013



Note: Announced divestitures; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases; Dollar amounts not inflated.

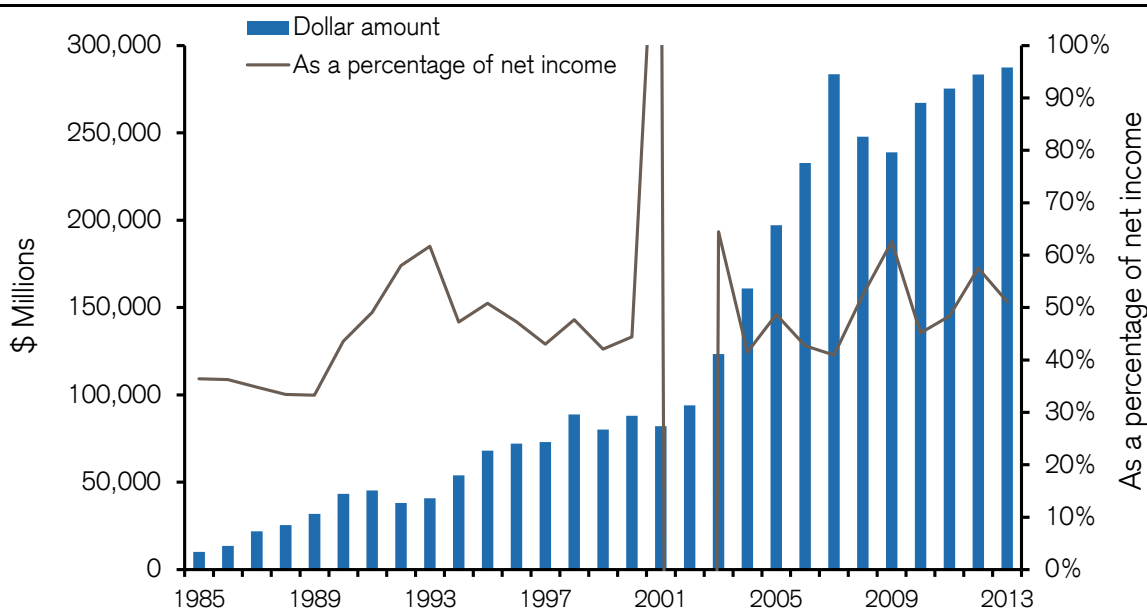
Source: Thomson Reuters Datastream, Credit Suisse HOLT, Credit Suisse.

Dividends. Exhibit 36 shows the annual amount of dividends on common and preferred stock for the top 1,000 companies in Europe, excluding the financial services and regulated utility industries, from 1985 to 2013. Dividends are very stable in Europe and were particularly resilient during the recent financial crisis.

The average dividend payout ratio, or dividends as a percentage of net income, was roughly 50 percent from 1985-2013. The average dividend yield, or dividend payment as a percentage of total market capitalization, was 2.7 percent over the same period. In 2013, the dividend yield was 2.9 percent. Countries with yields that were above average in 2013 included Norway at 4.4 percent, the U.K. at 3.2 percent, and Sweden at 3.2 percent. Countries with below-average yields included the Netherlands at 2.2 percent, Spain at 2.2 percent, and Germany at 2.4 percent.

Academic research shows that the trend in dividend policy in Europe and the U.S. is similar.⁵³ In both regions, there has been a decline in the fraction of firms paying dividends. In Europe, that fraction has fallen from 88 percent in 1989 to 51 percent in 2005. In the U.S., that fraction fell from more than 80 percent in the 1950s to roughly 20 percent in 1999. At the same time, dividends are becoming more concentrated among fewer firms in both regions.

Exhibit 36: Europe Common and Preferred Dividends, 1985-2013



Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Share Buybacks. Exhibit 37 shows the annual gross buybacks for the top 1,000 companies in Europe from 1985 to 2013. Buybacks were negligible until the late 1990s, rose considerably through 2007, and fell sharply during the recent recession. Similar to the results in other regions, buybacks are much more cyclical than dividends. The ratio of buybacks to dividends peaked in 2007 at three-fifths and declined to one-third in 2013.

Buybacks have totaled roughly 15 percent of net income, on average, from 1985-2013. The average buyback yield, or buybacks as a percentage of total market capitalization, was 0.6 percent over the same period, well below the 2.7 percent dividend yield. In 2013, the buyback yield was 0.9 percent. Countries with above-average buyback yields in 2013 included the U.K. at 2.1 percent, Denmark at 1.4 percent, and the

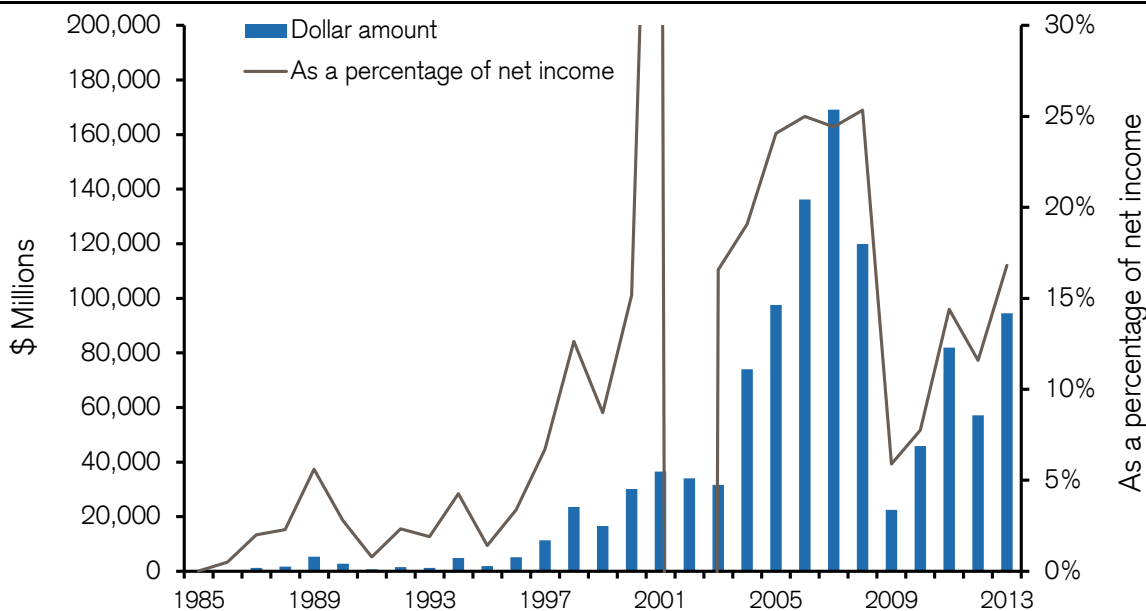
Netherlands at 1.2 percent. Countries with below-average yields included Italy at 0.1 percent, Germany at 0.3 percent, and Sweden and Switzerland at 0.5 percent.

Whereas the propensity for European firms to pay dividends has fallen, the fraction of firms repurchasing shares has risen. Similar to dividends, share repurchases are becoming concentrated among fewer firms in Europe.

Buybacks have been smaller in Europe than in the U.S. due to legal bans as well as stricter regulations on how companies have to implement and disclose them.⁵⁴ For example, open market share repurchases were not legal until 1981 in the U.K., until 1992 in Switzerland, and until 1998 in Germany. In France, buybacks were very difficult to implement until a change in the law in 1998.

In addition, whereas board approval is sufficient to initiate a buyback program in the U.S., companies must obtain shareholder approval for open market repurchases in the U.K., France, Germany, Italy, the Netherlands, and Switzerland. Even then, significant restrictions remain regarding the terms of timing, price, and amount of buybacks. Finally, companies in many of these countries also have additional reporting requirements on top of basic disclosure in financial statements.

Exhibit 37: Europe Gross Share Buybacks, 1985-2013



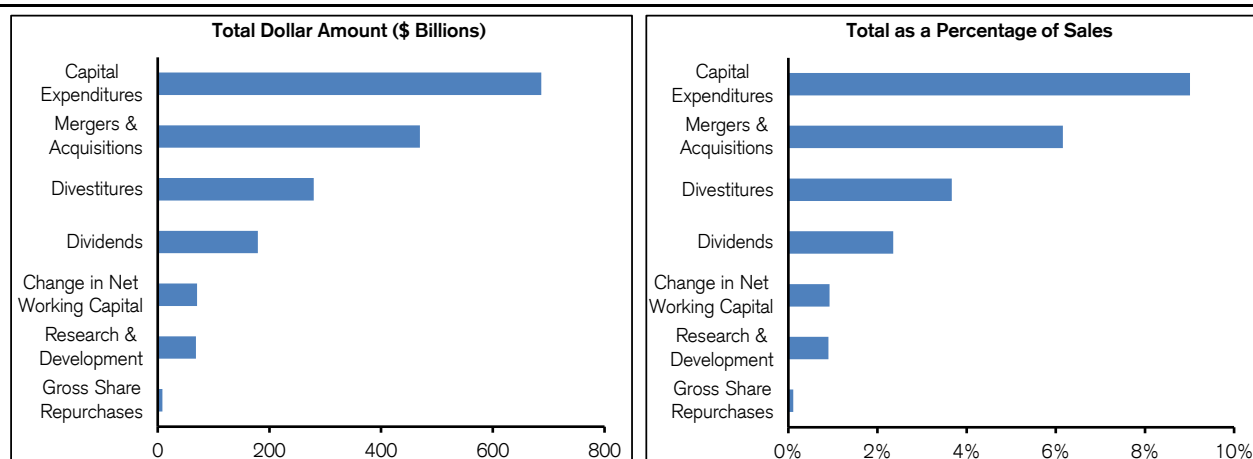
Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Asia/Pacific excluding Japan (APEJ)

Uses of Capital. Exhibit 38 shows how the top 1,000 companies in APEJ, excluding companies in the financial services and regulated utility industries, deployed capital in 2013. While just a snapshot for a particular year, the ranking reasonably reflects how companies in APEJ have allocated capital over time.

Exhibit 38: APEJ Capital Deployment, 2013

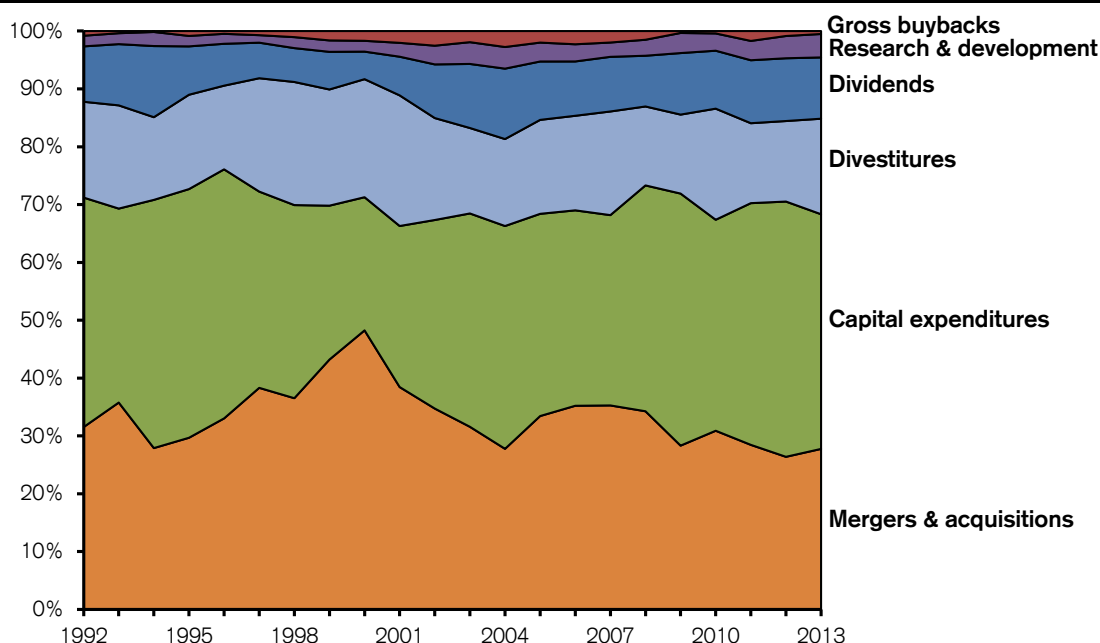


Source: Credit Suisse HOLT, Thomson Reuters Datastream.

Note: Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Exhibit 39 shows the breakdown of spending by source from 1992-2013. Again, we exclude changes in net working capital.

Exhibit 39: APEJ Capital Deployment, 1992-2013



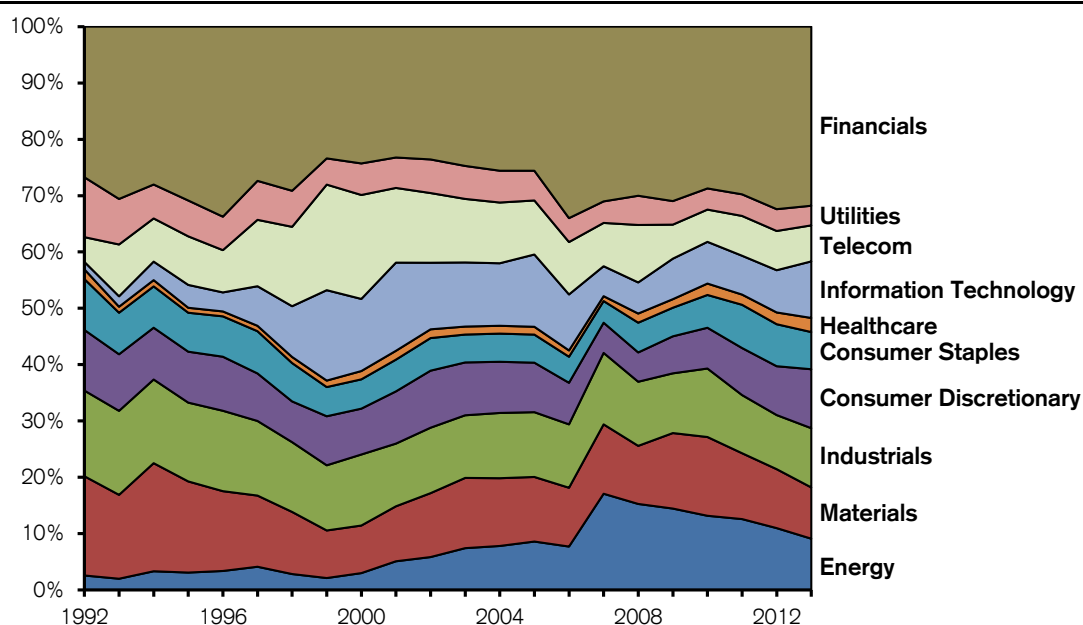
Source: Credit Suisse HOLT, Thomson Reuters Datastream.

Note: Data for R&D, capital expenditures, buybacks, and dividends exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Similar to 2013, capital expenditures and M&A are by far the largest uses of capital over time. An examination of the changes from 1992 through 2013 reveals some noteworthy patterns:

- Capital expenditures are the largest use of capital. Capital expenditures were 9 percent of total sales in 2013, modestly below the long-term average of 10.5 percent. In 2013, they were APEJ's largest use of capital, which is typically the case except for very big years for M&A. Measured as a percentage of sales, APEJ's capital expenditures greatly exceed those of the U.S., Japan, and Europe.
- M&A is very cyclical, ranging from a low of 5.5 percent of sales in 2012 to a high of 22.7 percent in 2000. The long-term average is roughly 10 percent, consistent with the levels of the U.S. and Europe. China really stands out, as its share of the region's total M&A went from less than 5 percent in the early 1990s to just over one-half in recent years.
- R&D spending has slowly trended higher over time but remains well below that of the U.S., Japan, and Europe both on an absolute basis and relative to sales. R&D rose steadily from 0.5 percent of sales in 1992 to a peak of 1.0 percent of sales in the mid-2000s, and stands at 0.9 percent of sales today. This rise reflects the change in the composition of the market, with the information technology sector growing from just 1 percent of the market in 1992 to 10 percent in 2013. (See Exhibit 40.)
- Share buybacks have historically been very modest and remain a small component of corporate payouts. Buybacks have averaged just 0.3 percent of total market capitalization over time, well below dividends at 2.2 percent. Regulatory constraints have contributed to the lower level of buybacks, particularly in the earlier years. For example, the governments didn't legalize buybacks in Australia until 1989 and in Hong Kong until 1991. These are among the largest economies in the region. In 2013, buybacks in China, India, and Taiwan were negligible.

Exhibit 40: APEJ Sector Composition, 1992-2013



Source: Credit Suisse HOLT.

Exhibit 41 shows a detailed history of capital deployment from 1992-2013. Again we see that the standard deviations of the growth rates are small for R&D, dividends, and capital spending relative to those of buybacks, M&A, and divestitures. Exhibit 42 represents the same deployment numbers as a percentage of sales.

Exhibit 41: APEJ Capital Deployment, 1992-2013

	Total Amount (in Millions of U.S. Dollars, Nominal)						
	M&A	Capex	R&D Expense	Net Working Capital	Gross Buybacks	Divestitures	Dividends
1992	24,273	30,558	1,418		622	12,758	7,375
1993	33,385	31,311	1,764	27,498	346	16,661	9,887
1994	30,119	46,350	2,628	32,931	171	15,441	13,287
1995	62,408	90,430	3,810	59,566	1,763	34,322	17,584
1996	87,322	113,864	4,554	23,652	1,257	38,261	19,158
1997	104,324	92,431	3,541	-22,459	1,931	53,379	16,745
1998	96,662	88,404	5,031	-3,614	2,774	56,354	15,504
1999	135,444	83,448	6,200	19,062	5,068	62,996	20,407
2000	236,737	112,970	9,162	28,045	8,278	100,163	23,380
2001	149,680	108,462	9,333	12,496	7,933	87,946	26,055
2002	132,228	124,191	12,334	8,739	9,624	67,132	35,338
2003	133,511	155,979	15,916	62,038	8,128	62,491	46,837
2004	158,116	219,449	21,293	77,388	15,712	85,658	69,352
2005	255,465	267,215	24,980	71,418	15,235	124,157	77,143
2006	340,894	327,275	28,769	87,156	22,131	158,328	90,975
2007	452,408	422,207	31,761	188,979	25,434	229,956	121,212
2008	406,045	462,848	32,736	-8,270	17,812	161,789	104,020
2009	313,116	481,970	38,437	158,979	3,656	151,049	117,638
2010	471,729	557,217	45,565	241,408	6,318	293,416	153,044
2011	428,568	629,619	50,294	192,069	25,701	208,285	164,055
2012	404,832	677,426	59,065	123,084	13,109	213,707	166,560
2013	469,490	686,665	68,607	70,527	8,545	279,522	179,308
CAGR	15.1%	16.0%	20.3%	4.8%	13.3%	15.8%	16.4%
St. Dev.	35.5%	24.3%	17.0%	496.4%	213.8%	38.9%	17.4%

Source: Credit Suisse HOLT, Thomson Reuters Datastream, and Credit Suisse.

Note: Dollar amounts not inflated. Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Exhibit 42: APEJ Capital Deployment, 1992-2013

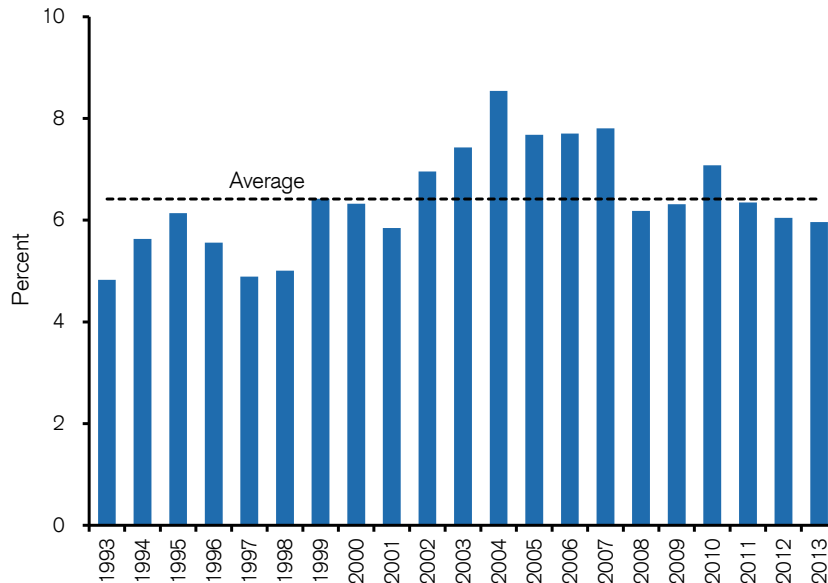
	As a Percentage of Sales						
	M&A	Capex	R&D Expense	Net Working Capital	Gross Buybacks	Divestitures	Dividends
1992	8.4%	10.6%	0.5%		0.2%	4.4%	2.5%
1993	8.8%	8.3%	0.5%	7.2%	0.1%	4.4%	2.6%
1994	5.9%	9.1%	0.5%	6.5%	0.0%	3.0%	2.6%
1995	8.5%	12.3%	0.5%	8.1%	0.2%	4.7%	2.4%
1996	10.5%	13.7%	0.5%	2.8%	0.2%	4.6%	2.3%
1997	15.8%	14.0%	0.5%	-3.4%	0.3%	8.1%	2.5%
1998	12.4%	11.3%	0.6%	-0.5%	0.4%	7.2%	2.0%
1999	14.6%	9.0%	0.7%	2.1%	0.5%	6.8%	2.2%
2000	22.7%	10.9%	0.9%	2.7%	0.8%	9.6%	2.2%
2001	14.0%	10.1%	0.9%	1.2%	0.7%	8.2%	2.4%
2002	10.1%	9.5%	0.9%	0.7%	0.7%	5.1%	2.7%
2003	8.4%	9.8%	1.0%	3.9%	0.5%	3.9%	2.9%
2004	7.5%	10.4%	1.0%	3.7%	0.7%	4.1%	3.3%
2005	10.3%	10.7%	1.0%	2.9%	0.6%	5.0%	3.1%
2006	11.2%	10.7%	0.9%	2.9%	0.7%	5.2%	3.0%
2007	11.7%	10.9%	0.8%	4.9%	0.7%	5.9%	3.1%
2008	9.6%	10.9%	0.8%	-0.2%	0.4%	3.8%	2.5%
2009	7.0%	10.8%	0.9%	3.6%	0.1%	3.4%	2.6%
2010	8.2%	9.7%	0.8%	4.2%	0.1%	5.1%	2.7%
2011	6.4%	9.4%	0.8%	2.9%	0.4%	3.1%	2.5%
2012	5.5%	9.2%	0.8%	1.7%	0.2%	2.9%	2.3%
2013	6.2%	9.0%	0.9%	0.9%	0.1%	3.7%	2.4%

Source: Credit Suisse HOLT, Thomson Reuters Datastream, and Credit Suisse.

Note: Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Recent Trends in Cash Flow Return on Investment and Asset Growth. CFROI today in the APEJ region is slightly below the long-term average, and well below the peak years of the mid-2000s. (See Exhibit 43.) The current level of 6.0 percent is below the historical average of 6.4 percent over the past twenty years.

Exhibit 43: APEJ CFROI, 1993-2013

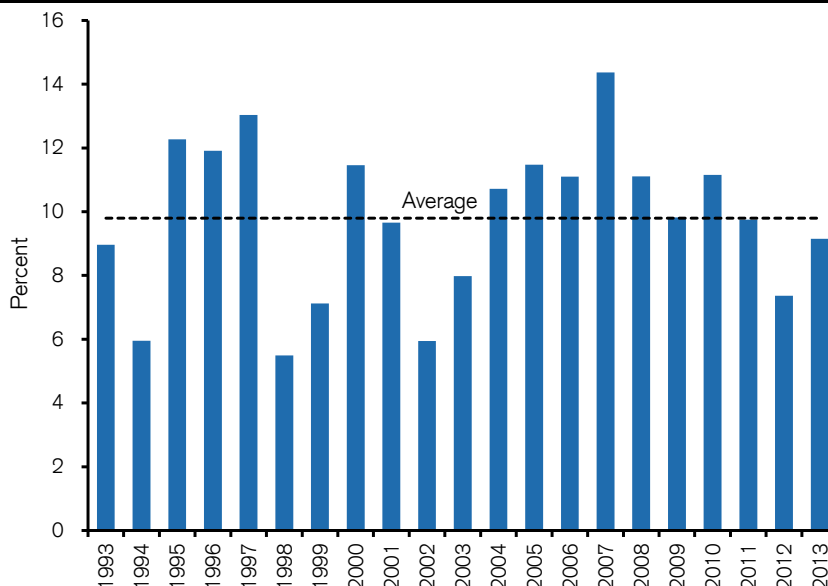


Source: Credit Suisse HOLT.

Note: Weighted aggregate of APEJ firms excluding financials and regulated utilities.

Exhibit 44 shows the annual rate of asset growth, adjusted for inflation, over the past twenty years. In 2012 and 2013, growth was low relative to the long-term average. Asset growth of 7.4 percent in 2012 and 9.2 percent in 2013 was below the average of 9.8 over the past twenty years. Asset growth in this region is the highest in the world.

Exhibit 44: APEJ Real Asset Growth Rate, 1993-2013

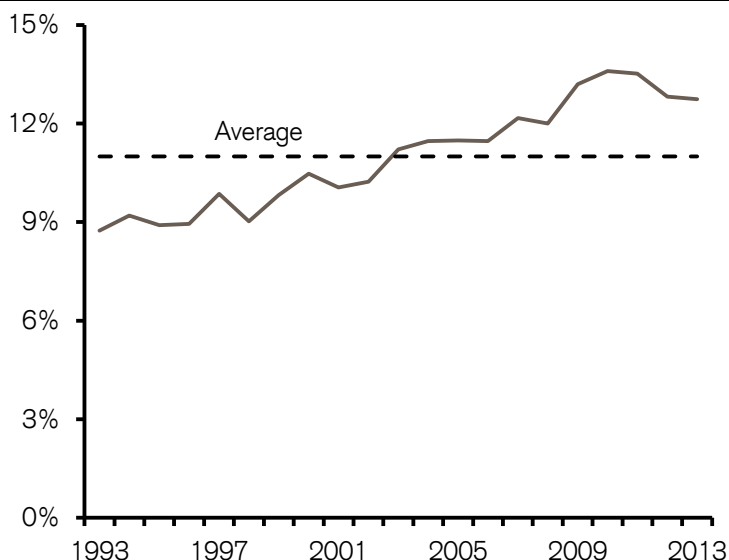


Source: Credit Suisse HOLT.

Note: Weighted aggregate of APEJ firms excluding financials and regulated utilities.

Exhibit 45 shows that today's cash as a percentage of assets of 13 percent is above the long-term average of 11 percent. The level of cash relative to assets shows a clear upward trend.

Exhibit 45: APEJ Cash as a Percentage of Total Assets, 1993-2013



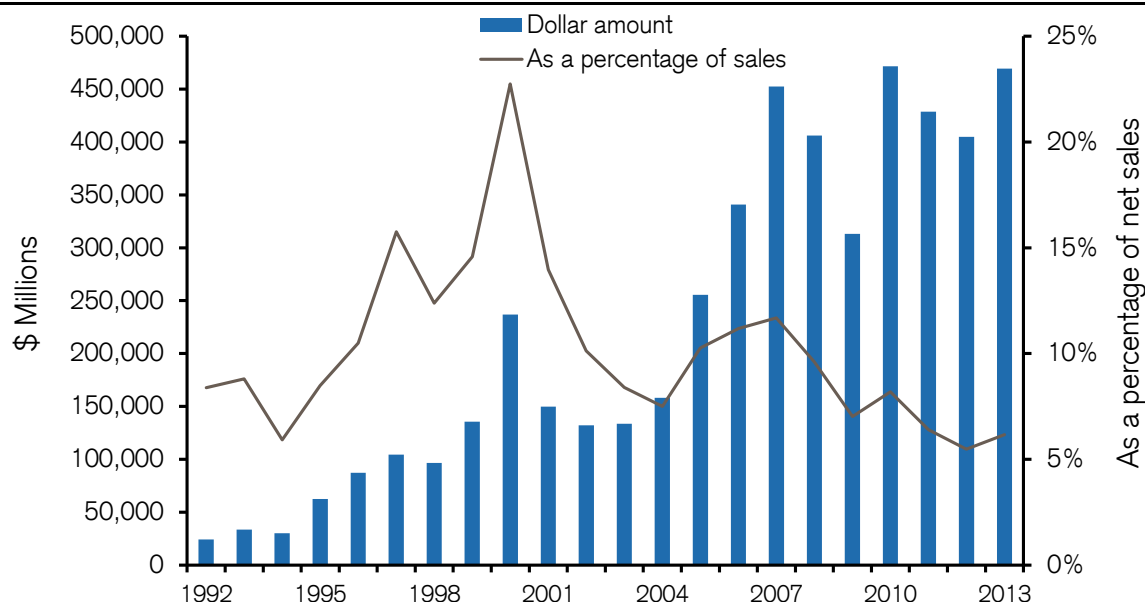
Source: Credit Suisse HOLT.
Note: Top 1,000 industrial firms.

Mergers and Acquisitions. Exhibit 46 shows the dollar amount of M&A, as well as M&A as a percentage of sales, from 1992 to 2013. M&A is very cyclical, ranging from a low of 5.5 percent of sales in 2012 to a high of 22.7 percent of sales in 2000. In 2013, M&A volume was 6 percent of sales, well below its long-term average of roughly 10 percent. This historical average is equal to that of the U.S. and Europe. But while M&A levels are comparable as a fraction of sales, the absolute level of M&A in APEJ lags that of the U.S. and Europe. In 2013, M&A volume in APEJ was one-half the level of the U.S. and nine-tenths that of Europe.

One notable difference across the regions is that absolute M&A volumes recovered more rapidly following the financial crisis in APEJ than it did in the U.S. and Europe. Only in 2014 did worldwide deal volume return to the level of 2007.

On a country basis, China leads the deal making in APEJ. Its share of the region's total M&A went from less than 5 percent in the early 1990s to just over one-half in recent years. Australia and South Korea were the next biggest contributors in 2013, representing 14 percent and 9 percent of the region's total M&A, respectively. India's M&A activity has not kept pace with China, with volume equal to just 4 percent of the region's total in 2013.

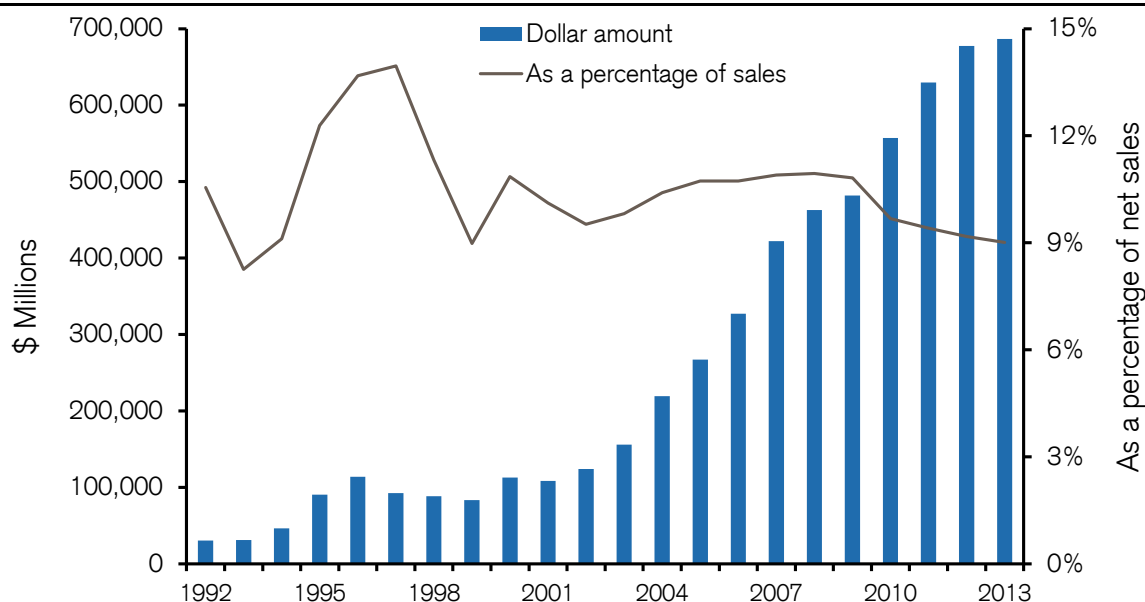
The trend in M&A activity in the region has been largely positive owing to economic growth and business reforms. In particular, China's rapid growth and its shift toward a more free market economy have driven deal activity.⁵⁵ But while M&A has been strong between Chinese companies, government restrictions aimed at ensuring Chinese companies maintain control of certain industries have limited cross-border deals.

Exhibit 46: APEJ Mergers and Acquisitions, 1992-2013

Note: Dollar amounts not inflated. APEJ announced domestic mergers; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases.

Source: Thomson Reuters Datastream, Credit Suisse HOLT, Credit Suisse.

Capital Expenditures. Exhibit 47 shows the dollar amount of capital expenditures as well as capital expenditures as a percentage of sales from 1992 to 2013. Capital expenditures were 9.0 percent of total sales in 2013, below the long-term average of 10.5 percent. In 2013, they were APEJ's largest use of capital, which is typically the case with the exception of large years for M&A. Measured as a fraction of sales, APEJ's capital expenditure ratio is much higher than that of the U.S., Japan, and Europe, and is slightly below that of GEM.

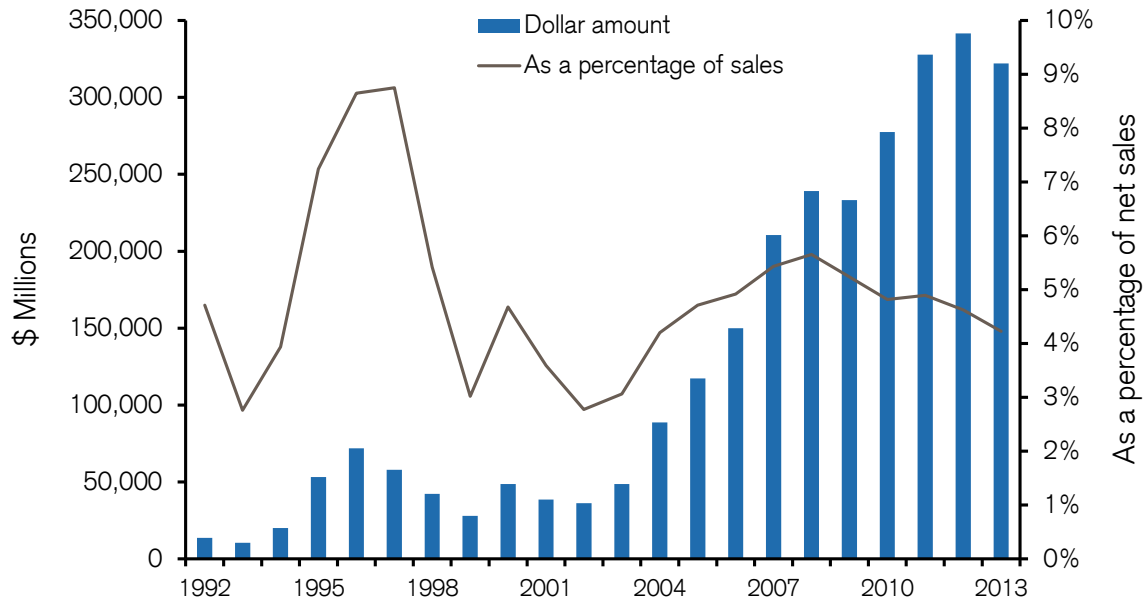
Exhibit 47: APEJ Capital Expenditures, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Exhibit 48 shows capital expenditures net of depreciation. Measured as a percentage of sales, growth capital expenditures have averaged roughly one-half of overall capital expenditures.

Exhibit 48: APEJ Capital Expenditures Net of Depreciation, 1992-2013



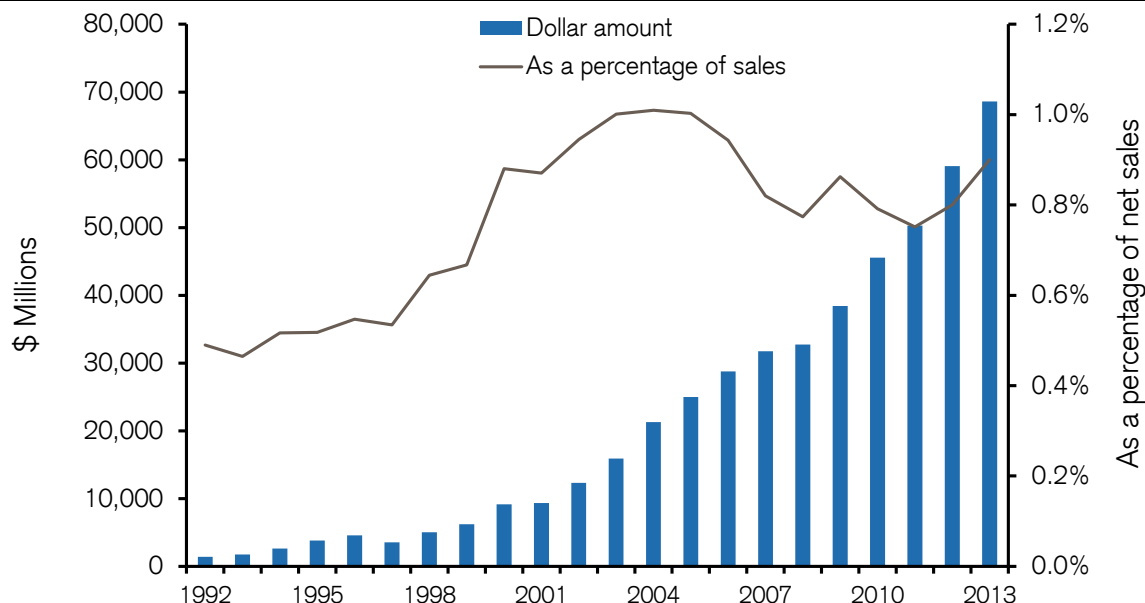
Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Research and Development. Exhibit 49 shows the dollar amount of R&D, as well as R&D as a percentage of sales, since 1992. R&D rose steadily from 0.5 percent of sales at the beginning of the period to a peak of 1.0 percent of sales in the mid-2000s, and currently stands at 0.9 percent of sales. R&D spending has risen substantially off of a low base, but remains well below the levels of the U.S., Japan, and Europe relative to sales. The rise in R&D during the full period reflects the change in the composition of the market. During this time, information technology, the most R&D-intensive sector, grew from 1 percent to 10 percent of the market.

Based on 2013 figures, the APEJ countries that spent the most on R&D as a percentage of sales were Korea at 2.0 percent and Taiwan at 1.8 percent. Notable laggards included Australia at 0.3 percent and India at 0.4 percent. China was in the middle at 0.7 percent.

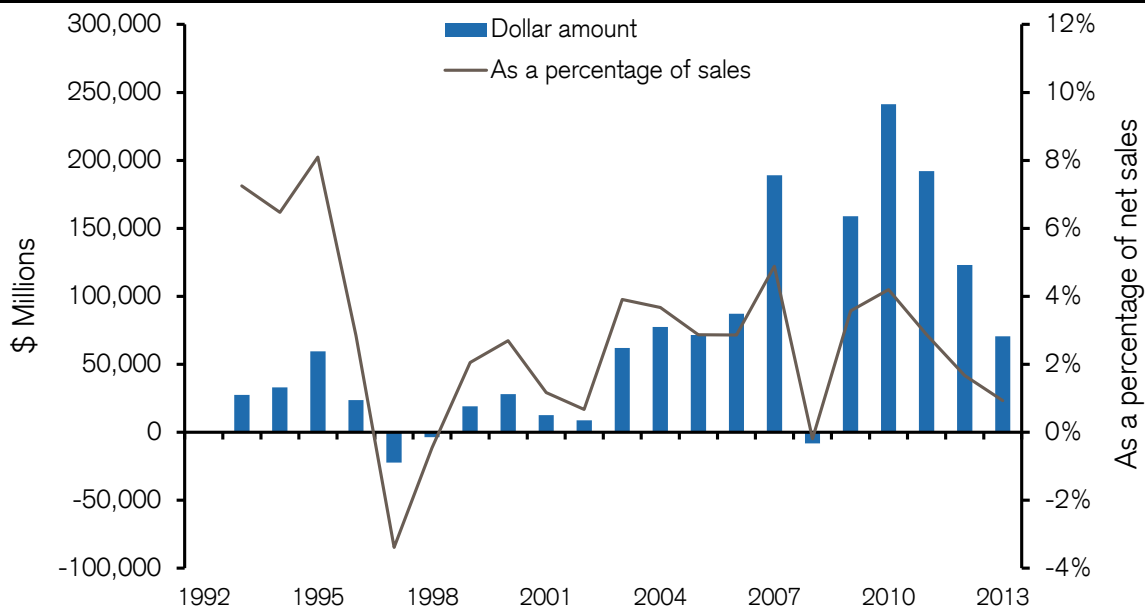
Businesses in APEJ countries account for roughly one-half of total R&D spending, with the government, academia, and private nonprofit companies contributing the rest.⁵⁶ Corporations in APEJ account for a smaller share of the total R&D spending than they do in the U.S. and Japan, which are around 70-75 percent, and in Europe, which is just above 60 percent. The business share of total R&D spending ranges from a high of 77 percent in Korea to a low of 15 percent in Vietnam. Among larger APEJ economies, the business share of R&D spending is 76 percent in China, 43 percent in Hong Kong, 58 percent in Australia, and 36 percent in India.

Exhibit 49: APEJ Research and Development, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Net Working Capital. Net working capital is roughly 15 percent of assets on average for companies in APEJ. Exhibit 50 shows the annual change in net working capital from 1992 through 2013. At year-end 2013, net working capital was \$1.5 trillion for the top 1,000 public firms in APEJ. We consider changes in net working capital as opposed to the absolute amount, because changes are what you should consider to be an incremental investment. Net working capital investments are an important use of cash in APEJ and are larger than R&D on average but smaller than M&A and capital expenditures.

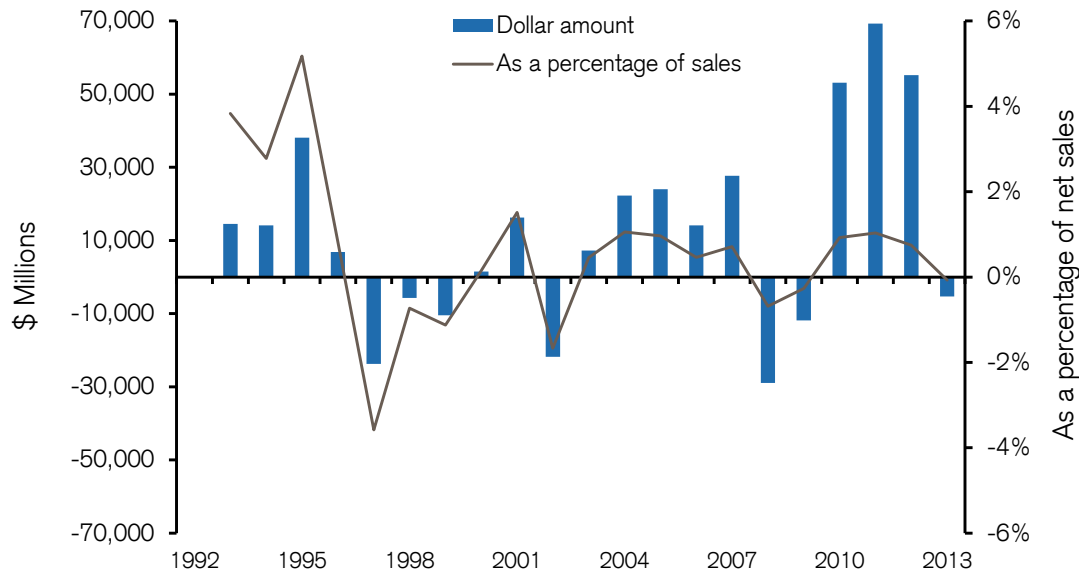
Exhibit 50: APEJ Change in Net Working Capital, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

The picture changes dramatically when we exclude cash. At the end of 2013, net working capital excluding cash was about \$280 billion for the top 1,000 APEJ industrial companies, roughly one-fifth the total net working capital sum. Exhibit 51 shows the change in net working capital excluding cash.

Exhibit 51: APEJ Change in Net Working Capital Excluding Cash, 1992-2013

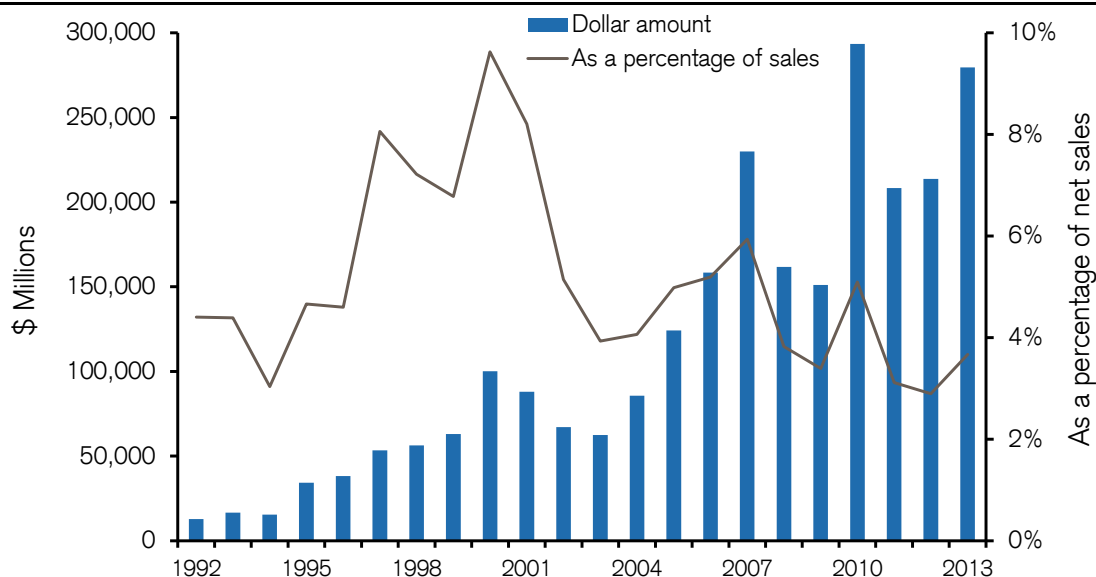


Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Divestitures. Exhibit 52 shows the magnitude of divestitures from 1992-2013. Similar to M&A, divestitures vary a great deal from one year to the next, and were in a range of 3.0 percent of sales in 1994 to 9.6 percent in 2000. Divestitures have averaged 5.1 percent of sales over time, one-half the level of M&A and much higher than buybacks, dividends, or R&D spending.

Exhibit 52: APEJ Divestitures, 1992-2013



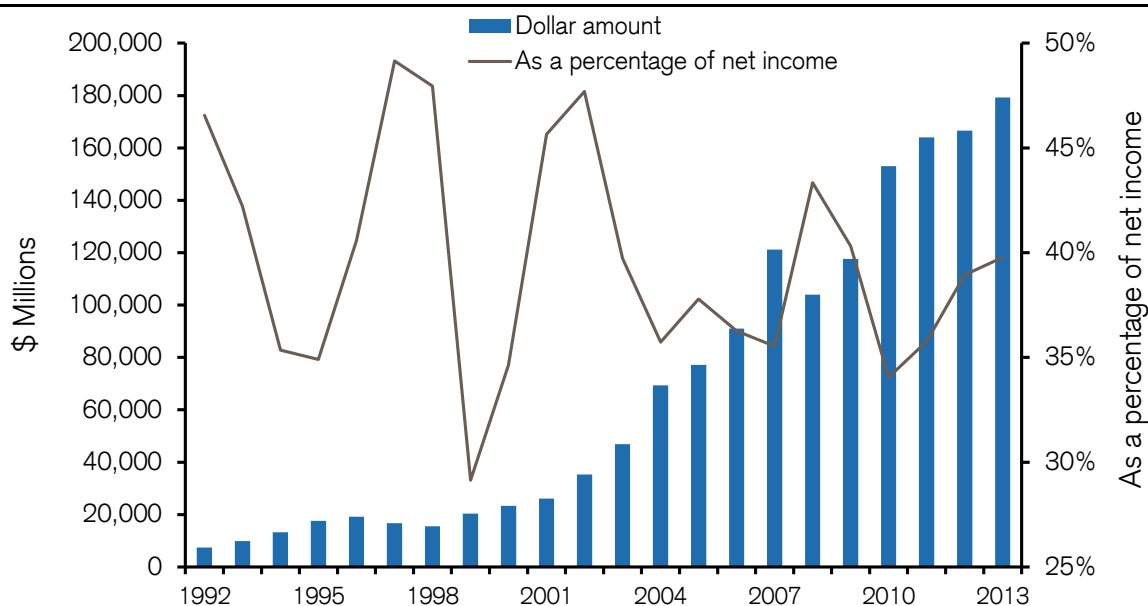
Note: Announced divestitures; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases; Dollar amounts not inflated.

Source: Thomson Reuters Datastream, Credit Suisse HOLT, Credit Suisse.

Dividends. Exhibit 53 shows the annual dividends on common and preferred stock for the top 1,000 companies in APEJ, excluding the financial services and regulated utility industries, from 1992 to 2013. Dividends are very stable in APEJ.

The average dividend payout ratio, or dividends as a percentage of net income, was roughly 40 percent from 1992-2013. The average dividend yield was 2.2 percent over the same period. In 2013, the dividend yield was 2.5 percent. Countries with above-average payouts included Thailand at 3.8 percent, Singapore at 3.3 percent, and Australia at 3.2 percent. Countries with below-average payouts included Korea at 1.0 percent and India at 2.0 percent.

Exhibit 53: APEJ Common and Preferred Dividends, 1992-2013

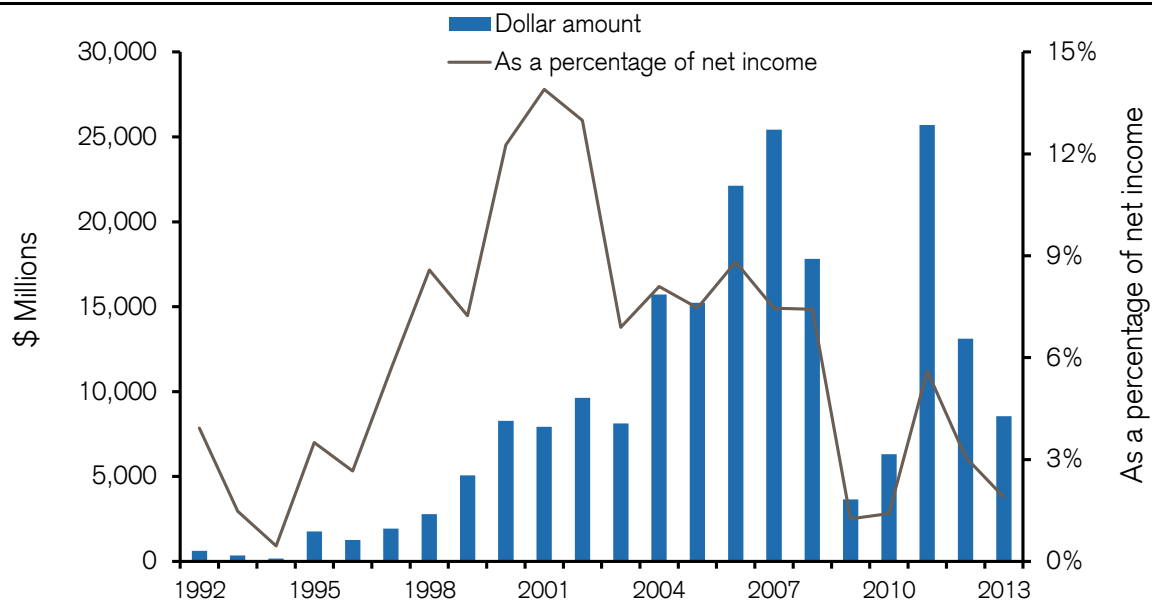


Note: Top 1,000 industrial firms. Dollar amounts not inflated.
Source: Credit Suisse HOLT.

Share Buybacks. Exhibit 54 shows the annual gross buybacks for the top 1,000 companies in APEJ from 1992 to 2013. Similar to other regions, we see cyclicalities. Buybacks rose throughout most of the 2000s but fell sharply in 2008-2010. Overall, buybacks remain a very small component of the corporate payout in APEJ.

Buybacks have been roughly five percent of net income, on average, from 1992-2013. The average buyback yield, or buybacks as a percentage of total market capitalization, was 0.3 percent over the same period, significantly below the 2.2 percent dividend yield. In 2013, the buyback yield was 0.1 percent. Australia was the only country in the region with a relevant buyback yield, at 0.6 percent, and China, India, and Taiwan all had a zero yield.

Regulatory constraints contributed to the lower level of buybacks in the earlier years. For example, the government of Australia did not legalize buybacks until 1989 and Hong Kong did not legalize them until 1991. These are two of the largest economies in the region.⁵⁷

Exhibit 54: APEJ Gross Share Buybacks, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

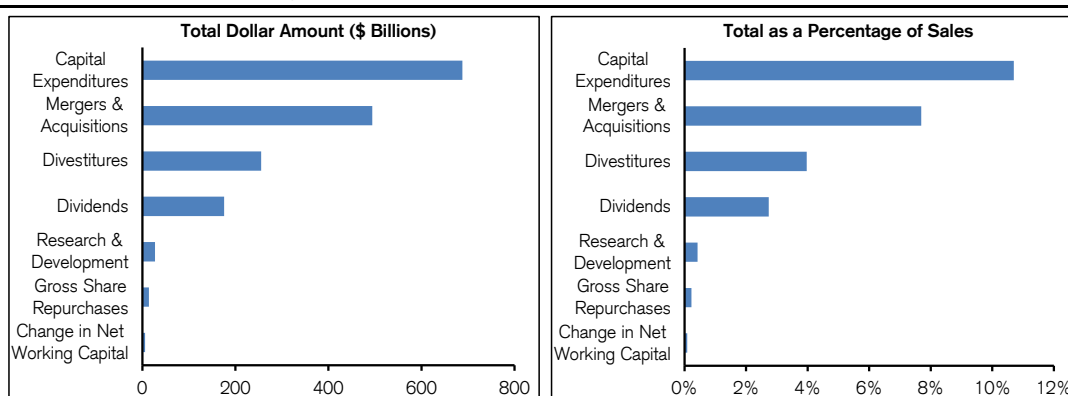
Source: Credit Suisse HOLT.

Global Emerging Markets

The countries in the GEM region overlap substantially with those in the APEJ region. This overlap helps explain why some of the trends in capital deployment are similar. In 2013, the shared countries constituted roughly one half the market capitalization of each region. China and India alone, which are mutual constituents, made up roughly one-third the market capitalization of each region in 2013. The appendix provides a full list of the countries in each region.

Uses of Capital. Exhibit 55 shows how the top 1,000 companies in GEM, excluding companies in the financial services and regulated utility industries, deployed capital in 2013. While just a snapshot for a particular year, the ranking reasonably reflects how companies in GEM have allocated capital over time.

Exhibit 55: GEM Capital Deployment, 2013

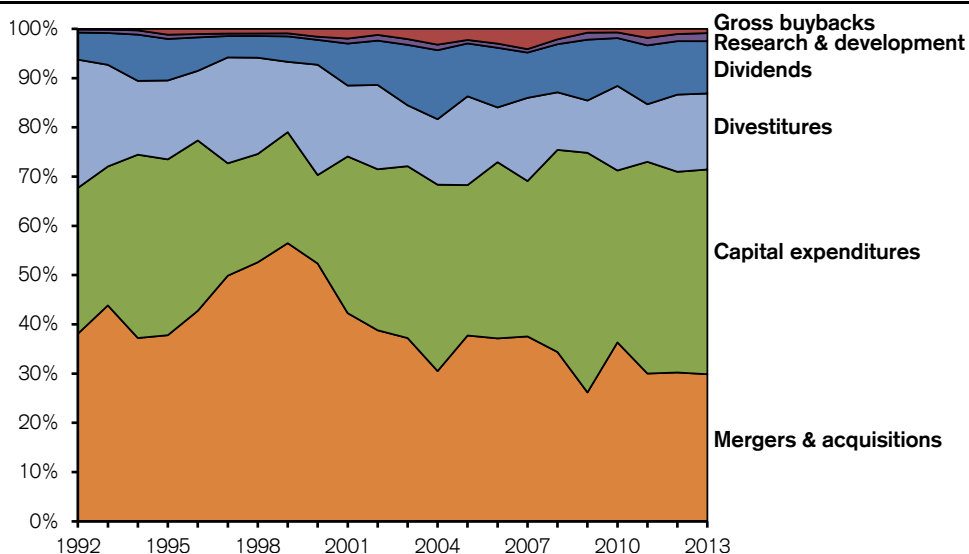


Source: Credit Suisse HOLT, Thomson Reuters Datastream.

Note: Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Exhibit 56 shows the spending by source from 1992-2013. Again, we exclude changes in net working capital.

Exhibit 56: GEM Capital Deployment, 1992-2013



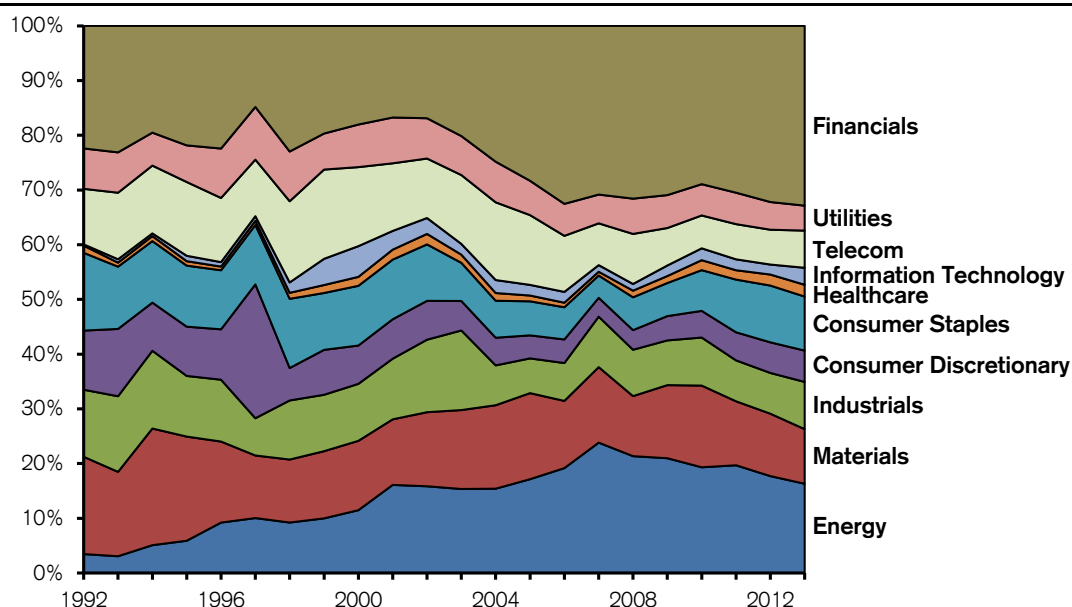
Source: Credit Suisse HOLT, Thomson Reuters Datastream.

Note: Data for R&D, capital expenditures, buybacks, and dividends exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

M&A and capital expenditures are by far the largest uses of capital over time. An examination of the changes from 1992 through 2013 reveals some noteworthy patterns:

- M&A is very cyclical, ranging from a low of 7 percent of sales in 2009 to a high of 33 percent of sales in 1998. The long-term average of 16 percent of sales greatly exceeds the 10 percent level shared by the U.S., Europe, and APEJ. The absolute level of M&A in GEM has risen sharply since the early 1990s as the result of strong economic growth and business reforms. The BRIC countries (Brazil, Russia, India, and China) now dominate M&A activity in the region. Together they accounted for 70 percent of the total in 2013, up from a share of less than 10 percent in 1992.
- Capital expenditures are the next largest use of capital. Capital expenditures were 11 percent of total sales in 2013, just below the long-term average of 12 percent. This long-term average exceeds levels in the U.S., Europe, and APEJ. A logical explanation for this gap is the composition of GEM economies. (See Exhibit 57.) Capital-intensive industries such as energy, materials, and industrials represent a greater share of the economy in GEM than in any other region.
- R&D spending is very modest and has remained in a narrow band of 0.3 to 0.4 percent of sales. This level is well below that of the U.S., Japan, and Europe. Again, sector composition plays a key role, as GEM has a very low concentration in information technology and healthcare, the most R&D-intensive sectors, and a high concentration in industries that rely on capital investments for growth. Relative to the other regions, GEM companies also spend less on R&D.
- Share buybacks have been a very minor use of capital. Buybacks have averaged just 0.4 percent of total market capitalization over time, which compares to dividends at 2.3 percent. BRIC countries in particular spend very little on buybacks. Buyback activity was extremely low until the mid-2000s, rose sharply in 2007, then plummeted in the ensuing years. Dividends have been far more stable.

Exhibit 57: GEM Sector Composition, 1992-2013



Source: Credit Suisse HOLT.

Exhibit 58 shows a detailed history of capital deployment from 1992-2013. Again we see that the standard deviations of the growth rates are small for R&D, capital spending, and dividends relative to those of buybacks, divestitures, and M&A. Exhibit 59 represents the same deployment numbers as a percentage of sales.

Exhibit 58: GEM Capital Deployment, 1992-2013

	Total Amount (in Millions of U.S. Dollars, Nominal)						
	M&A	Capex	R&D Expense	Net Working Capital	Gross Buybacks	Divestitures	Dividends
1992	22,365	17,386	361		74	15,293	3,232
1993	28,407	18,281	445	9,217	99	13,376	4,183
1994	27,547	27,548	640	21,018	221	11,087	6,952
1995	46,628	44,050	1,062	32,627	1,453	19,771	10,404
1996	74,615	60,368	1,187	18,191	1,820	24,668	11,873
1997	131,331	60,095	1,314	5,895	2,507	56,603	11,434
1998	150,766	63,050	1,459	1,711	2,686	56,027	12,646
1999	146,875	58,616	1,608	30,119	2,349	37,122	13,446
2000	209,496	71,921	2,577	43,276	6,361	89,633	20,208
2001	121,911	91,720	2,921	-4,951	5,660	41,538	24,587
2002	107,961	91,006	3,237	11,353	3,392	47,618	25,055
2003	128,521	120,502	4,044	48,552	7,165	42,709	42,374
2004	130,069	161,352	4,776	85,066	13,655	56,665	59,771
2005	274,620	222,321	5,136	56,840	16,381	131,161	78,141
2006	305,167	293,961	6,964	127,410	24,573	91,271	99,498
2007	528,681	444,361	9,836	163,469	57,856	237,920	129,494
2008	414,031	494,297	11,943	26,980	25,503	140,796	117,624
2009	285,226	530,148	15,492	115,976	8,350	115,681	134,642
2010	611,816	587,701	19,262	199,021	12,151	289,123	163,599
2011	457,721	655,693	23,234	165,589	27,793	178,156	182,420
2012	518,203	698,862	24,795	81,975	17,885	268,714	186,146
2013	494,327	687,982	27,064	5,730	14,220	255,351	175,792
CAGR	15.9%	19.1%	22.8%	-2.3%	28.4%	14.3%	21.0%
St. Dev.	45.2%	19.7%	17.0%	396.3%	132.4%	71.3%	22.5%

Source: Credit Suisse HOLT, Thomson Reuters Datastream, and Credit Suisse.

Note: Dollar amounts not inflated. Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

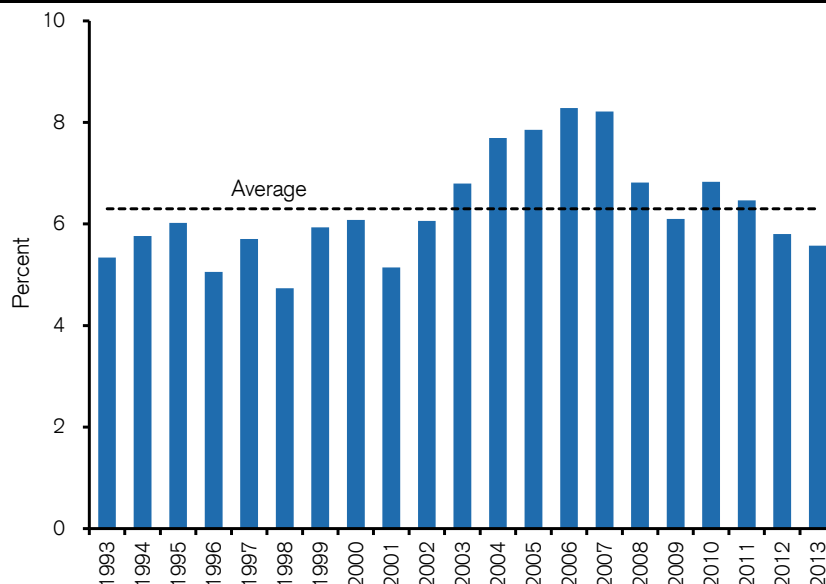
Exhibit 59: GEM Capital Deployment, 1992-2013

	As a Percentage of Sales						
	Net Working			Gross			
	M&A	Capex	R&D Expense	Capital	Buybacks	Divestitures	Dividends
1992	18.5%	14.4%	0.3%		0.1%	12.7%	2.7%
1993	18.5%	11.9%	0.3%	6.0%	0.1%	8.7%	2.7%
1994	12.7%	12.7%	0.3%	9.7%	0.1%	5.1%	3.2%
1995	13.9%	13.1%	0.3%	9.7%	0.4%	5.9%	3.1%
1996	18.2%	14.7%	0.3%	4.4%	0.4%	6.0%	2.9%
1997	31.4%	14.4%	0.3%	1.4%	0.6%	13.5%	2.7%
1998	33.5%	14.0%	0.3%	0.4%	0.6%	12.4%	2.8%
1999	27.2%	10.9%	0.3%	5.6%	0.4%	6.9%	2.5%
2000	29.0%	9.9%	0.4%	6.0%	0.9%	12.4%	2.8%
2001	15.6%	11.7%	0.4%	-0.6%	0.7%	5.3%	3.1%
2002	12.3%	10.3%	0.4%	1.3%	0.4%	5.4%	2.8%
2003	11.0%	10.3%	0.3%	4.2%	0.6%	3.7%	3.6%
2004	8.3%	10.3%	0.3%	5.5%	0.9%	3.6%	3.8%
2005	14.2%	11.5%	0.3%	2.9%	0.8%	6.8%	4.1%
2006	12.2%	11.7%	0.3%	5.1%	1.0%	3.6%	4.0%
2007	15.8%	13.3%	0.3%	4.9%	1.7%	7.1%	3.9%
2008	11.1%	13.3%	0.3%	0.7%	0.7%	3.8%	3.2%
2009	7.4%	13.8%	0.4%	3.0%	0.2%	3.0%	3.5%
2010	12.3%	11.8%	0.4%	4.0%	0.2%	5.8%	3.3%
2011	7.7%	11.1%	0.4%	2.8%	0.5%	3.0%	3.1%
2012	8.0%	10.8%	0.4%	1.3%	0.3%	4.2%	2.9%
2013	7.7%	10.7%	0.4%	0.1%	0.2%	4.0%	2.7%

Source: Credit Suisse HOLT, Thomson Reuters Datastream, and Credit Suisse.

Note: Data for R&D, capital expenditures, buybacks, dividends, and net working capital exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Recent Trends in Cash Flow Return on Investment and Asset Growth. The current level of CFROI, at 5.6 percent, is slightly below the average of 6.3 percent over the past twenty years. (See Exhibit 60.)

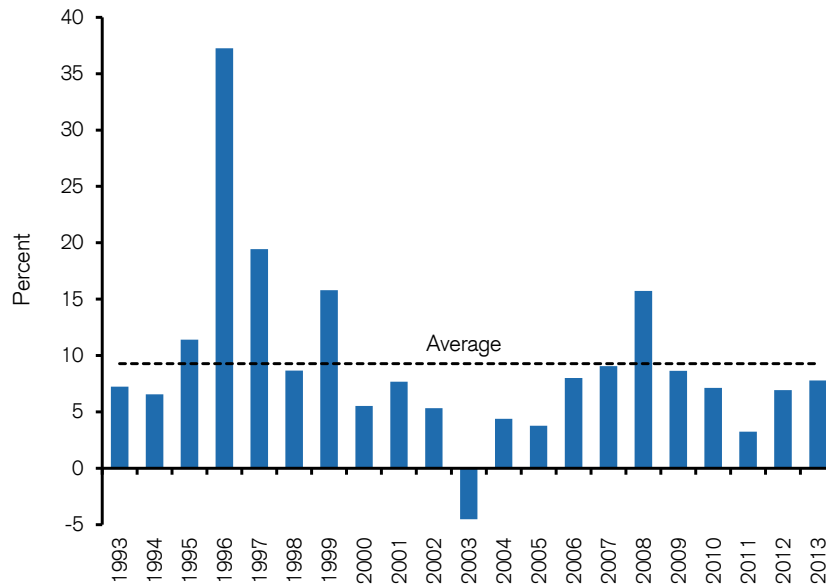
Exhibit 60: GEM CFROI, 1993-2013

Source: Credit Suisse HOLT.

Note: Weighted aggregate of GEM firms excluding financials and regulated utilities.

Exhibit 61 shows the annual rate of asset growth, adjusted for inflation, over the past twenty years. In the past five years growth has been weak relative to the long-term average. That said, the average is much higher than it is in developed economies.

Exhibit 61: GEM Real Asset Growth Rate, 1993-2013

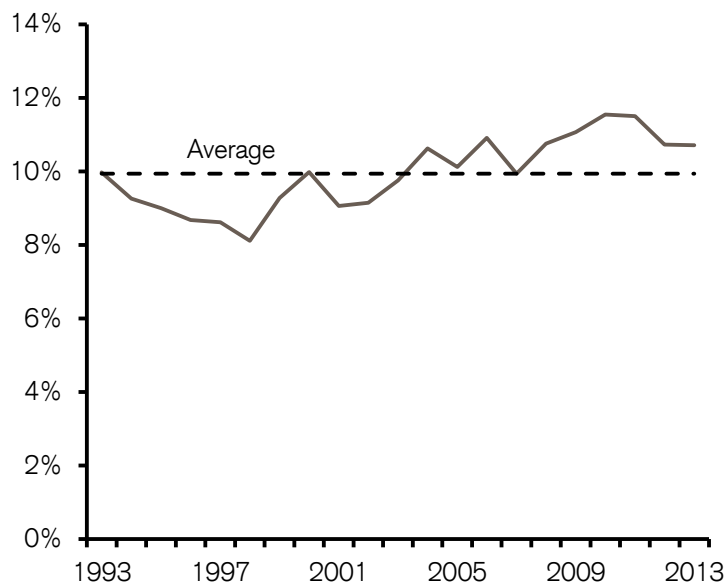


Source: Credit Suisse HOLT.

Note: Weighted aggregate of GEM firms excluding financials and regulated utilities.

Exhibit 62 shows that at 11 percent, today's cash as a percentage of assets is slightly above the long-term average of 10 percent. Cash holdings have been stable.

Exhibit 62: GEM Cash as a Percentage of Total Assets, 1993-2013



Source: Credit Suisse HOLT.

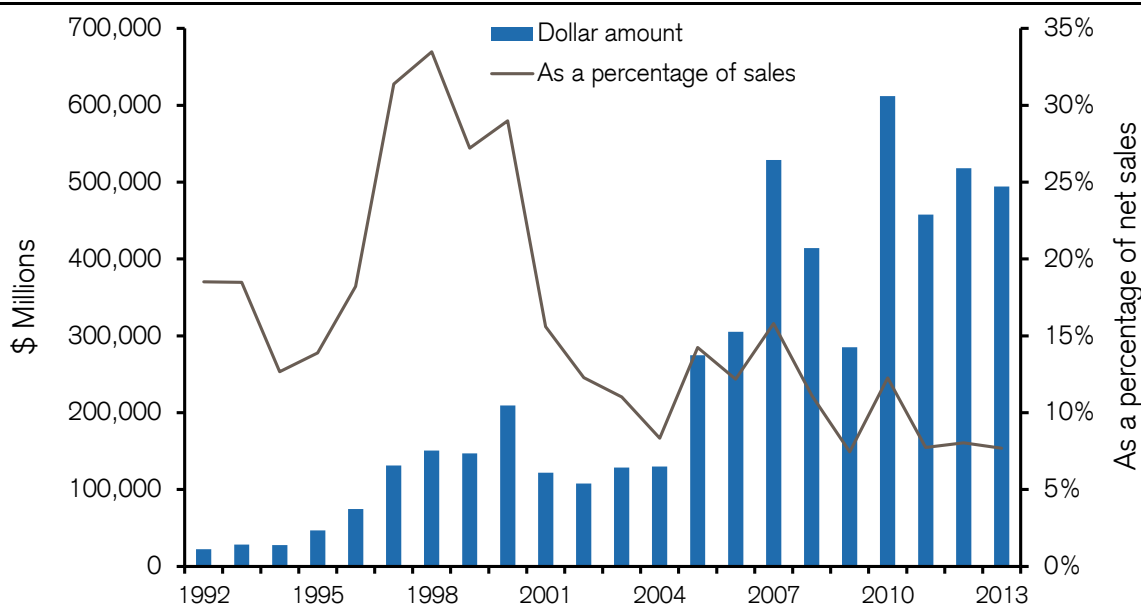
Note: Top 1,000 industrial firms.

Mergers and Acquisitions. Exhibit 63 shows the dollar amount of M&A, as well as M&A as a percentage of sales, from 1992 to 2013. M&A volume was 8 percent of sales in 2013, well below the long-term average of about 16 percent. This long-term average exceeds the 10 percent shared by the U.S., Europe, and APEJ. In absolute dollars, M&A in GEM in 2013 was still only one-half that of the U.S., reflecting the difference in the sizes of the economies. The total market capitalization of GEM is just two-fifths that of the U.S.

The BRIC countries dominate M&A activity in the region. Together they accounted for 70 percent of the total in 2013, up considerably from less than 10 percent in 1992. In 2013, China was 45 percent of the deal volume, followed by Russia at 11 percent, Brazil at 10 percent, and India at 4 percent. The biggest declines came from Argentina and Mexico. The combined share for those countries dropped from 60 percent in 1992 to only 4 percent in 2013.

M&A in GEM has risen sharply since the early 1990s as the result of strong economic growth and business-friendly reforms. In recent years, a number of governments in the emerging markets have sold off state-owned businesses. These companies often go on to merge with other companies, prompting M&A activity. And notably, some large emerging market companies have pursued major deals outside their borders.⁵⁸

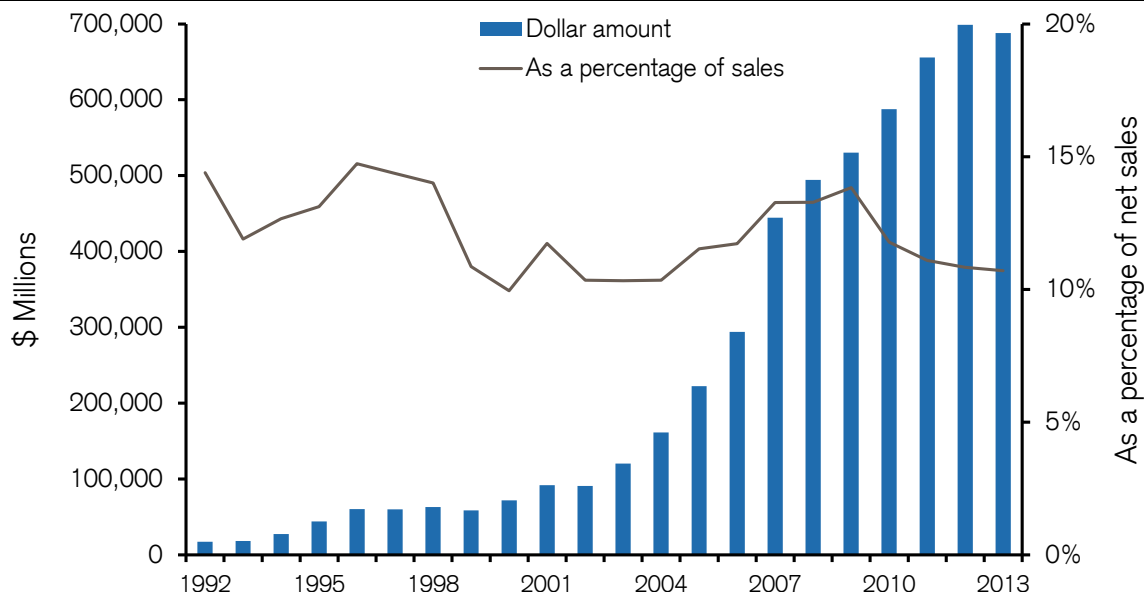
Exhibit 63: GEM Mergers and Acquisitions, 1992-2013



Note: Dollar amounts not inflated. GEM announced domestic mergers; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases.

Source: Thomson Reuters Datastream, Credit Suisse HOLT, Credit Suisse.

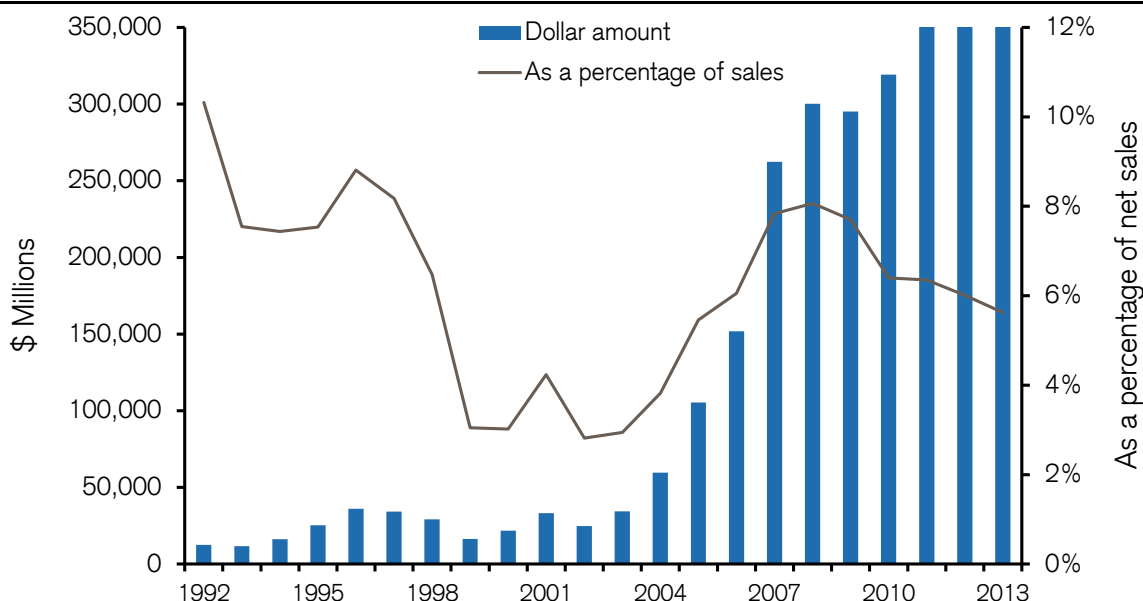
Capital Expenditures. Exhibit 64 shows the dollar amount of capital expenditures, as well as capital expenditures as a percentage of sales, from 1992 to 2013. In 2013, capital expenditures were GEM's largest use of capital, as M&A had a down year. Capital expenditures were 10.7 percent of total sales in 2013, below the long-term average of 12.1 percent. This long-term average exceeds the levels in the U.S., Europe, and APEJ. A logical explanation for this gap is the composition of GEM economies. The energy, materials, and industrial sectors represent 35 percent of the region's market capitalization, well above that of the other regions.

Exhibit 64: GEM Capital Expenditures, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Exhibit 65 shows capital expenditures net of depreciation. Measured as a percentage of sales, growth capital expenditures have averaged roughly one-half of overall capital expenditures.

Exhibit 65: GEM Capital Expenditures Net of Depreciation, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

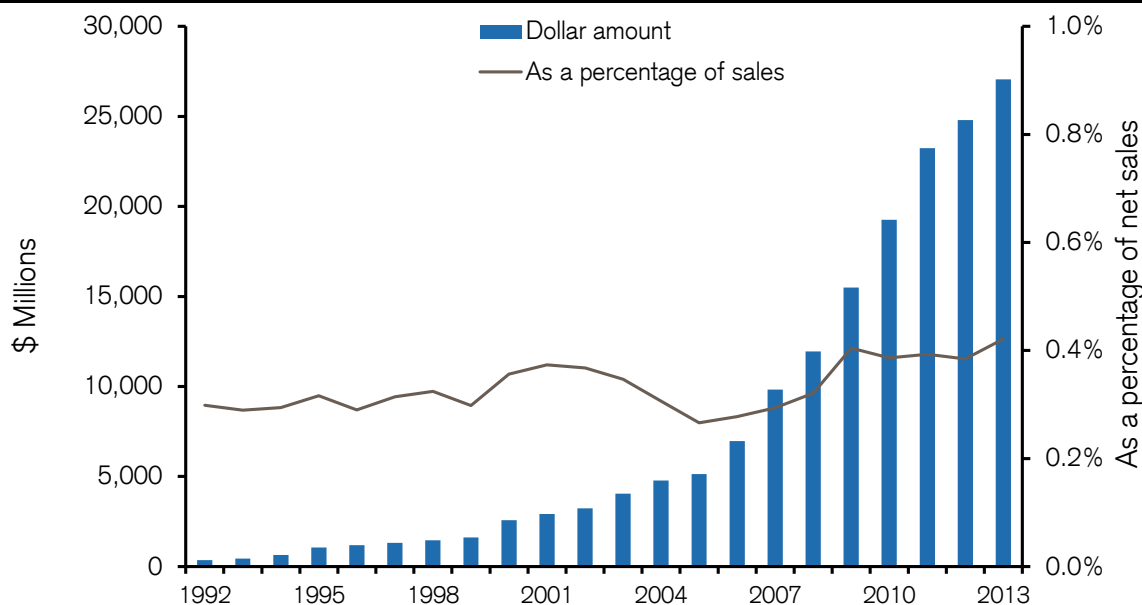
Research and Development. Exhibit 66 shows the dollar amount of R&D since 1992, as well as R&D as a percentage of sales. R&D has been in a narrow band of 0.3 to 0.4 percent of sales. This level is well below that of the U.S. and Japan, which are at 2.3 percent, and Europe, which is at 1.7 percent. Sector composition largely explains this difference. GEM has a very low concentration in information technology and healthcare,

the most R&D-intensive sectors, and a high concentration in industries that rely more heavily on capital investments. Specifically, IT and healthcare together have accounted for only three percent of total market capitalization on average over time.

In GEM countries, businesses account for 43 percent of total R&D spending on average, with the government, academia, and private nonprofit companies spending the other 57 percent.⁵⁹ Corporations in GEM account for a smaller share of the total R&D spending than they do in the U.S. and Japan (70-75 percent), Europe (about 60 percent), and APEJ (roughly 50 percent).

Among larger GEM economies, the business share of R&D spending is 76 percent in China, 58 percent in Russia, 39 percent in Mexico, and 36 percent in India. The business share of R&D spending is particularly low in Latin American countries at 32 percent on average. One notable change is in China, where the corporate share of R&D spending has risen from just 43 percent in 1996 to 76 percent today as the country continues to move toward a more market-based economy.

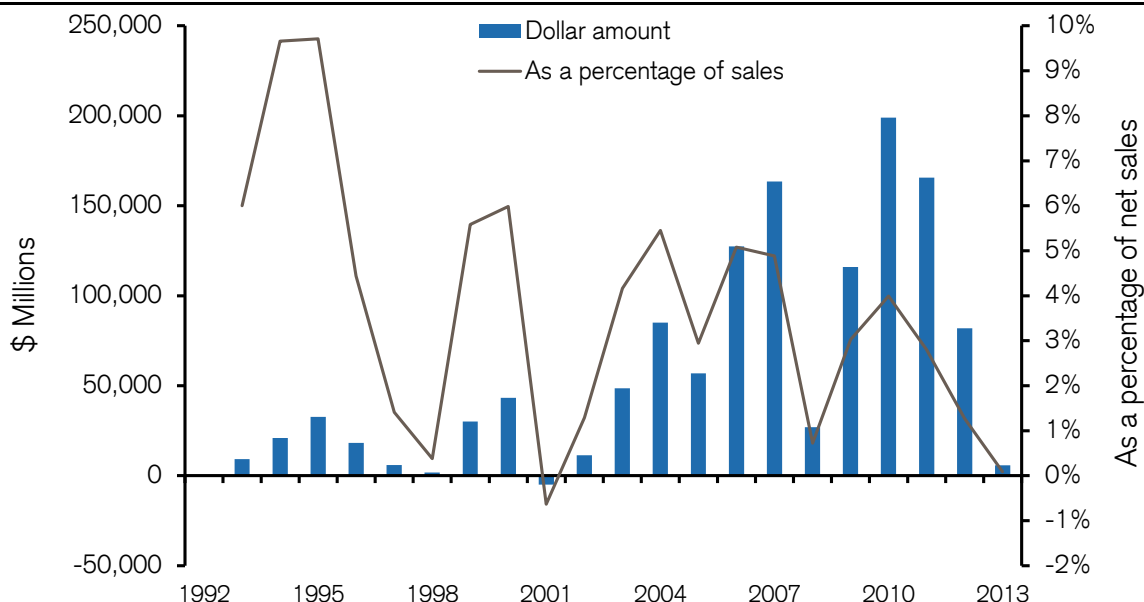
Exhibit 66: GEM Research and Development, 1992-2013



Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

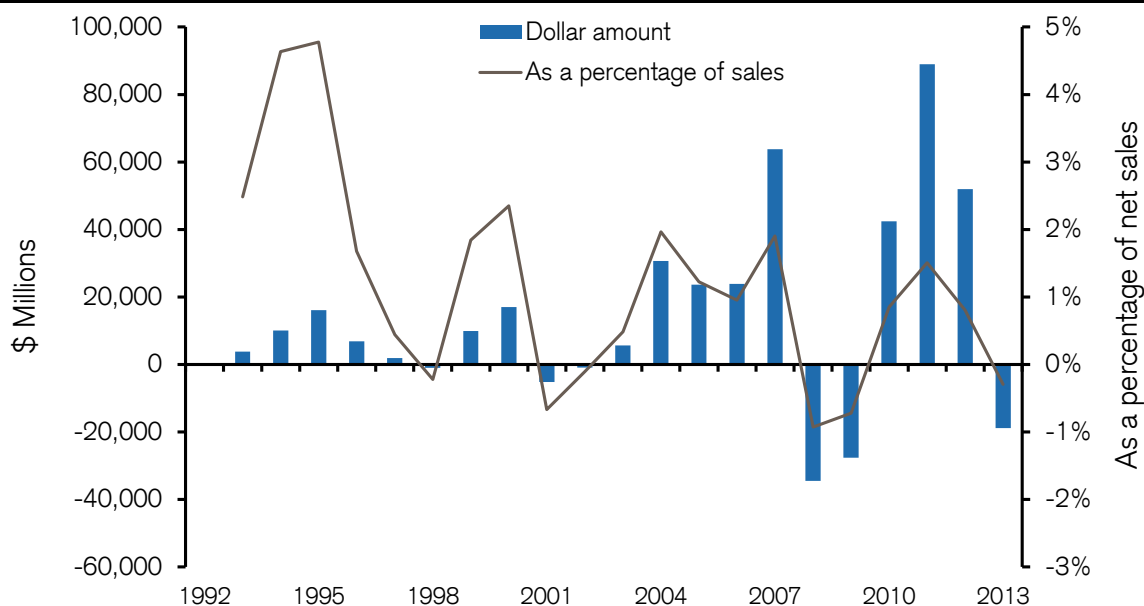
Net Working Capital. Net working capital equals roughly 15 percent of assets on average for companies in GEM. Exhibit 67 shows the annual change in net working capital from 1992 through 2013. At year-end 2013, net working capital stood at \$1.3 trillion for the top 1,000 public firms in GEM. We consider changes in net working capital as opposed to the absolute amount, because changes are what you should consider to be an incremental investment. Net working capital investments are a large use of cash in GEM, greater on average than R&D but smaller than M&A or capital expenditures.

Exhibit 67: GEM Change in Net Working Capital, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

We have defined net working capital to include cash. The picture changes dramatically if we exclude cash. At the end of 2013, net working capital excluding cash was about \$320 billion for the top 1,000 GEM industrial companies, roughly one quarter the total net working capital sum. Exhibit 68 shows the change in net working capital excluding cash.

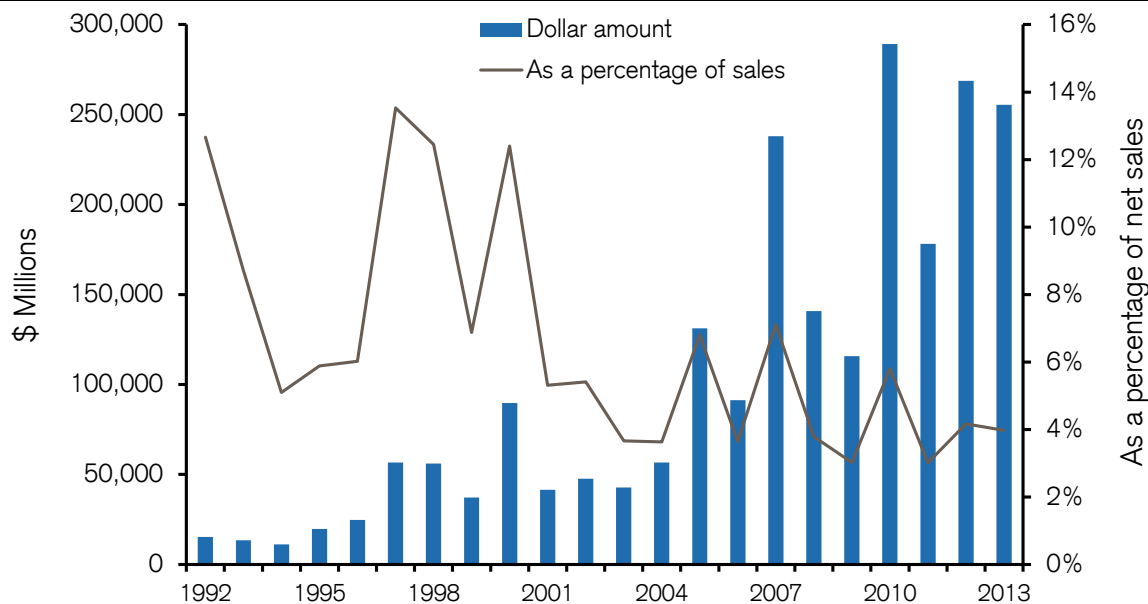
Exhibit 68: GEM Change in Net Working Capital Excluding Cash, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Divestitures. Exhibit 69 shows divestitures from 1992-2013. Similar to M&A, divestiture activity varies a lot from year to year, ranging from a low 3 percent of sales in 2009 to a high of 14 percent in 1997. Overall, divestitures have averaged 6.5 percent of sales over time, which is roughly two-fifths the level of M&A and much higher than dividends, buybacks, and R&D spending.

Exhibit 69: GEM Divestitures, 1992-2013

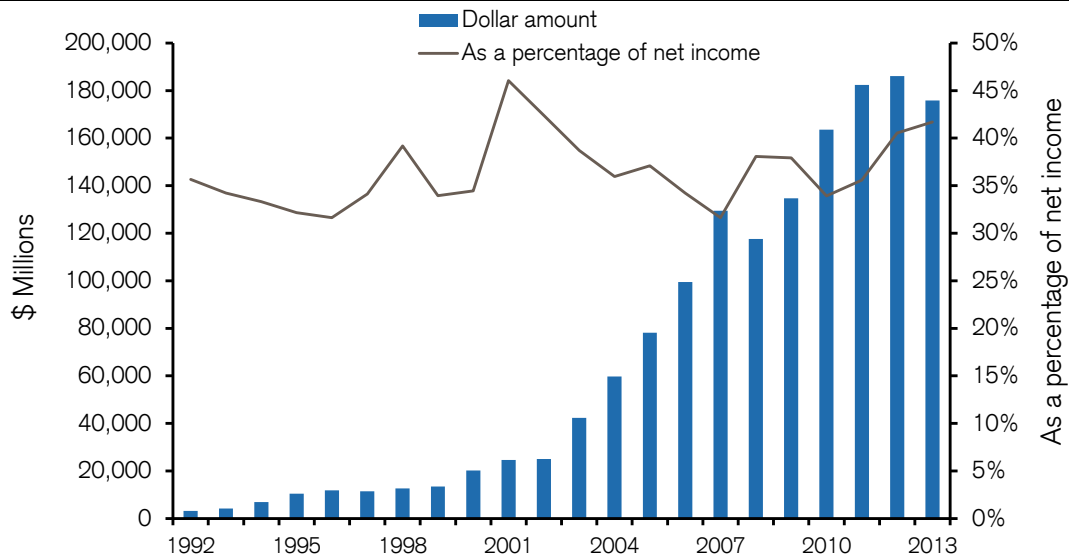


Note: Announced divestitures; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases; Dollar amounts not inflated.

Source: Thomson Reuters Datastream, Credit Suisse HOLT, Credit Suisse.

Dividends. Exhibit 70 shows the annual amount of dividends on common and preferred stock for the top 1,000 companies in GEM, excluding the financial services and regulated utility industries, from 1992 to 2013. Dividends are very stable in GEM.

The average dividend payout ratio was roughly 35 percent from 1992-2013. The average dividend yield was 2.3 percent over the same period. In 2013, the dividend yield was 2.7 percent. Countries with above-average yields in 2013 included Colombia at 5.8 percent, Saudi Arabia at 3.9 percent, Thailand at 3.7 percent, and Brazil and Russia at 3.2 percent. Countries with below-average yields included Mexico at 1.8 percent and India at 2.0 percent. While their economies are a relatively small share of GEM overall, the oil producing countries of the Middle East in particular have very high dividend yields.

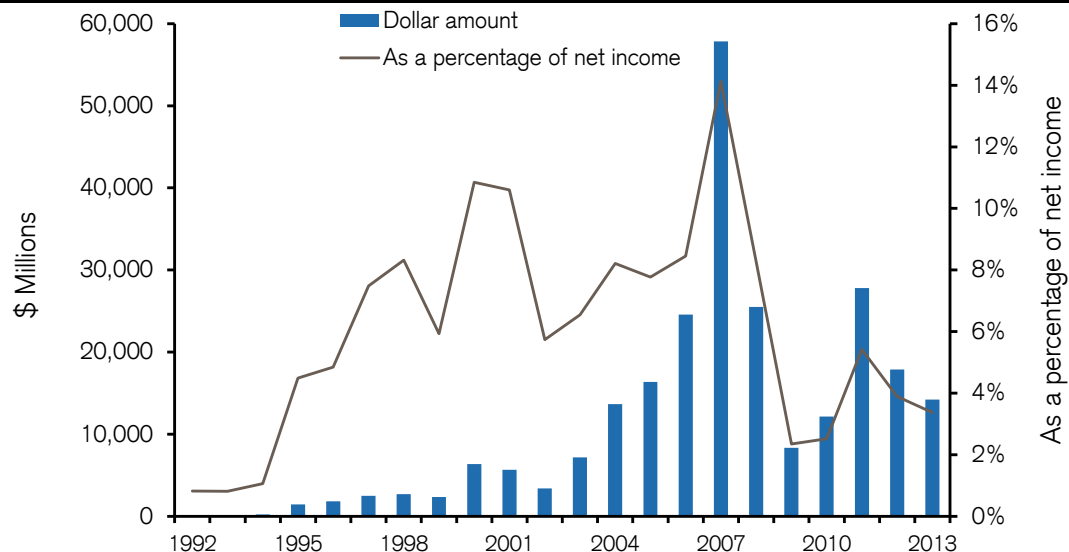
Exhibit 70: GEM Common and Preferred Dividends, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Share Buybacks. Exhibit 71 shows the annual amount of gross buybacks for the top 1,000 companies in GEM from 1992 to 2013. Buyback activity was extremely low until the mid-2000s, rose sharply in 2007, and then plummeted in the ensuing years. But even at their peak in 2007, buybacks were still less than 15 percent of net income.

Overall, buybacks have totaled roughly five percent of net income from 1992-2013. The average buyback yield was 0.4 percent, far below the 2.3 percent dividend yield. In 2013, the buyback yield was 0.2 percent. Countries with above-average buyback yields in 2013 included Mexico at 1.4 percent and Russia at 0.8 percent. The three other BRIC countries spend very little on buybacks. In 2013, the buyback yield was 0.1 percent in Brazil and zero in both India and China.

Exhibit 71: GEM Gross Share Buybacks, 1992-2013

Note: Top 1,000 industrial firms. Dollar amounts not inflated.

Source: Credit Suisse HOLT.

Part III: Assessing Management's Capital Allocation Skills

"All roads in managerial evaluation lead to capital allocation."⁶⁰

The final part of this report provides a framework for assessing a management team's capital allocation skills. This framework has four components. First, you want to study how a company has allocated capital in the past. Next, you need to examine the company's return on invested capital and, more importantly, return on incremental invested capital. Third is a careful consideration of incentives and corporate governance. And finally, you can compare management's actions to the five principles of capital allocation. You can find a more detailed version of this discussion in [Michael J. Mauboussin and Dan Callahan, "Capital Allocation: Evidence, Analytical Methods, and Assessment Guidance," *Credit Suisse Global Financial Strategies*, August 5, 2014.](#)

Past Spending Patterns. The first step in assessing a company's capital allocation skills is to see how management has allocated capital in the past. You should break the analysis into two parts, one dealing with investments in the operations (M&A, capital expenditures, R&D, and working capital) and the other with returning cash to claimholders (dividends, buybacks, and debt repayment).

The value of a business is the present value of future free cash flow (FCF).⁶¹ Free cash flow is defined as net operating profit after tax (NOPAT), a measure of the cash earnings of the business that assumes no financial leverage, minus investment (I) in future growth:

$$\text{FCF} = \text{NOPAT} - I$$

NOPAT is determined by sales and sales growth, operating profit margins, and the cash tax rate. Investment (I) is determined by changes in working capital, capital expenditures net of depreciation, and acquisitions net of divestitures. The product of this analysis is a clear understanding of profitability (sales, sales growth, and operating profit margins) and the investment choices the company has made (changes in working capital, capital expenditures, and M&A).

Such an examination is also useful to assess the change in practices from one CEO to the next. One CEO may seek to grow primarily organically, which will raise one set of analytical issues. Another may focus on profitability and emphasize cost cutting. Yet another may be more acquisitive, raising a separate set of issues. Assuming past behaviors provide some basis for anticipating future behavior, this analysis is very useful.

The second component of this analysis is to understand how and why management has returned cash to claimholders. This also requires considering a company's capital structure and whether it can or should change. The key is to understand the rationale and motivation for the decisions management makes to understand whether they are consistent with the principles of building long-term value per share.

Calculating Return on Invested Capital and Return on Incremental Invested Capital. The second component to assessing capital allocation is determining the output of management's decisions through an analysis of return on invested capital (ROIC) and return on incremental invested capital (ROIIC). ROIC provides a picture of the company's overall performance while ROIIC dwells on the efficiency of incremental spending. Our report, ["Calculating Return on Invested Capital: How to Determine ROIC and Address Common Issues,"](#) provides details on how to calculate ROIC and ROIIC and includes case studies.⁶² Here's a quick summary.

NOPAT is the numerator of ROIC. Because NOPAT assumes no financial leverage, the sum is the same whether a company is highly levered or free of debt. This is essential for comparability within and across industries.

Invested capital is the denominator of ROIC. You can think of invested capital in two ways that are equivalent. First, it's the amount of net assets a company needs to run its business. Alternatively, it's the amount of financing a company's creditors and shareholders need to supply to fund those net assets. These approaches are the same since dual-entry accounting requires that both sides of the balance sheet equal one another.

You can evaluate ROIC a number of ways. First and most fundamentally, companies that create value generate an ROIC above the cost of capital over time. This simply says that the company is earning in excess of the opportunity cost of capital. Second is the magnitude of the spread between ROIC and the cost of capital as well as how much a company can invest at a given spread. Companies with wide spreads that have limited investment opportunity may be less valuable than companies with narrower spreads but ample growth prospects.

Having defined and discussed ROIC, we must now emphasize that it's not the absolute ROIC that matters but rather the change in ROIC. Or, even more accurately, what's crucial is the expectation for changes in ROIC. Needless to say, the market is not always perfect at anticipating change in ROIC, so having a sense of where ROIC is going can be of great value.⁶³

One potentially useful measure is return on incremental invested capital, or ROIIC. ROIIC properly recognizes that sunk costs are irrelevant and that what matters is the relationship between incremental earnings and incremental investments.

The definition of ROIIC is as follows:

$$\text{ROIIC} = \frac{\text{Year}_2 \text{ NOPAT} - \text{Year}_1 \text{ NOPAT}}{\text{Year}_1 \text{ invested capital} - \text{Year}_0 \text{ invested capital}}$$

In words, ROIIC compares the change in NOPAT in a given year to the investments made in the prior year. Let's say a company's Year₀ invested capital is \$2,000 and it invests \$200 during the year (making Year₁ invested capital \$2,200). Further, NOPAT from Year₁ to Year₂ climbs from \$300 to \$350. Given these assumptions, ROIIC is 25 percent $[(\$350 - \$300) / (\$2,200 - \$2,000)]$.

It is preferable to calculate ROIIC on a rolling three- or five-year basis for businesses with investments or NOPAT that are lumpy. At the other extreme, you can take quarterly changes and annualize them if you want to see if there are any recent trends or improvements. Obviously these results will be the most volatile, but they can give you some insights into how the business is doing.

Incentives and Corporate Governance. One of the essential lessons of economics is that incentives matter. But it is also the case that incentives designed to achieve one objective can lead to unintended consequences.⁶⁴ The goal of this section is to consider whether the incentives a company has in place encourage judicious capital allocation. Most of these incentives address compensation.

Agency theory is the classic way to explain why the managers of a company may not act in the interests of the shareholders.⁶⁵ The idea is that conflicts can arise when there is a separation between ownership and control of a firm. There are three areas where these conflicts tend to arise.⁶⁶

The first is that while it is clear that shareholders want management to maximize the value of their holdings, management may derive benefits from controlling resources that don't enrich shareholders. For example, if remuneration is roughly correlated with the size of the firm, management may seek to do value-destroying M&A deals to grow.

The second area of conflict is with tolerance for risk. Since shareholders tend to hold stocks as part of a diversified portfolio and managers are disproportionately exposed to their own company, managers may seek less risk than shareholders would deem appropriate.

The final conflict is with time horizon. To the degree that compensation plans have a shorter time horizon than the period shareholders use to assess the merit of an investment, there can be a mismatch. So managers may dwell on short-term boosts in earnings. Indeed, research shows that a large majority of managers are willing to forego value-creating investments to deliver near-term earnings.⁶⁷

So what elements should you look for in an effective incentive program? The key is to look for a company that seeks to build long-term value per share with the belief that the stock market will ultimately follow that value. If the market fails to reflect that value, management can take action by sharpening communication or buying back stock.

There are three elements to an incentive compensation program that supports judicious capital allocation.⁶⁸ The first is to compensate senior executives with stock options or restricted stock units that are indexed to either the market overall or an appropriate peer group. Presuming that exogenous factors affect peers in a similar fashion as the target firm, indexing takes a large step toward isolating management skill and reducing the role of luck. Only individuals who can influence the stock price should be paid in equity, which limits the number of eligible executives.

Second, executives who run operating units, as well as front line employees, should be paid for exceeding long-term goals for the operating value drivers. These include sales growth, operating profit margins, and some measure of return on invested capital. Broader value drivers can be further broken down into leading indicators of value, performance measures that roll up to the value drivers.

Finally, recognize that the debate about the short term versus the long term is an empty one.⁶⁹ Instead, acknowledge that the goal is to maximize long-term value per share. This applies to activities that management expects to pay off quickly or in the distant future.⁷⁰

Five Principles of Capital Allocation. In their book, *The Value Imperative*, James McTaggart, Peter Kontes, and Michael Mankins describe four principles of resource allocation that apply readily to our discussion about capital allocation.⁷¹ We added one to expand the list to five and believe that these principles are a sound benchmark that you can use to measure management's mindset regarding their capital allocation practices.⁷²

1. **Zero-based capital allocation.** Companies generally think about capital allocation on an incremental basis. For example, a study of more than 1,600 U.S. companies by McKinsey & Company, a global consulting firm, found that there was a 0.92 correlation between how much capital a business unit received in one year and the next. For one-third of the companies, that correlation was 0.99.⁷³ In other words, inertia appears to play a large role in capital allocation.

The proper approach is zero-based, which simply asks, "What is the right amount of capital (and the right number of people) to have in this business to support the strategy that will create the most wealth?"⁷⁴ There is no reference to how much the company has already invested in the business, only how much should be invested.

Research by McKinsey suggests that those companies that showed a zero-based allocation mindset, and hence were the most proactive in reallocating resources, delivered higher TSRs than the companies that

took more of an incremental approach.⁷⁵ Further, academic research shows that those companies that are good at internal capital allocation tend to be good at external allocation as well.⁷⁶

- 2. Fund strategies, not projects.** The idea here is that capital allocation is not about assessing and approving projects, but rather assessing and approving strategies and determining the projects that support the strategies. Practitioners and academics sometimes fail to make this vital distinction.⁷⁷ There can be value-creating projects within a failed strategy, and value-destroying projects within a solid strategy.

Another reason to be cautious about a project approach is that it is easy to game the system. It is common for companies to have thresholds for project approval. For instance, a plant manager can approve small projects, business unit heads larger ones, the CEO bigger ones still, and the board of directors the largest investments. But at each level, analysts can manipulate the numbers to look good. One of the aspects of the institutional imperative, as Buffett describes it, is, "Any business craving of the leader, however foolish, will be quickly supported by detailed rate-of-return and strategic studies prepared by his troops."⁷⁸

The key to this principle is recognizing that a business strategy is a bundle of projects and that the value of the bundle is what matters. The CEO and board must evaluate alternative strategies and consider the financial prospects of each.

- 3. No capital rationing.** The attitude at many companies, which the results of surveys support, is that capital is "scarce but free." The sense is that the business generates a limited amount of capital which makes it "scarce," but since it comes from within it is "free."

The primary source of capital for companies in the U.S. is the cash they generate. The patterns of spending on the various uses of capital indicate the attitude of managements. Capital expenditures, R&D, and dividends receive priority, and M&A and share buybacks are considered when economic results are good. Internal capital allocation tends to be very stable from year to year, and inertia plays a large role. Business units may jockey for more capital but, as we have seen, the changes in year-to-year allocation tend to be modest. These observations are consistent with the "scarce but free" mindset.

A better mindset is that capital is plentiful but expensive. There are two sources of capital that companies can tap beyond the cash generated internally. The first is redeploying capital from businesses that do not earn sufficient returns. Management can execute this inside the company or sell the underperforming businesses and redeploy the proceeds. The second is the capital markets. When executives have value-creating strategies that need capital, the markets are there to fund them in all but the most challenging environments.

The notion that internally generated capital is free is also problematic. Thoughtful capital allocators recognize that all capital has an opportunity cost, whether the source is internal or external. As a consequence, managers should explicitly account for the cost of capital in all capital allocation decisions. Too frequently, companies select actions that add to earnings or earnings per share without properly reckoning for value.

The limiting resource for many companies is not access to capital but rather access to talent. Finding executives with the proper skills for success, including an aptitude for allocating capital, is not easy. This is a valid challenge but relates to recruiting and development, not access to capital.

- 4. Zero tolerance for bad growth.** Companies that wish to grow will inevitably make investments that do not pay off. The failure rate of new businesses and new products is high. Seeing an investment flop is no sin; indeed it is essential to the process of creating value. What is a sin, in our view, is remaining committed to a strategy that has no prospects to create value, hence draining human and financial resources.

Executives who follow this principle invest in innovation but are ruthless in cutting losses when they see that a strategy is unlikely to pay off. Many companies have the opportunity to create substantial value by exiting businesses where they have no advantage. This reduces cross-subsidization within the organization and allows for the best managers to work for the businesses that create the most value.

- 5. Know the value of assets, and be ready to take action to create value.** Intelligent capital allocation is similar to managing a portfolio of stocks in that it is very useful to have a sense of the difference, if any, between the value and price of each asset. This includes the value of the company and its stock price. Naturally, such analysis must include considerations such as taxes.

With a ready sense of value and price, management should be prepared to take action to create value. Sometimes that means acquiring, other times that means divesting, and frequently there are no clear gaps between value and price. As we have seen, managers tend to prefer to buy than to sell, even though the empirical record shows quite clearly that sellers fare better than buyers, on average.

As we mentioned in the introduction, the answer to most capital allocation questions is, “It depends.” Managers who adhere to this final principle understand when it makes sense to act on behalf of long-term shareholders.

Conclusion

Capital allocation is one of management's prime responsibilities. Yet few senior executives are versed or trained in methods to allocate capital most effectively. Further, incentive programs frequently encourage behaviors that are not in the best interests of long-term shareholders. We believe that the goal of capital allocation is to build long-term value per share.

This report had three parts. First we discussed the sources and uses of capital at a high level. In general, countries or regions with high returns on invested capital are in a position to fund a substantial percentage of investment. We also noted the differences for the major regions of the world. The differences reflect the nature of the underlying economy, stage of development, cultural norms, and regulations.

The second part examined the sources and uses of capital for Japan, Europe, Asia/Pacific excluding Japan, and Global Emerging Markets. The patterns in the U.S. and Europe are similar, with relatively strong spending on R&D, solid capital expenditure levels, active M&A, and a relatively generous shareholder yield.⁷⁹ The CFROI in the U.S. is substantially higher. Japan has a low CFROI and relatively modest growth. M&A is also muted, and shareholder yield is low—although there has been improvement in recent years. Developing markets spend an above-average amount on capital expenditures and working capital. But they have low shareholder yields and allocate little to R&D.

Finally, we set out a framework to assess the capital allocation practices of a management team. This framework includes examining past behavior, calculating return on invested capital, weighing incentives, and considering the five principles of thoughtful capital allocation.

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Appendix: The List of Countries Included in the Data for Each Region

Europe

For capital expenditures, R&D, net working capital, share buybacks, and dividends: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

For M&A and divestitures: Austria, Belarus, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Isle of Man, Kazakhstan, Latvia, Lithuania, Luxembourg, Macedonia, Netherlands, Norway, Poland, Portugal, Romania, Russian, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom.

Asia/Pacific excluding Japan

For capital expenditures, R&D, net working capital, share buybacks, and dividends: Australia, China, Hong Kong, India, Indonesia, Korea, Malaysia, New Zealand, Pakistan, Philippines, Singapore, Sri Lanka, Taiwan, Thailand, and Vietnam.

For M&A and divestitures: Australia, Brunei, Cambodia, China, Fiji, Hong Kong, India, Indonesia, Macau, Malaysia, New Zealand, North Korea, Philippines, Singapore, South Korea, Taiwan, Thailand, and Vietnam.

Global Emerging Markets

For capital expenditures, R&D, net working capital, share buybacks, and dividends: Argentina, Brazil, Chile, China, Colombia, Croatia, Czech Republic, Egypt, Hungary, India, Indonesia, Jordan, Kuwait, Malaysia, Mexico, Oman, Pakistan, Peru, Philippines, Poland, Qatar, Russia, Saudi Arabia, Slovenia, South Africa, Sri Lanka, Thailand, Turkey, United Arab Emirates, and Vietnam.

For M&A and divestitures: Argentina, Brazil, Chile, China, Colombia, Croatia, Czech Republic, Egypt, Hungary, India, Indonesia, Jordan, Kuwait, Malaysia, Mexico, Oman, Pakistan, Peru, Philippines, Poland, Qatar, Russian Federation, Saudi Arabia, Slovenia, South Africa, Sri Lanka, Thailand, Turkey, United Arab Emirates, and Vietnam.

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Q: Hugh Liedtke, the former CEO of Pennzoil, used to joke that he believed in the "bladder theory":

Companies pay dividends so that management can't p--s all the money away.

A: It's hard to improve on that. In the 1960s, in "A Modest Proposal," I suggested that companies should be required to pay out 100% of their net income as cash dividends. If companies needed money to reinvest in their operations, then they would have to get investors to buy new offerings of stock. Investors would do that only if they were happy both with the dividends they'd received and the future prospects of the company. Markets as a whole know more than any individual or group of individuals. So the best way to allocate capital is to let the market do it, rather than the management of each company. The reinvestment of profits has to be submitted to the test of the marketplace if you want it to be done right.

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Managing the Man Overboard Moment

Making an Informed Decision After a Large Price Drop

January 15, 2015

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- A key part of successful investing is the ability to keep emotions in check in the face of adversity.
- A particularly challenging situation is when a stock in your portfolio drops sharply, an event that precipitates what has been called a “man overboard” moment.
- This report provides analytical guidance if one of your stocks declines 10 percent or more, relative to the S&P 500 Index, in one day. Such drops tend to evoke strong emotional reactions and make sound decision-making difficult.
- We provide the base rates for more than 5,400 such events in the past quarter century. We refine the base rates by separating earnings announcements from non-earnings announcements and by introducing factors including momentum, valuation, and quality.
- We provide a checklist to guide you as you decide whether to buy, hold, or sell the stock.

Introduction

A key part of successful investing is the ability to keep emotions in check in the face of adversity. One example, the focus of this report, is when one of the stocks in your portfolio drops sharply. If you are the portfolio manager, you might feel frustrated, upset about the hit to returns, and worried about the business implications. If you are the analyst, you might feel anger, disappointment, and shame. None of those feelings are conducive to good decision making.

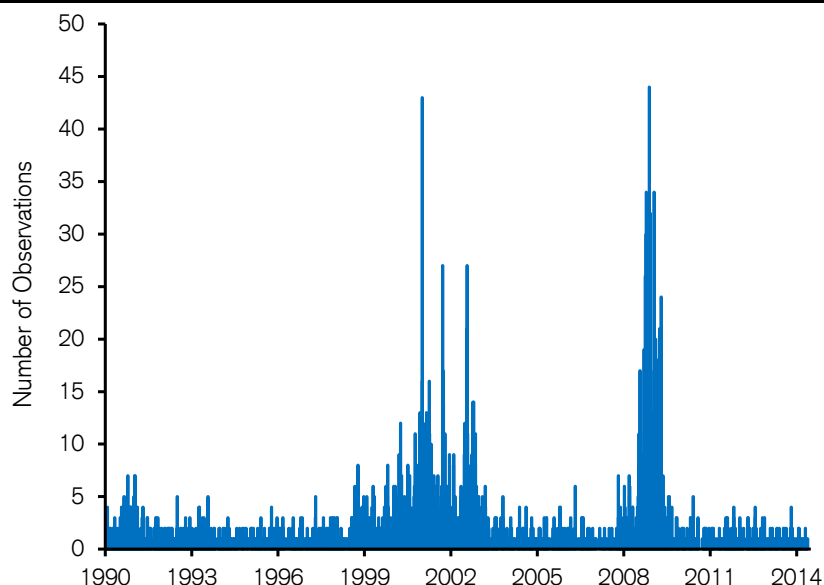
This kind of event precipitates what has been called a “man overboard” moment.¹ These moments demand immediate attention, are stressful, and require swift action. In an investment firm it is common for a number of professionals to stop what they are doing in order to discern a suitable course of action.

The use of a checklist is one approach to making good decisions under pressure. In his superb book, *The Checklist Manifesto*, Dr. Atul Gawande describes two types of checklists.² The first is called DO-CONFIRM. Here you do your job from memory but pause periodically to make sure that you have done everything you’re supposed to do. The second is called READ-DO. Here, you simply read the checklist and do what it says. READ-DO checklists are particularly helpful in stressful situations because they prevent you from being overcome by emotion as you decide how to act.

You can think of your emotional state and the ability to make good decisions as sitting on opposite sides of a seesaw. If your state of emotional arousal is high, your capacity to decide well is low. A checklist helps take out the emotion and moves you toward a proper choice. It also keeps you from succumbing to decision paralysis. A psychologist studying emergency checklists in aviation said the goal is to “minimize the need for a lot of effortful analysis when time may be limited and workload is high.”³

The goal of this report is to provide you with analytical guidance if one of your stocks declines 10 percent or more, relative to the S&P 500, in one day. More directly, we want to answer the question of whether you should buy, hold, or sell the stock following one of these big down moves.

Exhibit 1 shows the number of such observations from January 1990 through mid-2014. There were more than 5,400 occurrences in all, with clusters around the deflating of the dot-com bubble in the early 2000s and the financial crisis in 2008-2009. The bubble periods contain about 40 percent of the observations. These sharp drops happen frequently enough that they deserve a thoughtful process to deal with them but infrequently enough that few investment firms have developed such a process.

Exhibit 1: Number of Observations of 10%+ Relative Stock Price Declines, January 1990-June 2014

Source: Credit Suisse HOLT.

Structure of the Analysis

There are two broad approaches to making a decision. You can rely on the specific circumstances of a particular situation as well as your own experience. This is known as the inside view. Or you can examine a larger reference class to understand the base rates. This is known as the outside view.⁴

For example, if you are forecasting the returns for the stock market in the next year you can use the inside view to come up with an estimate based on current valuation, sentiment, and your own gut feel. Or you can use the outside view and examine how the stock market has done over the years. Both the inside and outside view are useful, and there is a specific way to combine the two to allow for an effective forecast.⁵ But research in decision making suggests that we naturally rely more on the inside view than we should.⁶ In fact, it is common for investors to be unaware of the base rates that are relevant in their decisions.

We use base rates to show how stocks perform after they have dropped sharply. To do this, we calculate the “cumulative abnormal return” for the 30, 60, and 90 trading days after the time of the decline. An abnormal return is the difference between the total shareholder return and the expected return. A stock’s expected return reflects the change in a broader stock market index, the S&P 500 in our case, adjusted for risk. The cumulative abnormal return, then, is simply the sum of the abnormal returns during the period that we measure.

We refine the large sample into relevant categories in an effort to increase the usefulness of the base rates.⁷ The first refinement is to segregate earnings and non-earnings announcements. Earnings releases constitute about one-quarter of our sample. Non-earnings announcements include releases of information that are scheduled, such as same-store sales updates, as well as unanticipated announcements, including a change in management or an earnings warning. In general, the cumulative abnormal returns following disappointing earnings releases are worse than for other announcements.

The second refinement is the introduction of three factors—momentum, valuation, and quality—that consider corporate fundamentals and stock market measures. All companies receive a score for each factor. The scores are relative to a company's peers in the same sector. You can find a detailed definition of the factors in Appendix A, but here's a quick summary:

- **Momentum** predominately considers two drivers, change in cash flow return on investment (CFROI®*) as the result of earnings revisions, and stock price momentum. Good momentum is associated with rising CFROI and strong stock price appreciation.
- **Valuation** reflects the gap between the current stock price and the warranted value in the HOLT® model. Valuation also incorporates adjusted measures of price-to-earnings and price-to-book ratios. Together, these metrics help assess whether a stock is relatively cheap or expensive.
- **Quality** captures the company's recent level of CFROI and whether the company has been able to consistently make investments that create value. Firms with high CFROIs and strong value creation score well on quality.

The final refinement is a separation between the full sample and the periods excluding the bubbles. We show the full sample including all events in exhibits 2 and 3, and the narrower sample excluding the bubble periods in exhibits 12 and 13. The bubble periods correlate with high volatility in the market, as measured by the Chicago Board Options Exchange Market Volatility Index (VIX). When you compare the full sample to the ex-bubble sample for earnings announcements, you will see that the average stock price changes for the equivalent branches are directionally the same more than 80 percent of the time. For the other events, the directional overlap is close to 90 percent.

The upside of adding refinements is that you can find a base rate that closely matches the case you are considering. The downside is that the sample size (N) shrinks with each refinement. We have tried to maintain healthy sample sizes even in the end branches, and we display the Ns along the way so that you can assess the trade-off between fit and prior occurrences.

We are almost ready to turn to the checklist and numbers, but we need to cover one additional item. All of our summary exhibits show the average, or mean, stock price return. That average represents a full distribution of results. For most of the distributions, the median return—the return that separates the top half from the bottom half of the sample—is less than the mean, which suggests the distributions have a right skew.

Further, the standard deviations of most of the distributions are in the range of 35-45 percent. While our summary figures show a tidy average, recognize that the figure belies a rich distribution. Appendix B shows the distributions for a handful of events. The base rate data can be extremely helpful in making a sound decision even if the outcome is probabilistic.

We're now ready to turn to the checklist and the numbers that show the base rates.

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The Checklist

You come into the office and one of the stocks in your portfolio is down 10 percent or more relative to the S&P 500. Here's what you do:

- ☐ **Earnings or non-earnings.** Determine whether the precipitating announcement is an earnings release or a non-earnings disclosure and go to the appropriate exhibit;
- ☐ **Momentum.** Check the HOLT Lens™ screen to determine if the stock had strong, weak, or neutral momentum going into the announcement. You can either go to the momentum section of the exhibit or continue;
- ☐ **Valuation.** Check to see if the valuation is cheap, expensive, or neutral. You can either go to the section in the exhibit that combines momentum and valuation or continue;
- ☐ **Quality.** Check to see if the quality is high, low, or neutral. Go to section in the exhibit that incorporates all of the factors.

We have two detailed case studies that we'll present in a moment, but let's run through an example to see how this works. The first item is to determine whether the announcement was a scheduled earnings release or not. Let's say it was an earnings event. That means we would refer to the data in exhibit 2.

Step two is to assess the momentum. We'll assume that momentum is strong. If you look at the left side of the exhibit you'll see the section that reflects momentum. If you focus on the results of the companies with strong momentum, you'll see a few figures. You'll notice that the 408 stocks in that reference class declined 14.9 percent, on average, the day of the event. You'll also see that those stocks modestly underperformed the market, with a cumulative abnormal return of -1.6 percent, in the prior 30 trading days.

You'll also see that the stocks in that class struggled in the subsequent quarter, with cumulative abnormal returns of -1.5 percent in the next 30 trading days, -1.9 percent in 60 trading days, and -0.6 percent in 90 trading days. We selected 90 trading days as the extent of this analysis because we felt it is a sufficient amount of time for an investment team to thoroughly reassess the stock's merit. We designed the READ-DO checklist to provide immediate guidance.

We now turn to valuation, which you can find in the middle of the exhibit, to see if we can sharpen the analysis. Let's assume the valuation was expensive. If we look 60 days out, we see that the 167 stocks in this group have an average cumulative abnormal return of -4.5 percent.

As a final check, we consider quality, which you can find on the right of the exhibit. Let's say quality is high. We've now shrunk our sample size to 62, and see that the 60-day cumulative abnormal return is -3.5 percent.

Exhibit 2: Earnings Event – Cumulative Abnormal Returns

Momentum							Valuation							Quality						

Exhibit 3: Non-Earnings Event – Cumulative Abnormal Returns

Momentum							Valuation							Quality						
Days							Days							Days						
-30 Event N = +30 +60 +90							-30 Event N = +30 +60 +90							-30 Event N = +30 +60 +90						
Strong							Cheap							High						
-4.6%	-13.8%	1,041	3.7%	4.9%	6.2%		-8.5%	-13.7%	280	5.1%	10.1%	14.3%		-11.7%	-13.8%	99	4.9%	9.9%	16.7%	
							Neutral							Neutral						
							-5.0%	-14.2%	289	4.7%	6.8%	7.9%		-8.1%	-15.7%	83	3.2%	6.5%	9.7%	
							Expensive							Low						
							-2.0%	-13.7%	472	2.2%	0.8%	0.4%		-5.5%	-11.8%	98	7.0%	13.4%	15.6%	
							Cheap							High						
							-9.3%	-14.6%	395	7.5%	17.1%	18.7%		-8.4%	-14.0%	79	5.3%	7.7%	10.2%	
Neutral							Neutral							Neutral						
-5.9%	-14.4%	1,067	4.7%	9.4%	11.3%		-4.6%	-13.8%	328	6.4%	9.8%	12.2%		-7.3%	-15.1%	109	3.5%	6.8%	2.7%	
							Expensive							Low						
							-3.1%	-14.6%	344	-0.2%	0.1%	2.0%		0.2%	-13.4%	101	5.5%	6.0%	11.6%	
							Cheap							High						
							-9.5%	-14.3%	1,008	13.9%	19.1%	22.1%		-4.5%	-13.4%	225	1.9%	-2.8%	-3.2%	
Weak							Neutral							Neutral						
-6.2%	-14.2%	1,867	11.1%	17.0%	18.8%		-2.6%	-14.4%	457	4.9%	11.2%	12.0%		4.8%	-14.4%	107	2.9%	3.0%	-0.3%	
							Expensive							Low						
							-2.0%	-13.8%	402	11.2%	18.5%	18.1%		-3.0%	-13.5%	140	2.1%	4.7%	6.8%	
							Cheap							High						
							-9.5%	-14.3%	1,008	13.9%	19.1%	22.1%		-14.1%	-15.3%	140	7.9%	21.7%	20.9%	
							Neutral							Neutral						
							-2.6%	-14.4%	457	4.9%	11.2%	12.0%		-13.9%	-15.2%	121	8.9%	13.6%	20.5%	
							Expensive							Low						
							-2.0%	-13.8%	402	11.2%	18.5%	18.1%		-0.2%	-13.4%	134	5.8%	15.4%	14.6%	
							Cheap							High						
							-9.5%	-14.3%	1,008	13.9%	19.1%	22.1%		-5.5%	-13.5%	127	3.0%	7.5%	9.8%	
							Neutral							Neutral						
							-2.6%	-14.4%	457	4.9%	11.2%	12.0%		-5.7%	-14.3%	93	5.1%	10.6%	11.5%	
							Expensive							Low						
							-2.0%	-13.8%	402	11.2%	18.5%	18.1%		-2.6%	-13.8%	108	11.5%	11.8%	15.5%	
							Cheap							High						
							-9.5%	-14.3%	1,008	13.9%	19.1%	22.1%		-7.0%	-14.5%	132	-2.5%	-4.5%	-3.7%	
							Neutral							Neutral						
							-2.6%	-14.4%	457	4.9%	11.2%	12.0%		3.8%	-14.8%	83	1.0%	2.5%	5.4%	
							Expensive							Low						
							-2.0%	-13.8%	402	11.2%	18.5%	18.1%		-3.6%	-14.6%	129	1.5%	3.3%	5.7%	
							Cheap							High						
							-9.5%	-14.3%	1,008	13.9%	19.1%	22.1%		-11.0%	-15.1%	282	10.4%	14.9%	23.0%	
							Neutral							Neutral						
							-2.6%	-14.4%	457	4.9%	11.2%	12.0%		-5.8%	-13.8%	295	15.9%	23.3%	26.0%	
							Expensive							Low						
							-2.0%	-13.8%	402	11.2%	18.5%	18.1%		-10.9%	-14.2%	431	14.7%	18.9%	18.8%	
							Cheap							High						
							-9.5%	-14.3%	1,008	13.9%	19.1%	22.1%		-8.7%	-14.6%	127	4.6%	11.2%	11.7%	
							Neutral							Neutral						
							-2.6%	-14.4%	457	4.9%	11.2%	12.0%		2.1%	-13.8%	154	6.6%	14.4%	15.5%	
							Expensive							Low						
							-2.0%	-13.8%	402	11.2%	18.5%	18.1%		-2.4%	-14.7%	176	3.7%	8.4%	9.1%	
							Cheap							High						
							-9.5%	-14.3%	1,008	13.9%	19.1%	22.1%		-4.5%	-12.8%	127	18.1%	25.7%	27.1%	
							Neutral							Neutral						
							-2.6%	-14.4%	457	4.9%	11.2%	12.0%		-1.3%	-14.8%	98	10.3%	22.3%	24.7%	
							Expensive							Low						
							-2.0%	-13.8%	402	11.2%	18.5%	18.1%		-0.6%	-14.0%	177	6.9%	11.2%	8.1%	

Source: Credit Suisse HOLT.

Note: The abnormal return for the event reflects only the day of the event.

Case Studies

We now turn to two case studies that provide detail about the analysis.

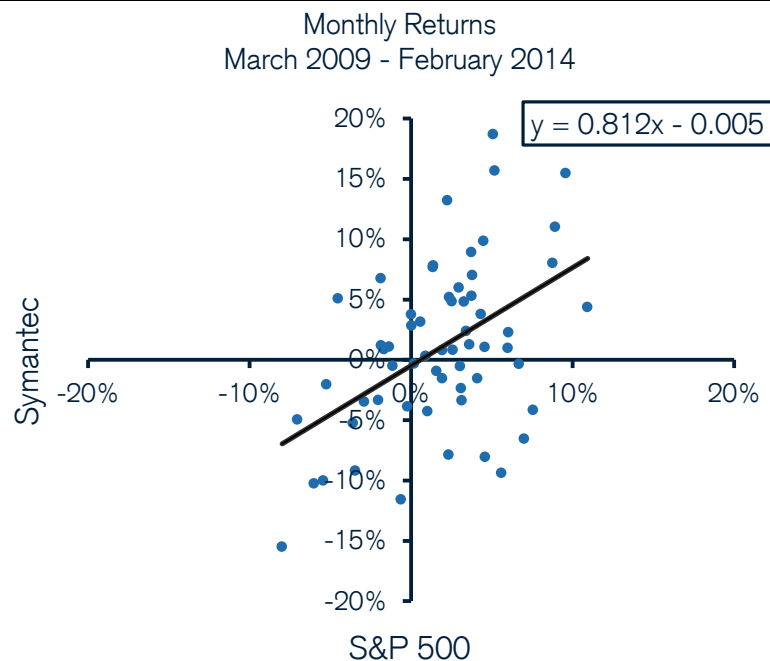
Symantec Corporation

Symantec Corporation announced that it fired its president and chief executive officer, Steve Bennett, after the stock market closed on March 20, 2014. The following day, March 21, the stock declined from \$20.905 to \$18.20, or 12.9 percent. The S&P 500 was down 0.3 percent. This was a non-earnings event.

Since we use cumulative abnormal return (CAR) for all of the stock performance data, it is worth taking a moment to explain the methodology. We calculate daily abnormal return using a simplified market model, which compares the actual return of a stock to its expected return. The expected return equals the total shareholder return of the benchmark, the S&P 500, times the stock's beta. The abnormal return is the difference between the actual return and the expected return.

We calculate beta by doing a regression analysis with the S&P 500's total returns as the independent variable (x-axis) and Symantec's total returns as the dependent variable (y-axis). We use monthly total returns for the prior 60 months. Beta is the slope of the best-fit line. Exhibit 4 shows that the beta for Symantec for the 60 months ended February 2014 was about 0.8. This is the beta we use for our calculations of daily abnormal returns during the month of March 2014.

Exhibit 4: Beta Calculation for Symantec



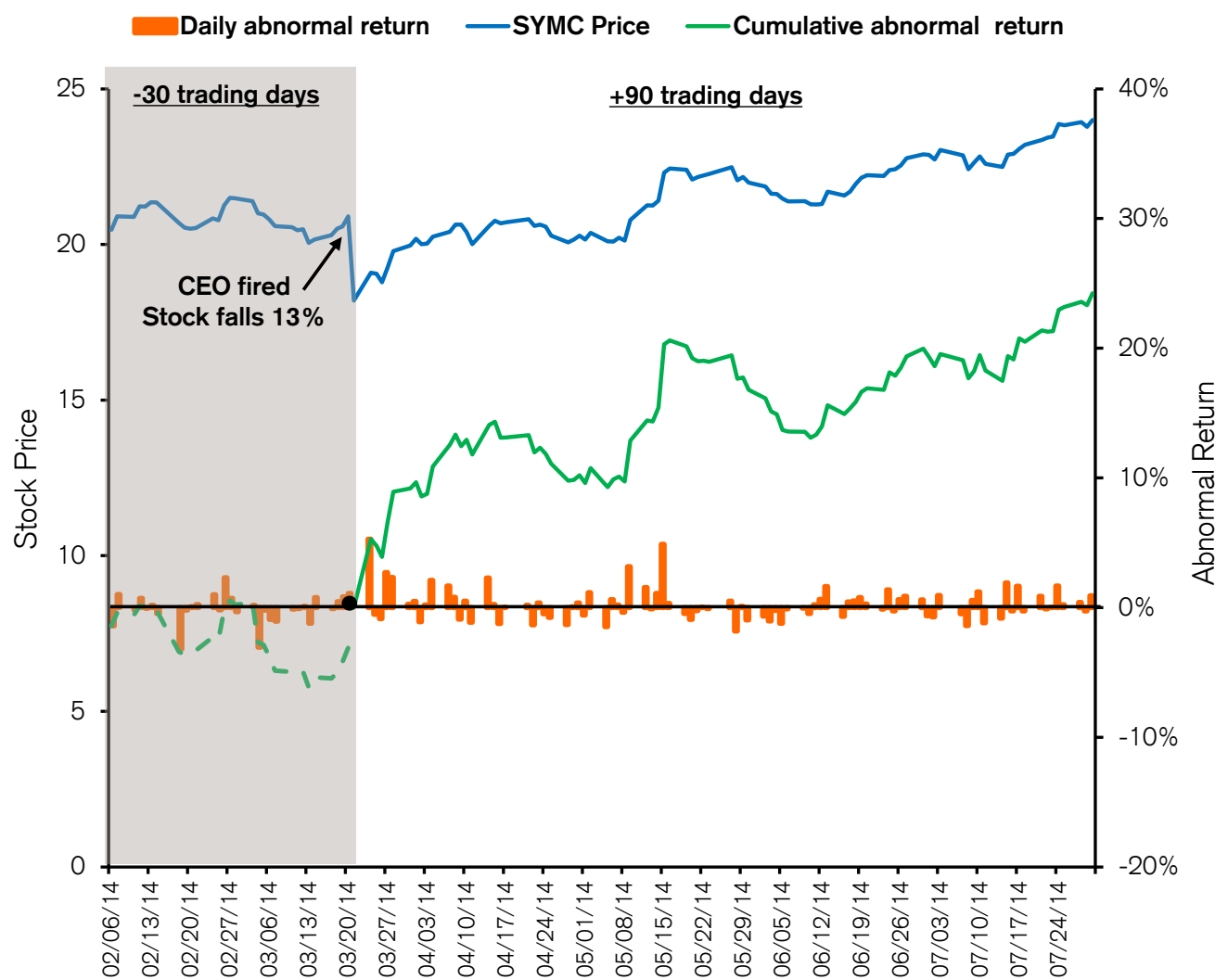
Source: Credit Suisse.

Using the 30 trading days following the event, we calculate a CAR of 9.3 percent as follows:

$$\begin{aligned}\text{CAR} &= \text{Actual return} - \text{expected return} \\ &= 10.3\% - (\text{Beta} * \text{Market Return}) \\ &= 10.3\% - (0.8 * 1.2\%) \\ \text{CAR} &= 10.3\% - 1.0\% = 9.3\%\end{aligned}$$

Exhibit 5 shows the chart of the stock's performance for the 30 trading days prior to the event through 90 trading days following the event. The top line shows the stock price itself. The middle line is the cumulative abnormal return. We reset the cumulative abnormal return to zero on the event date. The bars are the daily abnormal returns. It's evident that buying Symantec on the day after this event would have yielded good returns in the subsequent 90 days. Let's go through the checklist to see how we would have assessed the situation in real time.

Exhibit 5: Symantec Stock Price and Cumulative Abnormal Returns (February 6 – July 30, 2014)



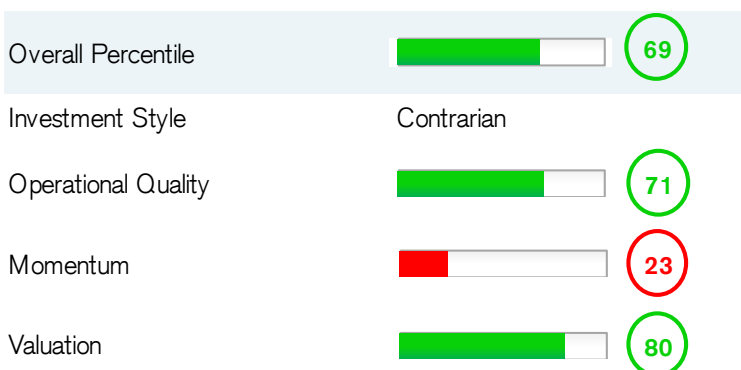
Source: Credit Suisse.

The first item on the checklist is the determination of whether the event was a scheduled earnings release. We know that this is an event not related directly to an earnings announcement, so we refer to exhibit 3 for guidance.

The next step is determining how the stock scores with regard to momentum, valuation, and quality through HOLT Lens. (Please contact your HOLT or Credit Suisse representative if you do not have access to Lens and would like to use it.) At the welcome page, search for the company of the stock under consideration. This takes you to the homepage for that company, which includes a Relative Wealth Chart. Toward the top of the page you will find a link called "Scorecard Percentile." If you click on it, you will see numerical scores, from 0 to 100, on momentum, valuation, and operational quality, among other items. For the purposes of this analysis, a score of 66 or more reflects strong momentum, cheap valuation, and high quality. A score of 33 or less means weak momentum, expensive valuation, and low quality. Numbers from 34 to 65 are neutral for the factors. Exhibit 6 shows you what this screen looked like for Symantec.

Exhibit 6: Symantec's Factor Scores

SYMANTEC CORP Scorecard Analysis



Source: HOLT Lens.

We see that momentum is weak (23), valuation is cheap (80), and quality is high (71). This allows us to follow the relevant branches in exhibit 3. Exhibit 7 extracts the branches that are relevant for Symantec.

Exhibit 7: The Branches that Lead to Symantec's Appropriate Reference Class

Momentum							Valuation							Quality						
Days							Days							Days						
-30	Event	N =	+30	+60	+90		-30	Event	N =	+30	+60	+90		-30	Event	N =	+30	+60	+90	
														High						

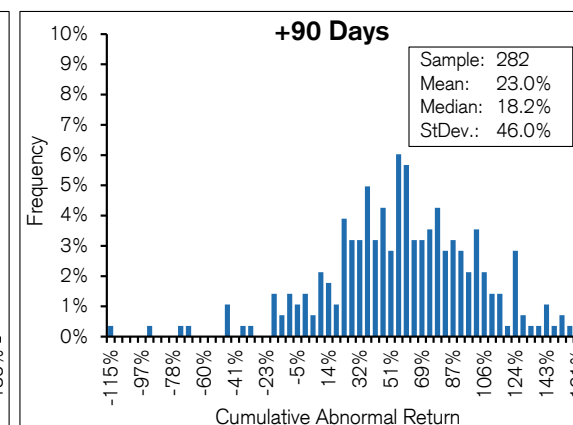
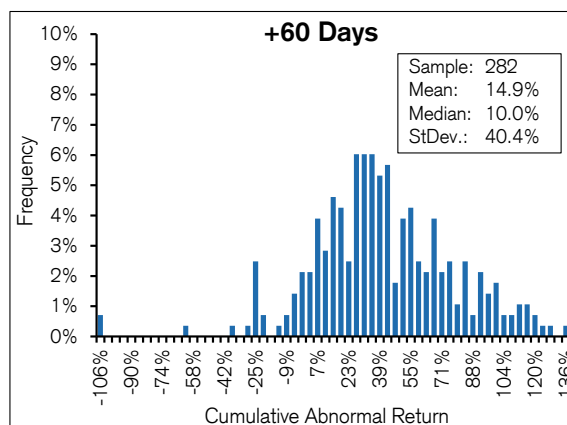
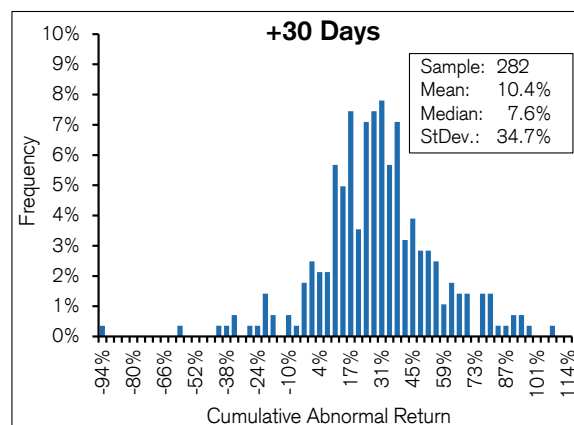
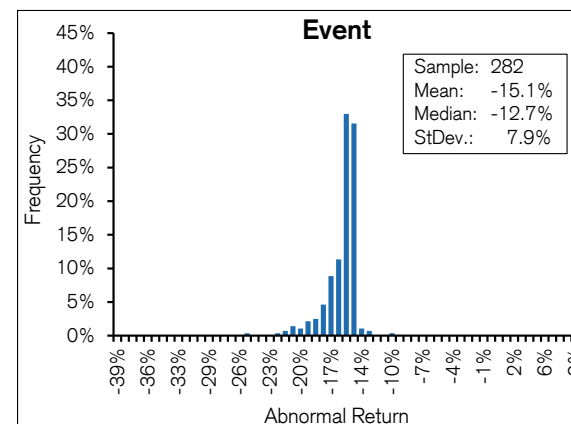
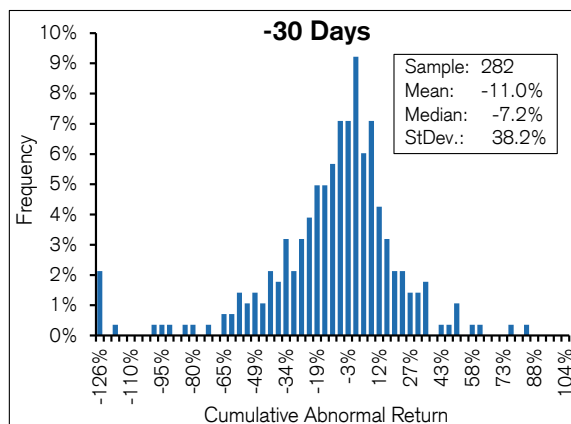
Source: Credit Suisse HOLT.

The cumulative abnormal returns are consistently positive for each branch of the tree for all of the time periods we measure. The final branch, with a sample size of 282 events, shows a 10.4 percent CAR for 30 days, 14.9 percent for 60 days, and 23.0 percent for 90 days. In this case, the base rates would suggest buying the stock on the day following the decline.

We can compare those base rates with what actually happened. The CAR for Symantec shares was 9.3 percent in the 30 trading days following the event, 15.4 percent for 60 days, and 24.2 percent for 90 days. The line for CAR in exhibit 5 also shows these returns.

While the results are consistent with the base rate, we must reiterate that the averages belie a more complex distribution. Exhibit 8 shows the distribution of stock price returns for the 282 companies in Symantec's reference class. For each of the return distributions that follow the event (+30, +60, and +90 days), the mean, or average, was greater than the median. The standard deviations are high at about 35 percent for 30 days, 40 percent for 60 days, and 45 percent for 90 days.

Exhibit 8: Distributions for Non-Earnings Events that have Weak Momentum, Cheap Valuation, High Quality



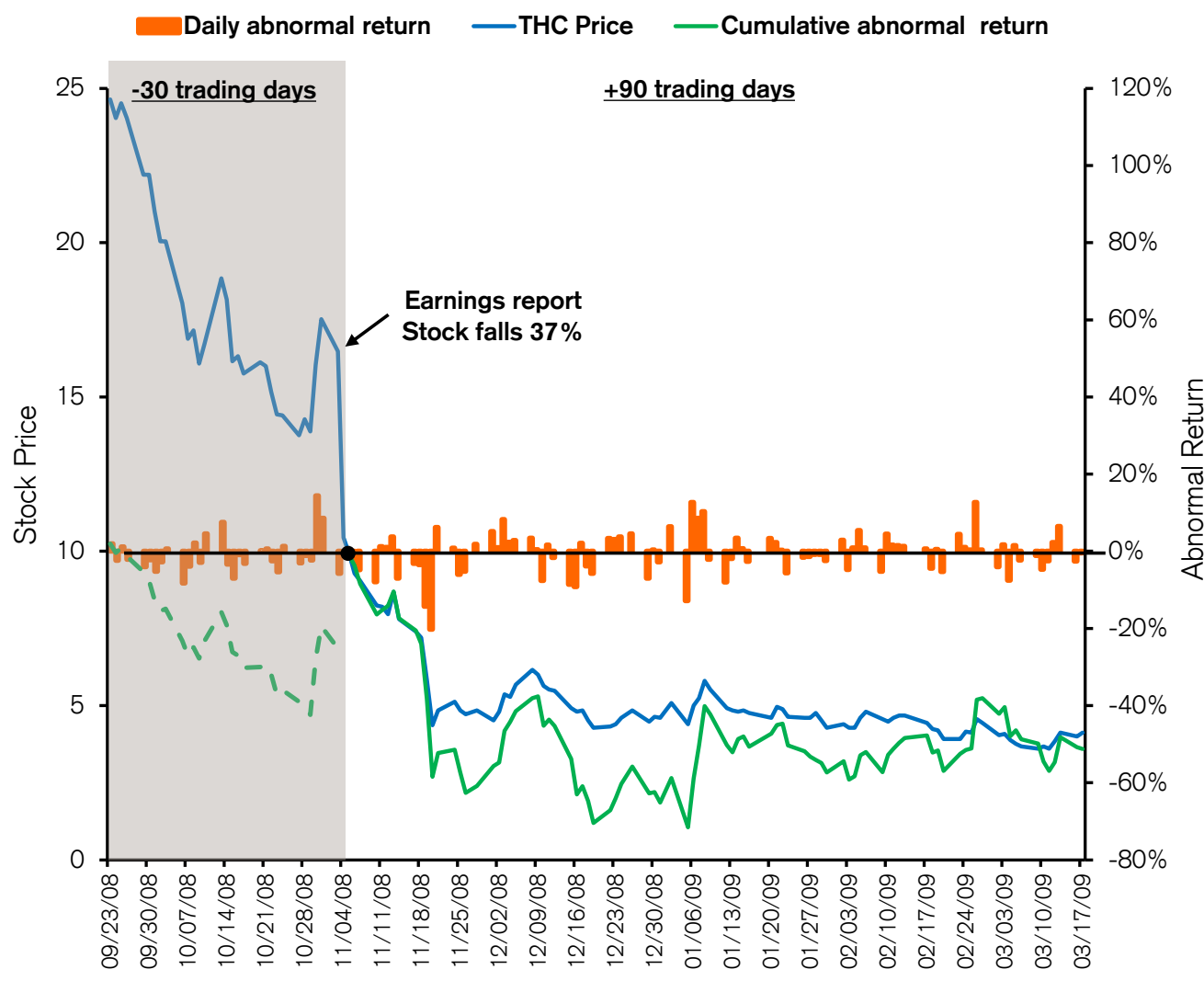
Source: Credit Suisse HOLT.

Tenet Healthcare Corporation

Before the stock market opened on the morning of November 4, 2008, Tenet Healthcare Corporation reported disappointing earnings. This was a scheduled earnings event and the stock declined 36.7 percent. The S&P 500 was up 4.1 percent.

Exhibit 9 shows the chart of Tenet Healthcare's stock performance for the 30 trading days prior to the event through 90 trading days following the event. The top line starting on the left shows the stock price, which not only drops precipitously on the day of the disappointing earnings release but also shows a steep decline before the announcement (-25.2 percent cumulative abnormal return). The stock continued to drift lower after the release. The bars in the middle of the exhibit are the daily abnormal return, and the line at the bottom is the cumulative abnormal return. This is a case where selling Tenet Healthcare stock, notwithstanding the weak results, would have made sense. Let's go through the checklist to see how we would have assessed the situation as it occurred.

Exhibit 9: Tenet Healthcare Stock Price and CAR (September 23, 2008 – March 17, 2009)



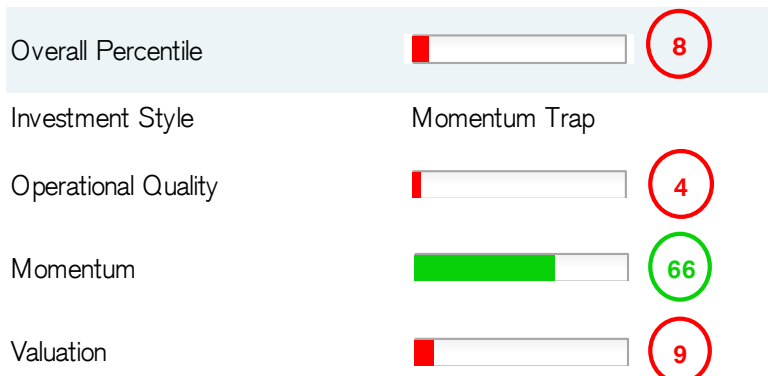
Source: Credit Suisse.

The first item on the checklist is the determination of whether the event was an earnings release. We know that it was scheduled, so we refer to exhibit 2 for guidance.

The next step is to determine the scores with regard to momentum, valuation, and operational quality. To do so, we go to the link, "Scorecard Percentile," on HOLT Lens. Exhibit 10 shows the scores.

Exhibit 10: Tenet Healthcare's Factor Scores

TENET HEALTHCARE CORP Scorecard Analysis



Source: HOLT Lens.

For Tenet Healthcare, we see that momentum is at the low end of strong (66), valuation is expensive (9), and quality is low (4). Despite Tenet Healthcare's weak stock price in the short term, the overall momentum score remained strong because of excellent stock price results, relative to peers, in the 52 weeks leading up to the announcement. While the momentum factor barely qualified as strong, scores for valuation and quality are unattractive. Exhibit 11 shows the branches in exhibit 2 that are relevant for Tenet Healthcare.

Exhibit 11: The Branches that Lead to Tenet Healthcare's Appropriate Reference Class

Momentum						Valuation						Quality								
Days			Days			Days			Days			Days			Days					
-30	Event	N =	+30	+60	+90	-30	Event	N =	+30	+60	+90	-30	Event	N =	+30	+60	+90			
Strong	-1.6%	-14.9%	408	-1.5%	-1.9%	-0.6%	Expensive	-1.2%	-15.4%	167	-2.4%	-4.5%	-3.2%	Low	-1.3%	-14.6%	56	-2.9%	-6.3%	-1.4%

Source: Credit Suisse HOLT.

The cumulative abnormal returns are consistently negative for each branch of the tree for all of the time periods we consider. The final branch, with a sample size of 56 events, shows a -2.9 percent CAR for 30 days, -6.3 percent for 60 days, and -1.4 percent for 90 days. In this case, the base rate would suggest selling the stock on the day following the decline.

We can compare these base rates with what actually happened. The CAR for Tenet Healthcare's shares was -60.9 percent in the 30 trading days following the event, -54.4 percent for 60 days, and -51.2 percent for 90 days. Exhibit 9 reflects these returns. Once again, note that there is a distribution of returns for that reference class, and the best we can do is make a probabilistic assessment.

Summary

The goal of this analysis is to provide you with useful base rates in the case that you see a sharp drop—a “man overboard” moment—in one of the stocks in your portfolio. These base rates are meant to offer some guidance in determining whether you should buy, sell, or do nothing the day following the event. You should keep this report handy, and when an event occurs you can pull it out and follow the steps in the checklist. The results contained here are a useful complement to fundamental analysis.

Because these events tend to be infrequent, most investors don't have a systematic approach, or data, to make a sound judgment. Further, large price drops almost always evoke a strong emotional reaction, which complicates the process of decision making even more.

Our examination of exhibits 2 and 3 suggests that the following characteristics are consistent with buy and sell signals:

Buy. For earnings releases, there is a clear and convincing buy signal for stocks with weak momentum prior to the event. This buy signal is strengthened if the stock has a cheap valuation and is of high quality.

The buy signal for stocks with weak momentum is even more pronounced for non-earnings events than it is for earnings releases, although these stocks had worse shareholder returns leading up to the event. This signal is stronger for stocks that have a cheap valuation, and is further amplified if the companies are of high or neutral quality. Symantec, the subject of our first case study, was a non-earnings event with weak momentum, cheap valuation, and high quality, and hence the data suggested a buy.

Sell. For earnings releases, momentum alone does not indicate a strong buy or sell pattern. But there is a fairly strong sell signal for stocks that have the combination of strong momentum and expensive valuation. The sell signal holds for stocks with strong momentum, expensive valuation, and any quality score. Tenet Healthcare, our second case, had strong momentum, expensive valuation, and low quality—factors that suggested selling the shares.

For non-earnings events, the cumulative abnormal returns following an event are largely positive. But we must note that these stocks as a group performed poorly prior to the event, down more than five percentage points relative to the market. There are a couple of combinations that suggest selling the stock. The strongest sell signal is for companies that combine strong or neutral momentum, expensive valuation, and high quality. Strong or neutral momentum and expensive valuation alone do not indicate a sell signal.

Making decisions in the face of uncertainty is always a challenge, but it is inherent to investing. Deciding what to do with a stock following a sharp decline is particularly difficult because emotions tend to run high after those events. This report provides grounding in the form of base rates in an effort to better inform decisions.

Momentum							Valuation							Quality						
														Days-30EventN=+30+60+90Days+30+60+90						
														High-3.9%-13.8%34-0.2%-2.4%0.0%						
														Neutral-3.9%-15.2%17-6.5%-0.3%2.7%						
														Low-2.2%-14.1%491.5%1.1%0.9%						
														High-2.6%-16.0%37-0.2%4.1%4.0%						
														Neutral-3.6%-13.7%20-1.3%-3.2%-1.6%						
														Low-0.2%-14.1%36-2.1%-6.2%-3.8%						
														High0.9%-14.8%45-1.1%-1.9%-0.6%						
														Neutral-1.3%-16.7%36-2.3%-2.5%-8.0%						
														Low0.0%-13.9%48-3.1%-6.5%-2.4%						
														Days-30EventN=+30+60+90Days+60+90						
														High-6.9%-15.0%400.1%-0.5%2.5%						
														Neutral-3.2%-14.1%441.0%0.8%5.2%						
														Low-4.6%-13.5%36-2.6%-2.9%-1.0%						
														High-1.1%-14.9%32-1.4%-1.7%-2.4%						
														Neutral-1.3%-14.0%291.7%4.2%7.2%						
														Low-2.7%-13.9%482.0%0.7%2.2%						
														High-3.1%-14.3%38-2.6%-3.1%3.0%						
														Neutral-0.6%-13.7%250.0%2.5%2.0%						
														Low0.0%-14.2%281.3%-2.6%-9.4%						
														Days-30EventN=+30+60+90Days+60+90						
														High-6.3%-15.0%533.8%6.3%0.7%						
														Neutral-2.6%-14.9%842.0%2.2%6.4%						
														Low-4.6%-13.7%784.1%1.2%4.5%						
														High2.7%-14.2%39-1.5%1.8%3.8%						
														Neutral-0.8%-14.2%29-3.8%-2.0%-1.2%						
														Low0.7%-15.5%570.9%-1.2%-4.3%						
														High3.7%-15.5%23-3.9%2.5%2.0%						
														Neutral8.0%-15.5%261.6%4.8%3.5%						
														Low2.5%-13.5%472.4%2.4%5.4%						

Source: Credit Suisse HOLT.

[illegible]

Source: Credit Suisse HOLT.

Appendix A: Definition of the Factors

Momentum: Momentum is a gauge of market sentiment. Stocks that score well have rising levels of expected CFROI as the result of upward earnings revisions, positive stock price momentum, and good liquidity.

- **CFROI Key Momentum, 13-week (60%)** - CFROI Key Momentum measures change in the level of expected CFROI following revisions in consensus earnings per share.
- **Price Momentum (52-week) (30%)** - Price Momentum is based on the percentage change in market value over the past 52 weeks.
- **Daily Liquidity Average (10%)** - Daily Liquidity Average reflects the number of shares traded in the last quarter, divided by 63 trading days, multiplied by the stock price at the end of the most recent week, divided by market capitalization.

Valuation: Valuation assesses the difference between the stock's warranted value, based on the HOLT framework®, and the stock's current market price. Stocks with the most upside are cheap, and those with the least upside, or downside, are expensive.

- **Percentage Change to Best Price (50%)** - Percentage Change to Best Price measures the difference between HOLT's warranted value and the current stock price. By using a discounted cash flow approach that standardizes financial figures, the HOLT model generates values that allow for the comparison of firms across regions, sectors, and accounting standards.
- **Economic P/E (30%)** - Economic P/E is HOLT's version of a price-to-earnings ratio. You can compare Economic P/E across companies and industries because the value-to-cost ratio is divided by CFROI, normalizing results. Specifically, $\text{Economic P/E} = (\text{Enterprise Value} / \text{Inflation Adjusted Net Assets}) / \text{CFROI}$
- **Value-to-Cost Ratio (10%)** - Value-to-Cost Ratio is analogous to price/book value, but reflects a number of adjustments that reduce volatility and better reflect firm value. These include inflation adjustments for old plant and inventory in gross investment, capitalized research and development (R&D), capitalized operating leases, the reflection of the contingent claim for stock options in debt, pension debt, preferred stock, and liabilities related to capitalized operating leases. The Value-to-Cost Ratio = $(\text{Market Value of Equity} + \text{Minority Interest} + \text{HOLT Debt}) / \text{Inflation Adjusted Net Assets}$
- **Dividend Yield (10%)** - Dividend Yield is the dividends paid in the last 12 months divided by the most recent share price.

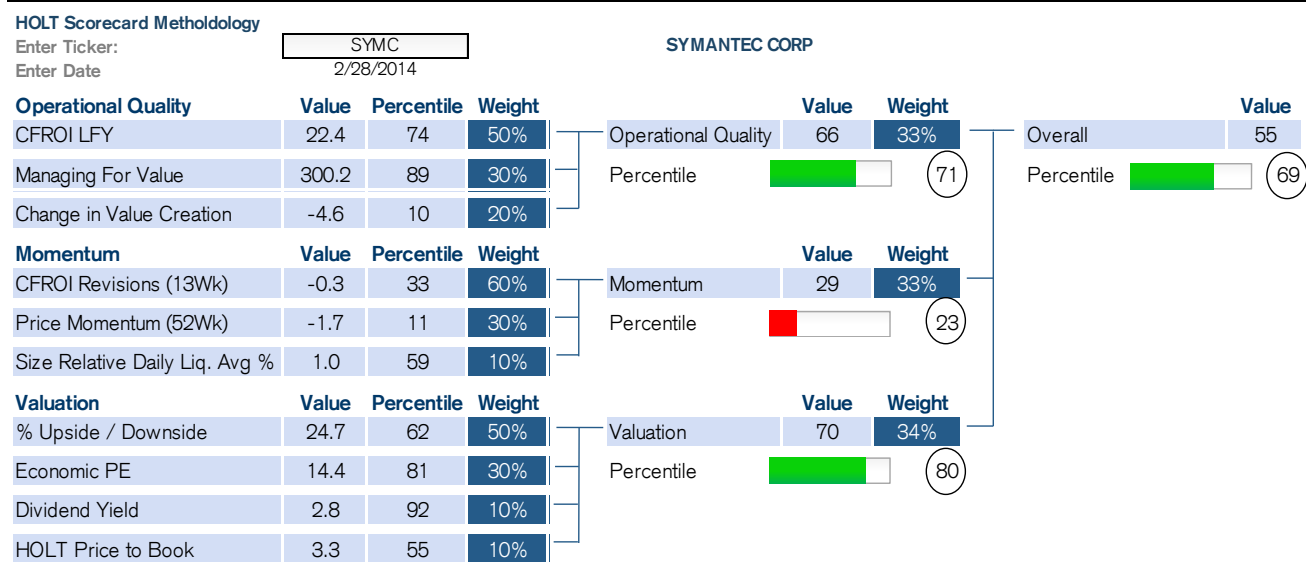
Quality: Quality measures a company's record of generating cash and managing growth, independent of expectations about the future. Firms that score well have high CFROIs and have shown the ability to grow profitable businesses or the willingness to shrink unprofitable ones.

- **CFROI Last Fiscal Year (50%)** - CFROI Last Fiscal Year is the ratio of gross cash flow to gross investment and is expressed as an internal rate of return. We use the CFROI for the last reported fiscal year.
- **Managing for Value (30%)** - Managing for Value equals the spread between CFROI and the Discount Rate, multiplied by the inflation-adjusted gross investment. This allows us to determine whether the company's growth creates value and is sustainable. Growth in businesses that earn a CFROI in excess of the cost of capital is value creating, while growth in businesses with a negative spread destroys value.
- **Change in Value Creation (20%)** - Change in Value Creation measures the improvement in "economic profit" in the most recent fiscal year. A positive value indicates that the company either increased the spread between CFROI and the discount rate, or grew in a business with a positive spread. $\text{Change in Value Creation} = (\text{CFROI} - \text{Discount Rate} * \text{Growth Rate}) - \text{Prior Fiscal Year Spread}$.

Once on HOLT Lens, you can find the scores on the homepage of each company by clicking on “Scorecard Percentile.” For more detail on the scores, you can select “More Information.” You will see a screen similar to exhibit 14.

The factor scores come from the end of the most recent month prior to the event. For instance, since the date of the event for Symantec was March 21, 2014, the factor scores are as of February 28, 2014. The factor scores do not capture the impact of the event itself. Similarly, the HOLT Scorecard on the day of the event does not reflect the stock’s price decline.

Exhibit 14: Detailed Breakdown of Symantec’s Factor Scores



Source: HOLT Lens.

Since the Scorecard updates daily, it does not align perfectly with the base rates we show. That said, the Scorecard reflects the event the following day.

Appendix B: Distributions of Stock Price Changes

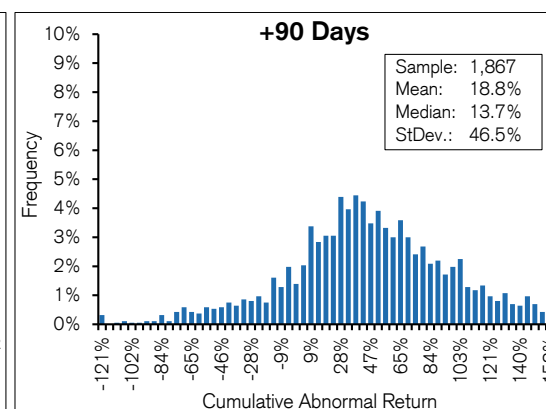
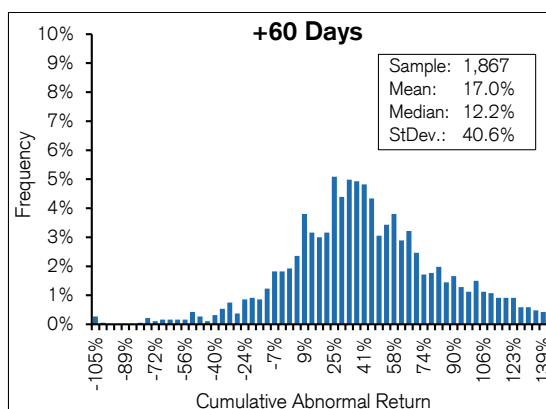
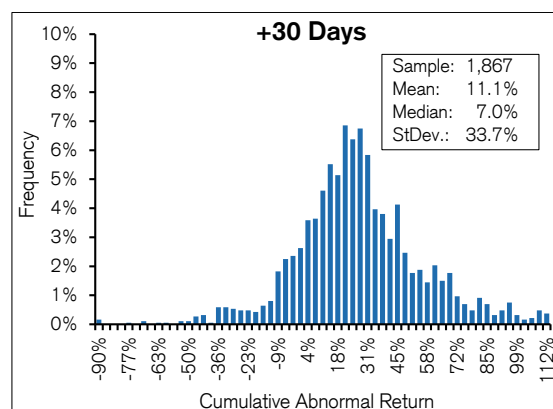
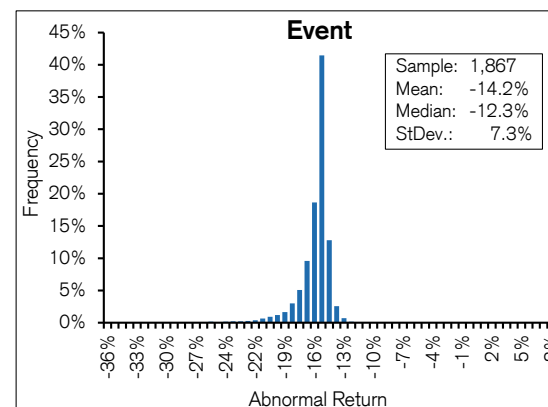
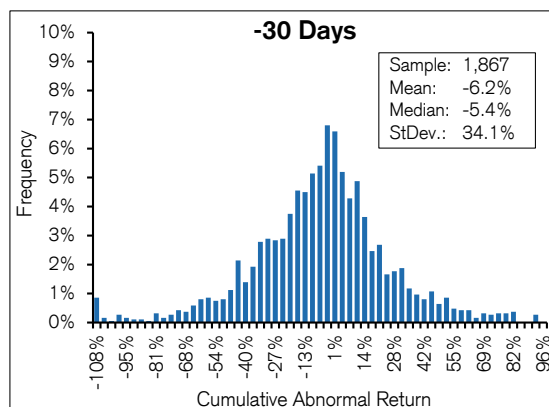
This appendix reviews the distributions that apply to Symantec, one of our case studies. These distributions reflect non-earnings announcements and contain all events, including the bubble periods. We also provide some statistical properties for each distribution, including the sample size, mean, median, and standard deviation.

Exhibit 15 shows all the cases with weak momentum and displays five distributions of cumulative abnormal returns, including the 30 trading days prior to the event, the event itself, and the cumulative abnormal returns for the 30, 60, and 90 trading days subsequent to the event. This is the first branch of the Symantec case study.

Exhibit 16 shows weak momentum and cheap valuation, which trims the sample size by nearly one-half. Here again we include the 30 trading days prior to the event, the event itself, and the cumulative abnormal returns for the 30, 60, and 90 trading days after the event. This is the second branch of the Symantec case study.

Exhibit 17 shows the final branch in the Symantec case study: weak momentum, cheap valuation, and high quality. The sample size is just over one-quarter of the prior branch. You can see the 30 trading days prior to the event, the event itself, and the cumulative abnormal returns for the 30, 60, and 90 trading days after the event.

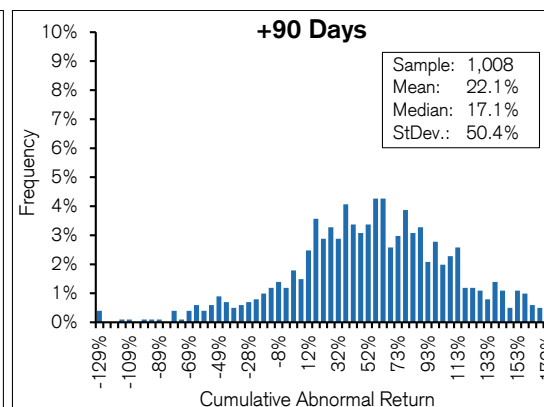
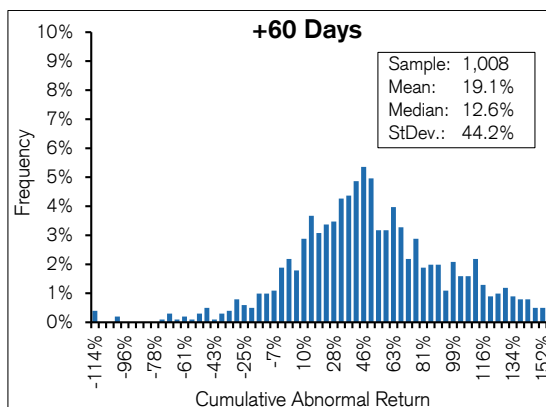
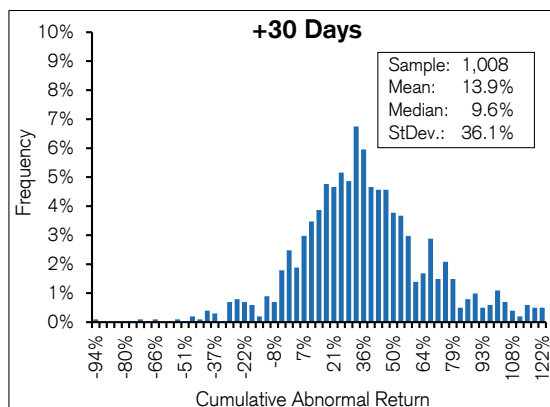
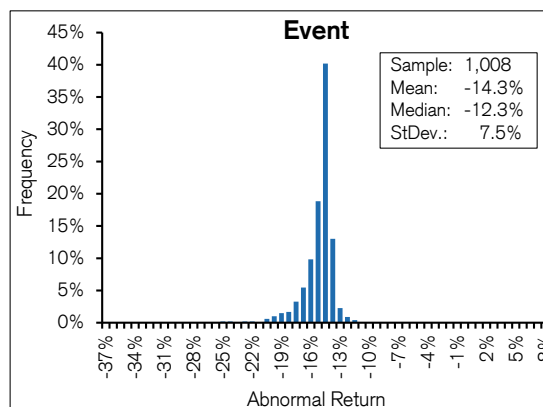
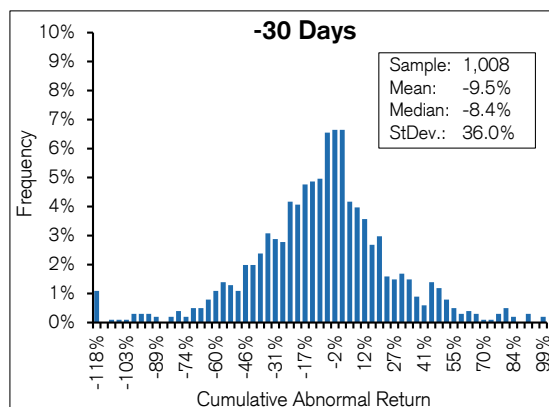
Please contact us if there are any other distributions and statistical properties you would like to see.

Exhibit 15: Distributions for the First Branch of the Symantec Case Study**Weak Momentum**

Source: Credit Suisse HOLT.

Exhibit 16: Distributions for the Second Branch of the Symantec Case Study

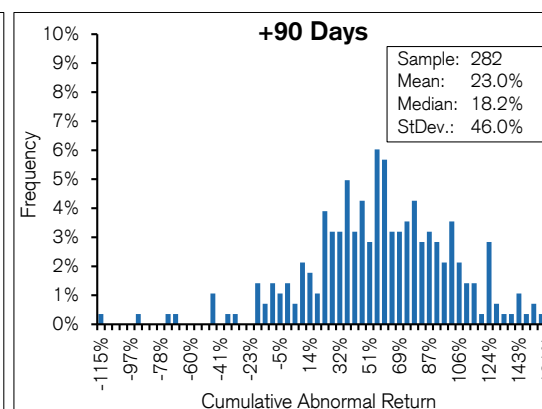
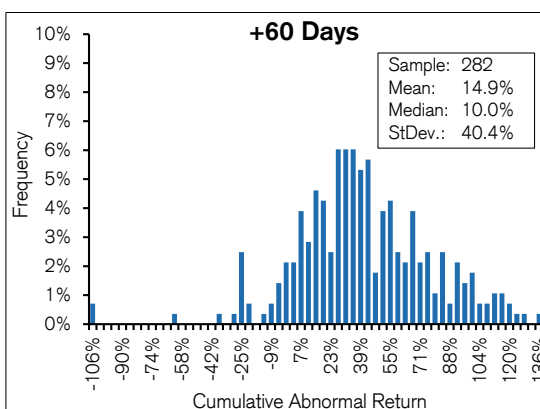
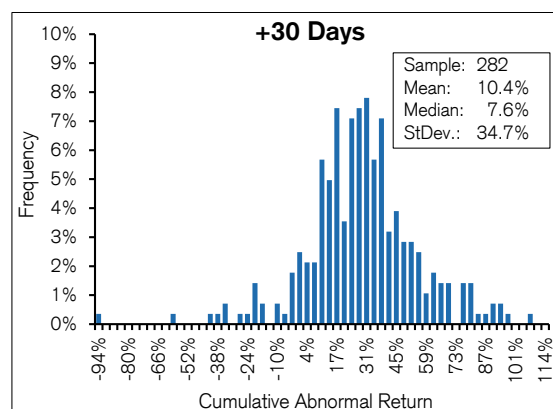
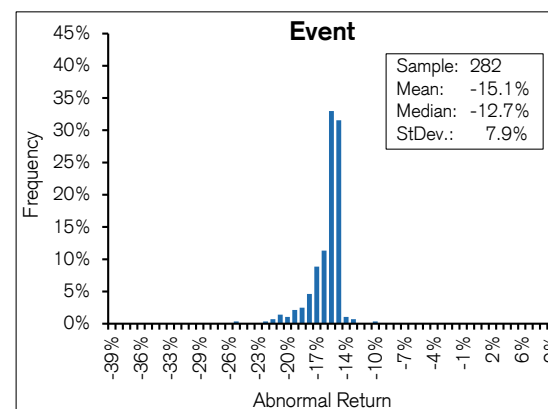
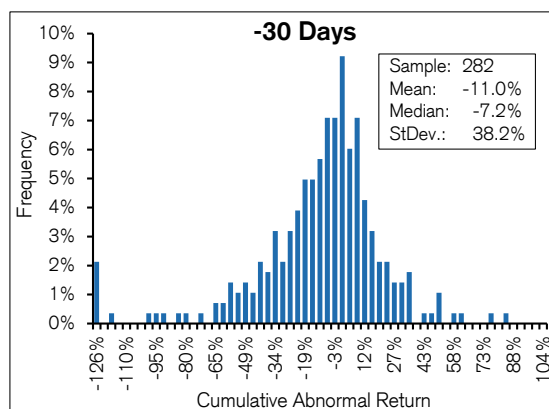
Weak Momentum, Cheap Valuation



Source: Credit Suisse HOLT.

Exhibit 17: Distributions for the Third Branch of the Symantec Case Study

Weak Momentum, Cheap Valuation, High Quality



Source: Credit Suisse HOLT.

Appendix C: A Quick Survey of the Academic Literature

There is a rich literature on abnormal price changes following large stock price moves. Much of this academic work was done in the mid-1980s through the mid-1990s. We found no papers that trace the steps we follow:

1. Observe relative price declines of 10 percent or more;
2. Sort based on scheduled earnings and non-earnings events;
3. Introduce factors to refine the reference classes;
4. Observe cumulative abnormal returns by reference class.

These studies are equivocal. Most do show statistically significant reversals after sharp one-day drops. But some of the potential explanations for the rebound, including stock market seasonality, changing risk, size effects, and the role of bid-ask spreads, call into question whether the price action reflects a true inefficiency. The papers we consulted include the following:

Atkins, Allen B., and Edward A. Dyl, "Price Reversals, Bid-Ask Spreads, and Market Efficiency," *Journal of Financial and Quantitative Analysis*, Vol. 25, No. 4, December 1990, 535-547.

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Bremer, Marc, and Richard J. Sweeney, "The Reversal of Large Stock-Price Decreases," *Journal of Finance*, Vol. 46, No. 2, June 1991, 747-754.

Brown, Keith C., W.V. Harlow, and Seha M. Tinic, "Risk Aversion, Uncertain Information, and Market Efficiency," *Journal of Financial Economics*, Vol. 22, No. 2, December 1998, 355-385.

Cox, Don R., and David R. Peterson, "Stock Returns following Large One-Day Declines: Evidence on Short-Term Reversals and Longer-Term Performance," *Journal of Finance*, Vol. 49, No. 1, March 1994, 255-267.

De Bondt, Werner F.M., and Richard Thaler, "Does the Stock Market Overreact?" *Journal of Finance*, Vol. 40, No. 3, July 1985, 793-805.

Jegadeesh, Narasimhan, "Evidence of Predictable Behavior of Security Returns," *Journal of Finance*, Vol. 49, No. 1, March 1994, 255-267.

Jegadeesh, Narasimhan, and Sheridan Titman, "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency," *Journal of Finance*, Vol. 48, No. 1, March 1993, 65-91.

Lehmann, Bruce N., "Fads, Martingales, and Market Efficiency," *Quarterly Journal of Economics*, Vol. 105, No. 1, February 1990, 1-27.

Savor, Pavel G., "Stock returns after major price shocks: The impact of information," *Journal of Financial Economics*, Vol. 106, No. 3, December 2012, 635-659.

Endnotes

¹ Thanks to Ian McKinnon of Sandia Holdings LLC, the first person we heard use this phrase, for allowing us to use it in the title of this report.

² Atul Gawande, *The Checklist Manifesto: How to Get Things Right* (New York: Metropolitan Books, 2009), 122-128. For checklists related to investing, see Mohnish Pabrai, Guy Spier, and Michael Shearn, "Keynote Q&A Session on Investment Checklists," *Best Ideas 2014, Hosted by John and Oliver Mihaljevic*, January 7, 2014. See <http://www.valueconferences.com/wp-content/uploads/2014/12/ideas14-pabrai-spier-shearn-transcript.pdf>.

³ Barbara K. Burian, "Emergency and Abnormal Checklist Design Factors Influencing Flight Crew Response: A Case Study," *Proceedings of the International Conference on Human-Computer Interaction in Aeronautics*, 2004.

⁴ Daniel Kahneman and Dan Lovallo, "Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking," *Management Science*, Vol. 39, No. 1, January 1993, 17-31.

⁵ Daniel Kahneman and Amos Tversky, "On the Psychology of Prediction," *Psychological Review*, Vol. 80, No. 4, July 1973, 237-251.

⁶ Maya Bar-Hillel, "The Base-Rate Fallacy in Probability Judgments," *Acta Psychologica*, Vol. 44, No. 3, May 1980, 211-233.

⁷ Dan Lovallo, Carmina Clarke, and Colin Camerer, "Robust Analogizing and the Outside View: Two Empirical Tests of Case-Based Decision Making," *Strategic Management Journal*, Vol. 33, No. 5, May 2012, 496-512.

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Michael Mauboussin and Daniel Kahneman In Conversation

The Santa Fe Institute Board of Trustees Chair Michael Mauboussin interviews Nobel Prize winner Daniel Kahneman. The wide-ranging conversation talks about disciplined intuition, causality, base rates, loss aversion and so much more. Don't want to read the transcript? You can [watch the talk online](#).



Michael Mauboussin: Thank you, John. Good afternoon, everybody. There is nothing much to add, but I did -- Steven Pinker has a blurb on Danny's book, which I will read, and I think it's appropriate. It says, "Daniel Kahneman is among the most influential psychologists in history, and certainly the most important psychologist alive today." I would certainly echo that and I want to thank you for all you've done for our community and I certainly personally feel very honored to be here.

What I felt I would do is maybe ask a few questions, and then we'll open it up to broader discussion. Just to open, the topic of the day, of course, is big data, but we know that many decisions are made using what we call expert intuition. Can you share a few thoughts on when intuition is likely to work, when it's likely to fail, perhaps, talk a bit about the work you did with Gary Klein?

I also loved just a little bit of the history on the contributions of people like Paul Meehl. I suspect many people know a little bit about this work, and even Orley ... Speaking of Princeton, even Orley Ashenfelter and his work on wine, and related to that...why are we hostile to algorithms? Why are these things fundamentally uncomfortable for us?

Daniel Kahneman: That's one question?

Yeah, it's kind of three things in one, but we'll start with expert intuition. When does it work?

“We really depend on immediate data, especially for the kind of tacit learning that is the basis of expertise.”

Well first of all, it works less often than we think, and it works less often than experts think. We did a study of that a few years ago, I mean, there is no question that there is such a thing as professional expertise. All you have to do is look at chess masters, they have it, and it's not only professional. All of us have expertise in many domains ... We can recognize the mood of a spouse or a friend from one word on the telephone. That's high-level skill and those are intuitions and they're quite reliable, quite robust, quite valid.

How we know how those intuitions develop? In a sense, they develop from big data. That is, they develop with a lot of experience. This is how chess players become masters. They develop with a lot of experience and there is one additional essential requirement that applies much more to people and not to big data of the kind that we saw today, and this is the immediacy of feedback. One of the things that I was struck by today is that when you're dealing with big data, you can look four months ahead, but the way that the human learning machine works is not like that. We really depend on immediate data, especially for the kind of tacit learning that is the basis of expertise.

That's one aspect of it, and the conclusion that Gary Klein - I worked with Gary Klein for many years on a joint article on that - and I'm smiling because he is really an adversary of mine, intellectually. I don't know if you've seen his books. What is, *The Power of...*?

The Sources of Power.

[The Sources of Power](#) is a very eloquent book on expert intuition with magnificent examples, and so he is really quite hostile to my point of view, basically. We spent years working on that, on the question of when can intuitions be trusted? What's the boundary between trustworthy and untrustworthy intuitions? I would summarize the answer as saying there is one thing you should not do. People's confidence in their intuition is not a good guide to their validity. Confidence is something else entirely, and maybe we can talk about confidence separately later, but confidence is not it.

What there is, if you want to know whether you can trust intuition, it really is like deciding on a painting, whether it's genuine or not. You can look at the painting all you want, but asking about the provenance is usually the best guide about whether a painting is genuine or not.

“Most of the time,
we have to rely on
intuition because it
takes too long to do
anything else.”

Similarly for expertise and intuition, you have to ask not how happy the individual is with his or her own intuitions, but first of all, you have to ask about the domain. Is the domain one where there is enough regularity to support intuitions?

That’s true in some medical domains, it certainly is true in chess, it is probably not true in stock picking, and so there are domains in which intuition can develop and others in which it cannot.

Then you have to ask whether, if it’s a good domain, one in which there are regularities that can be picked up by the limited human learning machine. If there are regularities, did the individual have an opportunity to learn those regularities? That primarily has to do with the quality of the feedback. Those are the questions that I think should be asked, so there is a wide domain where intuitions can be trusted, and they should be trusted, and in a way, we have no option but to trust them because most of the time, we have to rely on intuition because it takes too long to do anything else.

Then there is a wide domain where people have equal confidence but are not to be trusted, and that may be another essential point about expertise.

People typically do not know the limits of their expertise, and that certainly is true in the domain of finances, of financial analysis and financial knowledge. There is no question that people who advise others about finances have expertise about finance that their advisees do not have.

They know how to look at balance sheets, they understand what happens in conversations with analysts. There is a great deal that they know, but they do not really know what is going to happen to a particular stock next year.

They don’t know that, that is one of the typical things about expert intuition in that we know domains where we have it, there are domains where we don’t, but we feel the same confidence and we do not know the limits of our expertise, and that sometimes is quite dangerous.

Related to that, in the world of business, certainly in the world of investing, I think most people do try to blend some quantitative and qualitative aspects. I think there’s a phrase you’ve used called disciplined intuition, which is a phrase I love, by the way. I wonder if you can talk a bit about disciplined intuition and I think that you have this wonderful story in your book about setting up interview processes for the Israeli Defense Forces many years ago, but it also suggested there might be some structure about

how we make our decisions. Can you share a little bit about that? This idea of disciplined intuition, even in thinking about people's practical interview processes, and how one might think about that.

Well, yeah. It's a story I tell in my book and oddly enough, I'm in the process these days, I'm involved in trying to write an article with colleagues for the Harvard Business Review, and I discovered that, actually, what I want to write there is the story of something I did in the Israeli Army, actually 60 years ago, 59 years ago.

I was charged, this was 1955, and I was charged with setting up an interviewing system for the Israeli combat units to actually select who is fit for combat and who was not, and then to allocate people among different combat units, which it turned out we couldn't do.

The experience that I had there, it turns out, was very formative for me. I had read a book, and you mentioned that name, a very famous book by Paul Meehl, which appeared in 1954, which showed that when you pit against each other, human judgment versus very simple models, and he talked of regression models, but today we know that it can be even simpler than regression models. When you pit them against each other so that the human has access to all the data that are used in the model and then some, the model wins.

By now, there are more than 250 studies of this type, which compare the performance of professional experts to the performance of very simple models, and about half of them, the model wins outright, and then the other half it's a draw, which means, again, that the model wins because it's a lot less expensive. There are ... at least, there were not a few years ago when I last looked, there are no confirmed counter-examples. That's a massively important result.

I knew that result when I was doing that work in the Israeli Army, I was 21 years old, and so I instructed the interviewers who had to interview recruits, that they had to break down their judgment. They had to break down their interview into chapters. Each chapter was dedicated to figuring out one score for individuals, and there were six scores that they were to figure out. By asking many objective questions, but doing this one at a time, and independently of each other, so one at a time, one topic at a time, they were not to mix topics. Those were the instructions and we set up a list of questions.

“What I mean
by disciplined is
delayed intuition.
The problem with
our intuitions ... is
they come too fast.”

The story that Michael refers to is that these interviewers have had experience with a system, which was much looser. They were basically, they were trying to form an overall global impression of the individual, and assess how good a soldier that individual would be. We knew that that interview had a validity of essentially zero. They knew nothing, although they really liked that way of interviewing.

When I instructed them on this idea, which now I would call disciplined, not intuition. First of all, disciplined interviewing, break it down by topics, they were furious with me, because they liked using their intuition. People do like using their intuition, and one of them, I still vividly remember, he accused me of, “You’re making us into robots,” he claimed.

Then I made a concession, a very grand concession to them. I was 21, they were 19, I mean, we were all kids. The concession was that after you finish interviewing, and generating your six scores, you can close your eyes and give a rating. How good a soldier would that individual be on a scale from one to five. Then we later, a few months later, we had validity data that, as we knew how well those recruits had turned out as soldiers in units, and, in the first place, we were much better than the previous interview. By much better, I mean, we were only poor. It’s not that we were good, we had a correlation of, say, 0.3 roughly with the criteria, which is as good as psychology typically gets, and it’s better than other disciplines, but I won’t elaborate on that.

The thing that was a real surprise and an education for me, was that the close your eyes exercise was better than any of the independent grades. In fact, it was as good as the sum of the six, and it added content, there was something independent. The conclusion I draw from that, which is really quite general, is that--that’s the one that I’m trying to write an article about--the conclusion I draw from that is that there is a need for disciplined intuition. What I mean by disciplined is delayed intuition.

The problem with our intuitions, one of the many problems with our intuitions, is they come too fast. We form impressions very, very quickly, and then we tend to confirm them. If you do what we did in that interviewing system without really understanding the theory, because I certainly did not, which is to look at one thing at a time independently and reserve judgment until you have it all, and then you can close your eyes.

What comes to your mind when you close your eyes after that exercise is going to be much more valid than the intuition you might form if you don't go through the disciplined process.

This, I think, is a big deal, and it's not something that is very common. It leads you to a kind of thinking or to a kind of analysis that is fairly systematic, and with a stress on independence, that is, with a stress on assessing the various dimensions of the problems independently of each other to resist and to overcome a problem that otherwise defeats intuition repeatedly, which is called, I call it associative coherence, so it's the halo effect, it's a tendency to form a global impression and to derive the specifics from your global impression instead of going bottom up from the specifics to the global.

“Delaying intuition
is ... a good idea.”

Delaying intuition is, I think, a good idea.

I did want to pick up, this is actually one of the questions I had written down about associative coherence and then this idea of confidence. Do you have any optimism that the introduction of big data will help alleviate this problem or will this make the problem worse? Compound the problem? Because there are more things I can do to confirm my views, or things will be what they've always been?

I think that there were many things that impressed me about what went on today. I don't see how it could compound the problem because, as I understand the use of big data they would describe today, you have a huge mass of data, and then you search, and then the data sort of speak for themselves. Now occasionally, you might have an absurd result that you can pick out and reject, but otherwise, you have to be open to surprises, and there will be surprises, and so I don't think that...I don't see that as a major problem.

Another thread I'd like to pick up on is something that's come up in one of John's questions, as well, about causality and specifically I want to frame this in the context of regression toward the mean, which is obviously an extraordinarily important, yet, I think poorly understood concept. I wonder if you could just give a fairly formal definition of regression to the mean from a statistical point of view, and maybe offer a few common mistakes associated with it, maybe causality being one or you also have another lovely story in your book about the misinterpretation of feedback, might be another concept. Regression to the mean as a broader concept.

I'm sure how many people here ... Never mind. I suppose most people here know what regression to the mean is, it's a very familiar concept, and yet, it is not fully understood.

One of my favorite examples is that if you raise the question of why do smart women tend to marry husbands who are less smart than they are, it sounds like a good question. It sounds like a topic that is worthy of discussion, but it really isn't because I can reformulate that as being algebraically equivalent to the statement that the distribution of intelligence is essentially the same for men and for women, and the correlation of intelligence of husbands and their wives is less than perfect.

Those two descriptions are identical, I mean, they're exchangeable, they are algebraically equivalent. They don't sound equivalent. When I raised the question of why do smart women et cetera, you were looking for a cause, but actually, the effect, regression to the mean, that husbands of women who are selected for being very smart, are going to be less smart than the women they're married to. That is an effect without a cause. There is no causal explanation. You've got to rid yourself of the idea of causation to understand that result.

This is extraordinarily difficult to do, and by the way, it is not the only example of an effect without a cause. There is an example that I described in my book of a study that was done on the incidence of kidney cancer in counties across the United States. The counties where the incidence of cancer was high during the year that the study was conducted, they were characterized as being mostly rural and mostly Republican. I mean, a few characteristics of that kind, you have located them geographically. They would be in the center and south of the country.

Why? Everybody has a theory, but why? It turns out if I ask the question of what are the counties where the incidence of kidney cancer is particularly small, it's the same answer. It's counties, they're Republican and rural and so on. The reason is that the population is not the same across counties, and rural counties tend to have a smaller population, the samples are smaller, and it's because the samples are smaller, the incidents of high cancer rates and low cancer rates, is higher in small samples. It's an effect without a cause. Thinking causally will give you trouble when you encounter purely statistical irregularities.

“We tend to impose a causal interpretation on anything that we hear.”

The difficulty that we have, that the human mind has with these kinds of things. We tend to impose a causal interpretation on anything that we hear. We are built that way. Sometimes, it causes us to fall into gross misunderstandings of what is actually going on.

Also following up on that, just to help us to also sharpen our thinking, one of the potential uses of data is to better inform, like what you’ve called the outside view, you might call it base rates or reference classes. I wonder if you could just spend a moment talking, and you’ve already talked about these automatic processes. Maybe spend a moment talking explicitly about the inside versus the outside view, and I have a follow-up to that, but maybe that basic description might be very helpful and I’ll follow up.

I will count on the fact that people, most people here have not read what I wrote about this because it’s in a chapter that frankly many people who have bought the book never get to.

The chapter is called The Outside View, and it begins with a true story, and it’s one of my favorite stories so I’ll tell it.

When I was living in Israel, 40-45 years ago, shortly after I began working with Amos Tversky on our joint project on judgment and decision making, I became involved in writing a textbook for high schools on judgment and decision making without mathematics. The idea was to develop sort of critical thinking curriculum.

We worked on that for quite a while, a little over a year, and I had assembled a team of teachers and one of the members of the team or the dean of the school of education, Seymour. One day, I don’t know what possessed me, I had been at it for about a year, and we were really doing quite well. I asked a question of the team, when do you think we’re going to finish the book? Please, everybody write it on a slip of paper. When do you think that, and I gave it a formal definition so that it would pass what’s called a clairvoyance test. When will we hand in a draft for review to the Ministry of Education?

We all wrote it down and then we tabulated the answers, and they were all between 18 months and 30 months, a year and a half to two and a half years, including mine, and including Seymour’s. But Seymour was an expert on curriculum development and I had an idea, which ...

And I asked him, “Seymour, do you know about other teams that have tried to do what we are trying to do, not in that topic, but have tried to develop a curriculum where no curriculum existed before?” He said, “Yes.” He could think of several. So that was good.

I said, “Could you visualize those teams that you know about, when they were at approximately the same level of progress that we have achieved.” He said, “Yes.” He could do that. I said, “Well what happened to them?” The first thing he said, and he was really quite shaken when he said that. He said, “Not all of them actually wrote a book.” 40% of them gave up. Then we asked, “And those who did write a book,” he said, “I can’t think of any that took less than seven years. I can’t think of any that went on much beyond ten, so somewhere between seven and ten.”

“There are two different ways of looking at the problem.”

There are many things that are interesting in this story, I think, but what I drew from it was that there are two very different ways of looking at the problem. One is the kind of thinking that we had done in estimating a year and a half to two and a half years, and that is basically it’s not quite the best case scenario, but it is anchored on a plan, and it’s anchored on a reasonable extrapolation of what you have done so far, and that’s the way we normally would go about answering this problem.

I call that the inside view. It’s not necessarily the insider view, but it’s a view looking at the problem, at the specifics of the problem. Another way of looking at forecasting problems is to abstract completely from the case at hand and to look at the category to what the case belongs, and to ask what are the statistics of the category. Intuition tends to prefer the inside view. The outside view, by and large, will get you at least in the ballpark, which the inside view quite often doesn’t.

Nobody in our team thought that we had a 40% chance of failing, and certainly nobody had thought that it would take seven years. I can finish the story and tell you it took eight years and there was a book, and nobody ever used it, I wasn’t even there when the story was finished.

So that’s a contrast between two ways of looking at forecasting problems or problems in general. One is highly intuitive and it’s a normal way to go, and it’s the causal way to go. The outside view is non-causal, it is a statistical way of looking at the problem, and by and large, I would say almost any problem that you’re looking at, starting from the outside view, will give you an anchor, will give you a ballpark, and you should start from there, and look for reasons for deviating.

Yeah, I forgot to tell you one final part of the story. When I had told ... We had heard from Seymour what our future was likely to be, and sort of desperation, I asked in terms of our resources, and how well we're doing, how good we are, how do we compare to those teams you were thinking about? His answer was we were below average, but not that much. That's one part of the story.

I should add, I won't go into this, but for years, this was one of my favorite stories, it still is, but it took me years to discover who the real idiot in the story is, and of course it was I. It wasn't Seymour. I always thought Seymour had a problem that he had the information and he wasn't using it. But I had the information after that, we should have quit that day, and we didn't.

That, again, is a fairly typical thing. So you have the outside view and although, we had been given the outside view, and we believed in it, we didn't act on it. Because the inside view, the feeling that we had that we were doing well and that this was a good team, and that we were going to succeed, that overwhelmed [the new data] ... which is particularly ironic because we were writing a textbook that was supposed to rid people of precisely that mistake. Not only did I not see it then, I think, I didn't see it for years. So, there are real hang-ups in this whole domain.

Mauboussin: Let me follow up on that, I also want to pick up something you had mentioned. I heard you talk about at a conference a few weeks ago. There's one thing, we're optimistic, we tend to be optimistic about things that are important to us, so we want to call that some sort of a bias, and we were at a conference on strategy and you told a story, maybe you could tell it better than I, but basically you went to a company and they were talking about launching new products, and we know the success rate of new products is quite low. We know the success for entrepreneurs is quite low.

I guess the story is something along the lines of, you sort of explained this to him and the guy said, "Professor, if we listened to your advice, we never would have tried to launch these new products that have actually been successful for us." At what point do you balance this notion of optimism, which confers perseverance, versus saying, "Guys, we should just not write the textbook. Enough. We know that entrepreneurs fail at a very high rate. Let's just give up." How do we balance? Because societally, we want to people to persevere and try hard and start new things. By the same token, it may not be good for you or us as investors, or what have you.

“There isn’t all that much risk loving among people in general and among entrepreneurs.”

I think there are lots of data that the main reason that entrepreneurs take risk...they’re not risk taking. There isn’t all that much risk loving among people in general and among entrepreneurs. What there is, is people take risks because they don’t know the odds, and that’s--if you want a theory of this thinking, that would probably be the core of the theory. People take risks because they don’t fully appreciate the risks that they are taking, and that happens a great deal.

To the individual, this optimistic bias and the outside view, the inside view tends to be optimistic, but it’s not the only source of optimism. That is quite costly to the individual on average. Of course, without it, I have a chapter in the book that certainly nobody gets to ... It’s called The Engine of Capitalism, where I talk about optimism as being the engine that keeps the whole thing going. When you look at big successes and work your way back from big successes, somebody made a mistake in doing something that they had no business trying, and it was the spectacular success of that mistake that produced the big--there is a real trade-off. Optimism is a wonderful thing to have. If you have to wish one thing to your children it’s that they be optimistic.

Optimists live longer, among other things, and generally are happier, it’s much better to be an optimist than anything else. They also persevere more. They respond better to challenges. It’s very good to have optimists. On the other hand, I, for example, do not want my financial advisor to be an optimist. I have no need for optimism on his part. There is a real tension between the two, which I’m not proposing to resolve here, but it’s in any one problem that you deal with, that tension should be on your mind.

Mauboussin: I have another topic I’d like to draw out, which I think is also very much related to this big data, and that is that as we embrace big data, it suggests often in many organizations change. For example, one of the simple themes of Moneyball might be the numbers guys competing with the scouts, and if you embrace the numbers, then the scouts are basically losers, and the numbers guys are the winners. Obviously one of your also major contributions is this concept of loss aversion, and there are going to be losers and winners. How do we think about the notion--Can you speak about the notion of loss aversion and changing organizations, and to what degree people will or will not embrace some of the changes suggested by big data as a consequence of these true senses of loss?

“People who initiate the reform do not fully appreciate the resistance that they will encounter.”

I think the main contribution that Amos Tversky and I made during the study of decision making is a sort of trivial concept, which is that losses loom larger than gains. When people look at disadvantages and advantages, the disadvantages are more salient and attract more attention, and are weighted more in decision making than the advantages. It's a big difference, it's been measured in many contexts. As a very rough guideline, if you think two to one, you will be fairly close to the mark in many contexts.

We call that loss aversion. In the context of change and of reform in general, I mean, reforming government, reforming the civil service, change in an organization, there is one thing that is guaranteed when you're making a big change. There will be losers and there will be winners. Some people will derive some advantage from the change, other people will derive some disadvantage. You can know ahead of time that the losers, the potential losers, will fight harder than the potential winners, and when you look at that, that's almost invariably the case, in part because the losers know what they're about to lose and the winners are not sure. In part, because losses loom larger than gains.

What typically happens in changes and in reforms of many kinds is that the people who initiate the change, the people who initiate the reform do not fully appreciate the resistance that they will encounter. There is a piece of research that is highly relevant to that, but I like a lot. There is an effect in decision making that's called the endowment effect. That is that if ... And it was first studied, I think, by my friend Jack Knetsch in the context of sandwiches. My selling price for a sandwich I own is higher than my buying price for the same sandwich when I do not own it, and it's a very strange result, but that's how he first observed it. Substantially higher.

People tend--for the sandwich it is particularly bizarre because you could get another, but when people own a good and they have to give it up, giving up is more painful than getting something.

But, it turns out that Jack Knetsch did a bit of research. I'm not sure it has been replicated and I'm really almost afraid that it won't hold up because it's such a nice result. When you have an advisor selling a sandwich on behalf of somebody else or buying a sandwich on behalf of somebody else, that effect is gone, there is no loss aversion. That's really important.

Loss aversion is emotional, the reluctance is emotional, and if I'm making a decision on behalf of somebody else, I don't feel that emotion, which means, by the way, that advisors are likely to be more rational in the

long run because loss aversion is costly. It may also be true of leaders of organizations. When they make a change, they see the situation after the change, everything will be better than it is now. They do not appreciate the losses, the changes that people will experience, and the fact that the losses are going to be painful, and they end up compensating the losers because, quite often, that's the only way of getting something through. This, I think, is one of the major reasons why reforms and changes are almost invariably more expensive than anticipated. It's because that aspect of the change is rarely anticipated.

Mauboussin: Do you have any prescriptions as to how to mitigate that effect?

Take the outside view, that would be my prescription. I mean, if you look at other attempts to do similar things, you will see it there. You will see it there more clearly than you are likely to see it in your own case.

I want to ask another question about decision making within organizations. I know one idea that has captured your attention a bit is this concept you're calling noise. I think noise has a lot of meanings to different people, but perhaps you could explain when you're thinking about this concept of noise, what that means, why it's interesting to you, and again, what the significance is to organizations and decisions.

“One thing that has intrigued me most is this concept of noise.”

In the last few years, I've been doing consulting and the one thing that has intrigued me most is this concept of noise. I'll spend a few minutes and I'll tell you about it.

We know why Paul Meehl was right when in 1954, he said that formulas, very simple formulas, are better than judges. And we know it from a very interesting study that was done. It was done with clinical psychologists but I'm pretty sure that it will apply more broadly. You have people who are using a profile of information to make predictions about a set of cases. They could predict how much a person will earn or some quantitative criteria.

There are a number of things that you can do, and you know the criteria, you know the outcome that people are trying to predict, so you can look at the accuracy of the individuals, then you can apply the statistical model, you can look at the information, and you can predict the criterion, the statistical model beats the judges, that's not surprising. Now you do something else. For each of these judges, you build a model, and what the model does is it predicts the prediction that the individual will make. This

is nothing to do with the outcome. You build a linear model that predicts what the judge will say.

Now, in a holdout sample, in a new sample, you compare the accuracy of the judge to the accuracy of the model of his or her own model. The model of the judge is better than the [actual] judge. If you think about this, in a majority of cases, this is really an important result because it tells you where it comes from, why people are inferior to formulas, and people are inferior to formulas because a formula, when you give it the same input, twice, it will always have the same output. This is not true of people. People vary and they vary over time, so, I mean, one, I think of is x-ray readers, radiologists. When they look at the same x-ray twice, so I read, they reach different conclusions 20% of the time. That's noise. That's what I would call noise.

In many organizations, you have many functionaries that are making decisions on behalf of the organization, and at least in principle, they're interchangeable. An obvious example is the justice system. You have judges and we assume that the same defendant in principle, it ought to be the case that [they are treated the same]. Now this happens in many organizations. For example, you have credit rating agencies. You have different individuals rating. What you would want is you would want all the individuals to be interchangeable. It turns out they're not.

And so, we did research in a financial services company, quite a large one and a well-known one, and we did research on two categories of employees, and I can't tell you more for obvious reasons. You'll see why, actually, in a minute. These are decisions that people make by looking at written material. They pore over material and then they put out quantitative judgment in dollars. You have many of these individuals making--and, in principle, it's random who gets what. We ran an experiment and it was very brave of them to let us run the experiment. We ran an experiment where we presented the same material to 40 people, five different cases. The interesting thing is we asked the executives, suppose we take two individuals at random, how much will they differ in percentages?

It's odd but the answer typically, and you'll feel the same, actually, 5%-10%. You expect that well-trained individuals will come up with the same number. The real answer is 50%--45% to 50%. It's a huge problem, actually, because those errors, that variability, is costly. You can analyze how it is. When error is costly, noise is costly.

“When error is costly, noise is costly.”

We tend to think of mistakes or errors as bias, that it's a systematic error, but nonsystematic error is costly. For the statisticians here, if you have a square loss function, then noise and bias are actually additive. It's the same.

What was very striking was that here's an organization, it has a big and costly problem, and it doesn't know it. It doesn't know it because it very rarely happens because organizations, unlike Google, most organizations do not experiment, so it had never occurred to them to run that experiment.

They thought that their employees agree with each other, but they don't. Furthermore, experienced employees disagree with each other just as much as novices, so experience does not bring convergence. What it does bring is increased confidence. That's the point I was making earlier.

That, we are now trying to figure out, what are the limits of this problem? Because I think probably there are many organizations that have that kind of problem, as we have as individuals. I'll give you another example just to stretch the thinking about that. You have financial advisors who deal with clients, and they have a list of clients and they have to prioritize the list depending on various characteristics of the clients. Do they do it the same way? Probably not. And if they don't do it the same way, they can't all be right. If there is a solution, you would want them to converge on that solution. Noise is not advantageous in that case. And, I can't think of many examples. There is no evolution when there is no selection, where error and noise are essential. When there is no selection, noise is generally costly.

We're going to open it up in just a moment. This is a good time to think about your questions. Before I open it up, I do want to ask. Certainly one of the themes of today or big data in general is to think about forecasting. Thinking about the future. You recently warmly endorsed a book by Philip Tetlock called Superforecasting. I just wonder if you could share with us a bit what you found interesting or useful about that book. Yeah, what you found interesting about that book and maybe a quick synopsis of the journey that Phil's been on and where he is today.

Phil Tetlock is a social scientist, he's a psychologist, he's also a friend of mine, I mean, full disclosure. In 2005, he published a really important book on political and strategic forecasting. In that book, he looked at pundits and CIA analysts and people whose business it is to make, to predict the political and strategic future, and he had them make long-term predictions, and then he waited ten years.

Will there be a regime change? Will there be financial crisis? Will there be a transition to democracy? Whatever.

Basically, the conclusion of the book was that people cannot do it. Another conclusion was the more they think they can do it, the less they can do it. That is, the more overconfident the people were, and the more they have a theory about what's going on, the less they can do it. Those were some very good conclusions, and I drew heavily on that work in my own.

In recent years, Phil has turned to a different project encouraged by IARPA, the Intelligence Advanced Research Projects Agency. There was a contest among academic institutions among groups of academics at different universities, there was a contest for organizing predictions--so, a forecaster tournament of forecasting accuracy where people were to assign probabilities to events. This was short-term, six weeks to a few months, and how do you improve forecasting accuracy? There were many, several groups, and Phil Tetlock and his wife, Barb Mellers, they headed one group, and they won hands down.

Not only did they win overall, I mean, they have, by the way, those were very large number of forecasts. What they did is they advertised for people who were interested in playing that game, and they, I think, in the first year, had 3,000 people who made sort of weekly predictions about assigning probabilities to political events. They worked in teams and they also made individual judgments. At the end of the year, they identified the top 2%, and those later were called the Superforecasters. And they've been following those top 2% of forecasters who are just very good at it.

That includes a wide range of people from—I mean, there are many people with quantitative ability and expertise and so on, but there's, I think, a pharmacist somewhere in Alaska or maybe ... who beats the CIA in terms of the accuracy of her probabilistic predictions. That's interesting to me at multiple levels. The first place because I was very impressed by the first book and so I was skeptical that he would actually find it, and I wasn't very optimistic when Phil started.

The fact that short-term prediction is possible is not revolutionary. I mean, we would expect that long-term prediction still isn't probable. What there is in the book is an analysis of how they do it, what makes somebody into a forecaster, and those ideas are pretty simple, but they're also widely applicable.

We had mentioned several of them, so it's a mixture of the inside view and the outside view. It's clearly disciplined intuition, it is clearly an attempt to make independent judgments and then to collate it. Many of the standard ideas that when you apply them, it turns out it really improves your ability to understand problems in the real world.

I think it has applications. I'm more skeptical, by the way, about the applications to the political strategic world because I'm not sure that the decision makers are equipped to deal with their decisions as gambles, but in the financial industry, as an adjunct or replacement to judgment, where judgment is used and not big data, then it's quite interesting, I think.

Thank you. With that. We'll open it up. Yeah, just grab a mic. Josh, yeah, grab a microphone and we'll ...

Speaker 4: You mentioned the inconsistency both within individuals given the same data point and then, of course, the divergence between individuals within an organization. At what level of aggregation does that dissipate? I'm thinking in particular of Scott Page's work on diversity prediction theorem and some of the prediction market stuff that you touched on with Tetlock.

Mauboussin: All right. Does wisdom of crowds help us address some of them?

There are certain things that are washed out in aggregation, and so, for example. In personnel assessment, which is a topic in which I've been interested recently, and performance assessment in organizations. There was...where ratings are used, there are two ... All of you are familiar with it. There's forced ranking is used by about half of the large companies and ratings and used in other companies. Where people are rated by a single manager, most of the variance, more variance is attributable to differences among managers than to differences among the people that they rate. There are huge differences in how different managers use the same rating scale. That gets washed out in aggregation, so I read recently about how they do things in Google, and there, there are multiple ratings. You would expect that sort of variation to be eliminated.

On the wisdom of the crowd, Superforecasters clearly beat prediction markets. There is the wisdom of the crowd. It's not entirely clear how far wisdom of the crowd--at least to me, I haven't seen compelling evidence that it's far superior to simple averaging of independent opinions.

Superforecasters have been compared to prediction markets, and they're better in that context.

Mauboussin: They also found Superforecasters who work in teams work better than Superforecasters working by themselves, which is also an interesting finding. Billy, I've got a question here. Yeah.

Speaker 5: Hi, Professor Kahneman. I asked you about this during the break, but in biomedical research and psychological research, there's a real crisis in non-replicable research. I just wonder in your field, as well, and I just wonder how do you think that that applies to these larger questions of predictive algorithmic systems or disciplined intuition or whatever? These are structured published research in top journals, right?

I'm a psychologist and we are in the midst of a sort of crisis on reproducibility of our own results because there was a study published in Science a couple of months ago that really was quite disappointing in terms of replication. This morning, I must say that my key impression was that Hal Varian has the best job in the world. I mean, I just imagine he lives in heaven so far as I'm concerned. Because he doesn't have a problem with reproducibility, he has very, very large samples. The problem of reproducibility is that the samples are too small relative to the size of the effects that are measured.

What happens when samples are small, is that people develop-- Researchers develop very bad habits, and the bad habits are to protect themselves against finding nothing, they try many things, and then they report selectively and they fool themselves, and the result is reproducibility is low, it's quite low in medical research. I don't remember the statistics but they're worse than psychology. There is a real problem. What seemed very clear today was that when you have huge data, that problem, the problem of ... Look, I mean, it's the same as in regression. The problem with regression is not that something happens in the second time that you measure it. The error is in the first time.

It's how stable the results are, how true the results were when you measured them. At least big data won't have that problem. The stability of relationships and other samples in the past, the future will be like the past. That's a problem, but my impression was that at least when the data is huge, and the questions are relatively limited, they can be quite ...

The question can be quite complex. The search universe, relative to this amount of data, it's a very favorable ratio. I was very envious of the guys who do big data.

Speaker 6: Hi, how are you? I wanted to go back to the point that you made about using the category to shape decision making more than this specific example, certainly from an insider's point of view. How do you think about situations where you may be creating a new category or at least there's not an obvious comparator. For example, to take a very simplistic example from the consumer world, think about pricing the first cup of Starbucks coffee. You wouldn't have gone to the category of 7-Eleven coffee said, "Well, 99 cents seems about right." How do you think about those sorts of situations?

In that particular example, that's what, I suppose, market research is for. You do research, there are no guarantees that the market research will be accurate, but it would certainly be better than guessing. The question that you're asking about unique events and unusual events, that has been in the background of today. For example, in the discussion this morning about abduction, sort of the new hypothesis, the new idea. Certainly, there are people, and everybody thinks of Steve Jobs in that context always as somebody who had intuitions that turned out right, and the question in my mind following this morning was whether that kind of performance could be duplicated in big data.

I couldn't see any reason why not. Ultimately, I think intuitively, we bridge those gaps and we're not even aware of the fact that we don't have a good comparison case, but ultimately, big data are going, there is a hope or a fear with big data that they'll be going beyond where we go with confidence with our [own] intuition.

Mauboussin: Maybe I can offer one reason with big data. Maybe he was just lucky.

Where.

Mauboussin: Steve Jobs.

Yeah. I think unquestionably he was lucky and he didn't hit it every time. Yeah. I mean, it's a topic that Michael and I are both very concerned with, which is the role of luck, and we've both emphasized the role of luck. It's very hard for me.

It's interesting because think of what we have been talking about-- statistical thinking, causal thinking. It's very difficult when you think of Steve Jobs and you've read about him, and he's in the cinemas, as well. It's difficult not to see a causal system in front of you, so that makes it very difficult to view what happened as an instance of luck. It could be luck.

Mauboussin: It's like your famous equation, your Brockman equation. Maybe you should share what your--The Brockman equation is good, it's good.

John Brockman is sort of an intellectual impresario who also is an agent for authors, and he asks a yearly question and publishers ask it of 150 people, quite often interesting people, to give brief answers to--and publishes the result. I think there is one that's just out, and they're not turning out to be bestsellers. A few years ago, before they weren't bestsellers, his question was, "What is your favorite formula?" I answered. My favorite formula was about success, and I wrote success equals talent plus luck and great success equals talent plus a lot of luck. That's the formula that Michael refers to.

Speaker 7: That was great and I have two questions, I guess. One bears on this abduction point, and I think where does the following fit into your thinking? I think it's distinct from data. I think about things like think about general relativity, and so what happens here is we have a few things. One is tensors, an interesting mathematical form, we have non-Euclidean geometry, the intuition that you can treat time as if it were a spatial dimension. None of this has to do with the size of the data set. It has to do with a certain kind of schema, some formal structure mathematical computation algorithm, which is not arrived at by observing regularities in data sets. That's, I think, what explains revolutions in science.

Einstein says, "You know, Minkowski, that's useful. I can borrow that schema." Where do these kinds of structures appear in your framework?

Many years ago, when I was a graduate student, I was exposed to somebody who thought he knew what creativity was, and he built a test, which is still in use, it's called the remote association test. The remote association test is you're given three words, and they're all three linked to some common concept, and I'm not going to try to think of example. Actually, in my book, I did cite a couple of the examples.

I've always thought, I mean, I asked him how well will this predict the creativity of architects and other people that were studying at the time, and he answered very arrogantly, "Well if the criterion is good, the correlation should be perfect because this is creativity."

He convinced me, and I think that creativity is putting remote things together, it's seeing connections that are there, and that are real, and you recognize it once the connection has been made, but we often said, "Oh, I would never have seen it." This is our experience of the creativity of others is that they have seen a pattern that we can recognize after the fact, that we would never have seen it. That was in the background of my remarks earlier, that I'm not sure that that pattern would not be uncovered in big data. In principle, I think it should be discoverable in big data. There is no magic. It was there. He put together things that existed. It didn't come out of nowhere.

The same is true, I'm quite convinced, of Jobs. Clearly, you can't say that Einstein was luck. I mean, that possibility isn't there, but all the elements were there, he just, nobody else could put them together, or didn't put them together. Could is an impossible word in that context, and he did, but no magic.

Speaker 8: Your work in psychology became, after a few decades, let's say, almost a textbook in economics. Meaning that one discipline became a mainstream in another discipline a few decades afterwards. Relating to what Doyne Farmer talked about today, I wonder what you think it would take to economics these days to be able to be open to other disciplines related to the things that came up today about new type of theories and how to also the way to absorb big data into economic theory and empirics.

First of all, I'm not an economist, so I would be completely free not to answer the question at all because it's not my field. I do have a couple of remarks on this. In the first place, I think this idea of economics as a closed discipline and as very resistant to change doesn't seem to be true. I mean, I have a prize in economics, and I was considered a heretic 25 years ago. That's very, very quick when that happens. I want to cite the Nobel Prize that was given yesterday to my friend, Angus Deaton. He's an economist, and I have learned more about how to resist my own causal intuitions from him than I have from anybody else because he was trained, and he attributed that to his discipline as an economist to be very, very careful about causality.

There is a mode of thinking about social science that other social sciences can borrow from that work. I'm not on the complaining side when it comes to economics.

Speaker 9: Has your work ever gone into ethics? My question is motivated by your comment on loss aversion and when a system or a corporation is changed, and it affects the losers more than the winners. Does that impose an ethical framework or consideration on how do we factor that in? Should we, as a society, be looking for better solutions or does it say anything about income inequality of distributions?

Let me try for a short answer. Obviously, loss aversion has to be ethically relevant. In fact, it is strongly relevant to the intuition that people have about the fairness of behaviors. Many years ago, Richard Thaler and Jack Knetsch and I did a study of perceptions of fairness in the market, and it's all about losses. There are constraints on what people are allowed to do in imposing losses on others. There are much fewer constraints, you don't have to share your profits, but you cannot impose losses just in order to make a profit for yourself if you care about being perceived as fair. Clearly, all of this is highly relevant.

There is a major distinction that comes up in decision making and it comes up in ethical discussions, as well. The distinction is between final states and changes. You can think in terms of final states like what is the ideal distribution of a good, or you can think of the current situation and evaluate ways of changing from the current situation. You don't get to the same conclusions when you're thinking of the ideal state and when you're thinking of changes, and the ethical intuitions that we have are primarily about changes, but we do have intuitions about ideal distributions, we have intuitions about changes, and they don't fit together. I don't think, when you look carefully at human ethical intuitions, our intuition, that they are not consistent, but you cannot ignore losses in thinking about ethics. You cannot merely consider an ideal world because you've got to get there, and getting there involves gains and losses.

Speaker 10: Hi. You talked about how confidence does not equate to validity. Is there a logical basis for the value human beings place on confidence in that we elect people who seem confident to run companies and run countries. Is there a logical basis for that given what you've said how it actually doesn't mean anything.

That's really a beautiful question, which was why do we put so much value on confidence? There has been a lot of work in recent years among psychologists on how we form impressions of other people. There seem to be two major dimensions in the impressions we form, and one of them is warmth from good to bad, warm to cold, and the other one is competence or dominance. It turns out that competence or dominance is very important to us when we value it. People, it is one of the, when people are exposed to pictures of individuals, they form an impression of competence and strength at the same speed that they form an impression of likability, which is really less than a second.

Confidence is part of that complex, it's part of that, and we want that. We want the people that we depend on to be competent and to be confident, and that is true about our leaders, it is true about our parents. We're afraid of competence and dominance from strangers and people that we don't like, but we very much need it from people who lead us. There is a huge desire for confident leaders. There is a huge desire for intuitive leaders. If you think of a national leader, you think of two who reach the same decision, and one of them reaches it quickly and the other slowly, we tend to be more attracted to the one who reaches the conclusion quickly.

This is very deep that wishful confidence, and also, naturally, there is a wish for ourselves to be confident, to feel confident, but it's fed that is when I act confidently I'm rewarded for it by other people, similarly, by the way, for optimism. Optimism is rewarded by other people.

Speaker II: What's your thoughts on why some rules tend to work, have a high probability of working such as stopping at a red light, but other rules, like you were talking about with employee valuations following a set rules don't tend to necessarily work very well? What can executives do in advance to increase the odds that the rules they're setting fall in the higher probability range?

Again, the issue is one of clarity and clarity of feedback, unequivocal feedback. The example of stopping at a red light, that's one extreme of the distribution, where you know if you violated that rule or not. When it's - the less clear it is, whether you violated a rule or not, the more likely it is that the rule will be violated.

Speaker 12: This is more of a comment, but I would be interested in your reaction. The question on competence, it occurs to me that in many small scale situations, you want somebody confident, the captain of a ship, for example, you want somebody who knows what they're doing. There are a lot of small scale situations. It seems to me it's only a few special situations, maybe major political questions, financial advice, and things like that where people are confident but not competent.

You use a very interesting phrase in your question. You said, "We want somebody who knows what he's doing." But confidence is we want somebody who looks, who presents himself as if he knows what he's doing. That's not exactly the same thing, but we do want that, as well.

Speaker 13: Somewhat along the same lines, in your discussion of the entrepreneur harking back to that. The idea that entrepreneurs basically are people who made mistakes and got lucky. There's an alternative explanation, which is that they are people who are not only confident of their ability, but confident that whatever mistakes they stumble into, they will be able to find a way through. Okay? That may be the ultimate, I mean, that's an ultimate form of optimism, and it seems to be a decision tree optimism. Would you comment on that?

It's certainly the case that leaders and entrepreneurs, they don't view themselves as gamblers. They view themselves as captains of a ship in a stormy sea. It's a very, so it's clear that this is their view. I did not mean to say that the entrepreneurs who are successful were just lucky. Obviously, they had to be very talented. What I did say was that in general, they tend to overestimate their odds, and that in many cases, if they didn't overestimate their odds, they wouldn't take the gamble. The best example is a study that was done a long time ago about small businesses, owners of small businesses like restaurants and laundromats and so on. Where people are asked--where the survival rate is known, it's about 1/3 for five years in the United States, so small business has a 2/3 probability of not existing five years after it's set up. So when you ask people who open small business, what they think their odds of success are, they're very high. 85% and up. Some of them are certain they will succeed.

When you ask them what is the probability that a business like yours will succeed, it's much lower, it's about 2/3. But you can see that if somebody opens an Italian restaurant, clearly they're optimistic about the Italian restaurant. Otherwise, they wouldn't do it. It is also the case that there is that over-estimate.

There is another source of data, which I find really quite interesting. There is an institution in Canada that will assess startups and innovations and inventions for their commercial potential. If you have an invention, you can send it to them, and they will rate it for you, and they're really very good at it, especially rating things as hopeless.

If they rate something as hopeless, it really is hopeless, and then you can, over the years, they have accumulated data on what are the reactions of people upon being told that their invention is hopeless. Approximately 50%, I think, carry on anyway and fail, but, of course, it's the same perseverance that causes others to succeed.

Speaker 14: I have one question, actually, and that is in your opinion, it's been said, for example, in many systems that your success is in part a function of the context of the environment in which you find yourself. From a physicist's perspective, you would say that in some cases, the susceptibility of a system, the small perturbations can be infinite. In other situations, it's zero or almost zero. What if Jobs had been born ten years earlier or ten years later? What if he had not met Steve Wozniak? Okay. This is where luck enters into it, to some degree. What about all the pairs of people in their garage trying to reinvent the Internet today as opposed to Brin and Page?

Kahneman: I don't know. What if the owners of Google had been offered \$1 million instead of \$750,000-- I think that was the amount that was offered, that would have been a big difference to a lot of things. Michael has a book on luck and skill, and I discuss it in exactly the same way. Yeah. Success has a lot of luck into it. We can say it differently because that can be misleading. Talent is necessary but it's not sufficient, so whenever there is significant success, you can be sure that there has been a fair amount of luck.

Speaker 15: In terms of your thoughts, I guess we haven't really sort of characterized it as this, but when you look at these, it seems like an issue of competence and confidence, complexity seems to be the issue in terms of, I guess, what discerns the good from the meaningful. Here we are in 2015, we have very polarized sort of political landscape, and it seems that a lot of the people just don't understand complexity. How do we get people up to speed or do you have any perceptions in terms of really in this idealistic sort of motif, how to bring complexity to the masses?

I feel bad about ending this conversation on such a note, but my answer is no. I don't see how to do this. I mean, I really don't see how it's possible.

In the book I wrote, I distinguish those two ways of thinking about things, faster and slower. When you're talking to the public at large, and you want to get action or you want to get something embraced and so on, you have to speak to their fast thinking. You have to have a story that is engaging that people can relate to.

Communicating complexity, by communicating scientific evidence, scientists are deluded to some degree about themselves, and certainly about the public, about the compelling power of evidence. Evidence is not all that compelling. That's what we see all around us. People who have strong beliefs without any evidence, and who can resist any evidence to the contrary, and complexity is really not what people are after, and so I'm not optimistic at all. I could have said simply no, but I'm just saying it more slowly. Thank you.

Mauboussin: Thank you. Thank you, everybody. I do want to give another thank to all of our core organizers, John Rundle, who also is our wonderful MC for the day. Marty Liebowitz, thanks again, Marty, for not only your help in putting this all together, but also your hosting the event. Chris Wood, who unfortunately was unable to join us from SFI. I would just say on behalf of all of my colleagues at Santa Fe Institute, thank you all for attending today. Certainly, let us know if you'd like to learn more about SFI, we would certainly welcome that, welcome your interest, and we hope to have the opportunity to exchange more ideas in the future. Have a great afternoon, everybody.

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Animating Mr. Market

Adopting a Proper Psychological Attitude

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"If you want to make money on Wall Street, you must have the proper psychological attitude. You must look at things under the aspect of eternity."

Ben Graham

The Legacy of Ben Graham

- To be an active investor, you must believe in market inefficiency to get opportunities and in market efficiency for those opportunities to turn into profits.
- The Mr. Market metaphor is very powerful because it makes an abstract idea concrete, encouraging an appropriate way to think about markets.
- One way to animate Mr. Market is to consider the wisdom of crowds. What's key is that crowds are wise under some conditions and mad when any of those conditions are violated.
- Diversity breakdowns, which can happen for sociological as well as technical reasons, lead to extremes.
- Look for cases where uniform belief has led to a mispricing of expectations and hence a way to make money.

The Proper Psychological Attitude

Ben Graham, a renowned investor and revered teacher, opened his course at Columbia Business School by saying, “If you want to make money on Wall Street, you must have the proper psychological attitude.” Referring to a passage in *Ethics* by the philosopher Baruch Spinoza, he added, “You must look at things under the aspect of eternity.” Translated loosely, this means you need to take an objective point of view.¹

Warren Buffett, chairman and chief executive officer of Berkshire Hathaway and Graham’s most famous student, suggests you need to read three chapters in order to shape that attitude²:

- Chapter 8 from *The Intelligent Investor* by Ben Graham (“The Investor and Market Fluctuations”);
- Chapter 20 from *The Intelligent Investor* (“‘Margin of Safety’ as The Central Concept of Investment”);
- Chapter 12 from *The General Theory of Employment, Interest and Money* by John Maynard Keynes (“The State of Long-Term Expectation”).

The focus of this discussion is chapter 8, and in particular Ben Graham’s parable of Mr. Market. We have three goals:

1. Argue that the Mr. Market metaphor remains a powerful way to think about markets;
2. Introduce a handful of ideas, some of which were not fully developed when Graham introduced the metaphor, to help animate the concept;
3. Provide some concrete ways to think about using Mr. Market to your benefit.

Graham opens chapter 8 by noting that stocks fluctuate (of course) and that there are two ways that a participant in the market can profit from those swings. The first is “timing,” the endeavor to anticipate the action of the stock market. The second is “pricing,” buying stocks for less than they are worth and selling them for more than they are worth.

He adds quickly that timing doesn’t work for an investor and remains the purview of the speculator.³ Notwithstanding the parade of commentators in the media, the evidence that experts predict poorly in complex domains is quite clear and well documented. The best work in this area is by Philip Tetlock, a professor of psychology at the University of Pennsylvania, who studied the predictions of hundreds of experts making political, economic, and social forecasts over 20 years. His conclusions would have come as no surprise to Graham: “. . . many pundits were hardpressed to do better than chance, were overconfident, and were reluctant to change their minds in response to new evidence.”⁴

Graham goes on to argue that a useful way for an intelligent investor to think about the market is through the parable of Mr. Market. In Graham’s version, you own a small stake in a private company that costs you \$1,000 (approximately \$10,000 in today’s dollars). One of your partners is an obliging fellow named Mr. Market who tells you, every day, what he thinks your stake is worth and, further, offers a price at which he’s willing to buy you out or offer you an additional interest.

In his telling of the Mr. Market parable, Warren Buffett adds that Mr. Market has “incurable emotional problems.”⁵ Sometimes he is euphoric and sees only favorable outcomes and hence names a very high buy-sell price. Other times he is depressed and sees only negative outcomes and provides a very low buy-sell price.

But, in fact, there are plenty of days when Mr. Market is doing fine and his price is sensible.

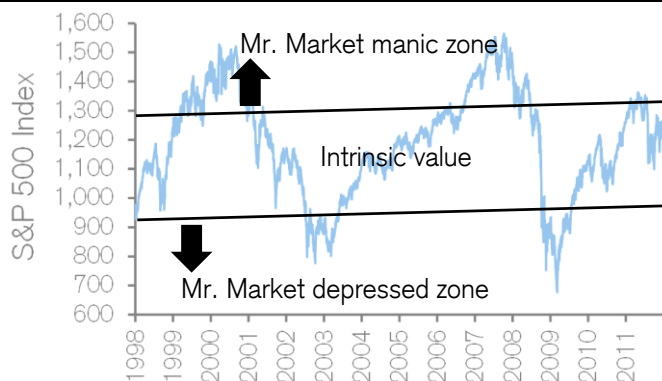
In 2013, the Nobel Prize in economics went to three men. One of the recipients, Robert Shiller, is a professor at Yale University known for showing that markets are inefficient. Another was Eugene Fama, a professor at the University of Chicago known for his advocacy of market efficiency. (The third was Lars Hansen, also at the University of Chicago.)

This leads to the first point worth stressing: to be an active investor, you must believe in both inefficiency *and* efficiency. In other words, you have to think that both Shiller and Fama are right—just not at the same time. Naturally, if markets are perfectly efficient there's no reason to try to beat them through active management. But it's also true that there's no reason to try to beat the market through active management if you think markets are always inefficient. That's because even if you are savvy enough to buy a dollar for fifty cents, there's no reason to believe that the price and value will ever converge in a perpetually inefficient market.

A maxim that Graham spoke, but never wrote formally, is, "In the short run, the market is a voting machine but in the long run it is a weighing machine." This quotation is sometimes taken as evidence of short-termism. We believe this is a misreading of the message. A better interpretation is that sometimes the market prices stocks incorrectly, but that price and value ultimately converge in the future.⁶

Intrinsic value equals the present value of future free cash flow. Because the future is unknowable, you might think of intrinsic value as a range. Indeed, prices are often in that range—Mr. Market is getting things mostly right. But there are times when Mr. Market becomes manic and names a very high buy-sell price, and other times when he's depressed and names a low price. See exhibit 1.

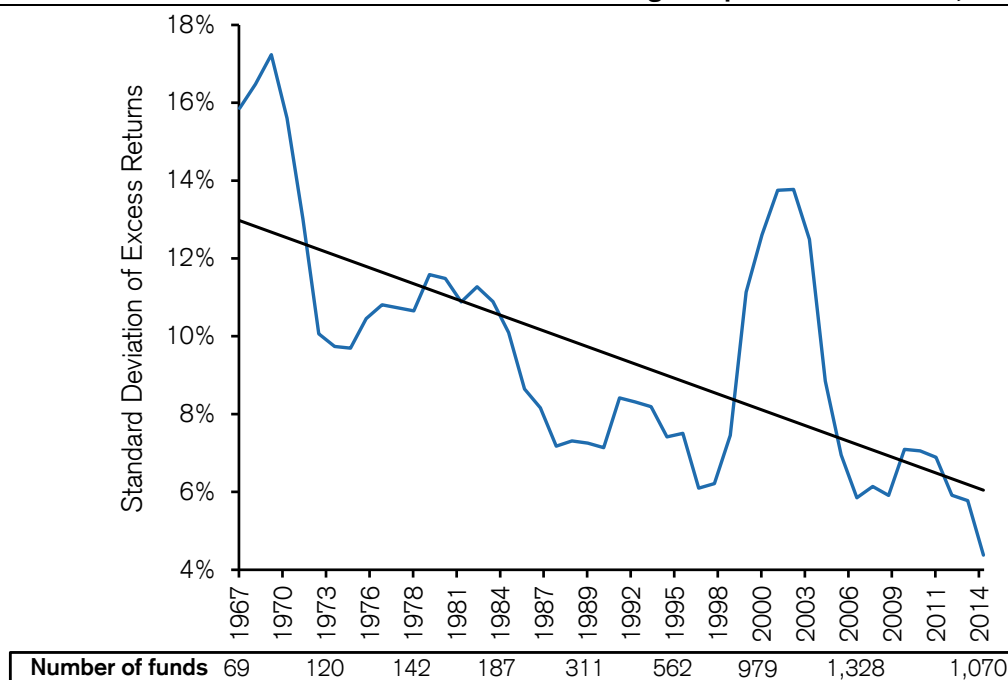
Exhibit 1: Mr. Market Goes to Extremes



Source: Credit Suisse.

Graham's point, to which we will return, is that the intelligent investor uses Mr. Market's swings as *information* that he or she can take advantage of, rather than being *influenced* by the price action. This, of course, is very difficult to do psychologically.

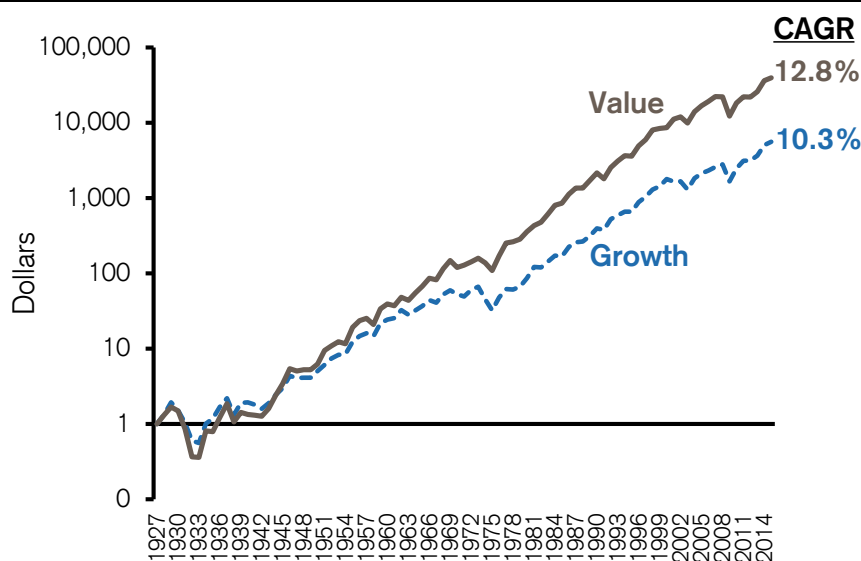
Before leaving this part of the discussion, two additional points are worth making. The first is that it is not easy to generate returns in a portfolio, adjusted for risk, that exceed the S&P 500 or any relevant benchmark. And it has become more difficult over time. One way we can show this is through the standard deviation of excess returns. Exhibit 2 shows the five-year average standard deviation of excess returns for U.S. large capitalization mutual funds from 1963 through 2014. If you imagine excess returns as a bell-shaped distribution—which is not true but not so far off to be useless—then the bell has gotten skinnier over the decades. Indeed, the 2014 figure set a new low mark.

Exhibit 2: Standard Deviation of Excess Returns for U.S. Large Capitalization Funds, 1967-2014

Source: Markov Processes International, Morningstar, and Credit Suisse.

Note: Shows five-year average of standard deviation of excess returns.

Second, value investing works. Exhibit 3 shows value versus growth going back to 1927. The exhibit displays the difference in the compound annual growth rate (CAGR) for a portfolio of expensive stocks versus one of cheap stocks, based on the ratio of price to book value. Now it's reasonable to ask whether the value premium of 250 basis points is the result of risk or behavioral issues. The balance of the evidence suggests that the behavioral explanation better fits the facts. This is all very consistent with Mr. Market.⁷

Exhibit 3: The Value Premium, 1927-2014

Source: Kenneth R. French, see <http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/>.

Note: From series "4 Portfolios Formed on Size and Book-to-Market"; Annual series uses average equal-weighted returns for "big" stocks; CAGR = compound annual growth rate.

The Wisdom and Madness of Crowds

So now let's roll up our sleeves and ask about the various theories to explain market efficiency. Going in, we need to acknowledge that any satisfactory theory has to accommodate two realities. First, markets are hard to beat. Second, markets periodically zoom to excesses on the upside and downside.

There are three basic theories to explain market efficiency.⁸ The first is to assume that investors are rational, which means that they make normatively acceptable choices based on expected utility theory and correctly update their views based on new information.

The second is to assume a small set of rational investors who use arbitrage to remove pricing errors. We can relax the assumption that all investors are rational and rely on a handful of them to make sure the trains run on time and the mail is delivered.

The final theory is the wisdom of crowds, the idea that a group of diverse individuals can come up with an efficient price. We are going to argue that this fits the Mr. Market story the best, but before we get to those details, let's look very quickly at rational agents and arbitrage.

There are few remaining hard-core believers in rational agents. But it is still a common way for financial economists to describe and discuss markets. In a debate about whether markets are rational, Mark Rubinstein, a professor at the University of California, Berkeley, took the affirmative side. Here's what he said in the paper that outlined his case (the emphasis in italics and underlining is original):⁹

When I went to financial economist training school, I was taught ***The Prime Directive*** . . .
Whatever else I would do, I should follow ***The Prime Directive***:

Explain asset prices by rational models. Only if all attempts fail, resort to irrational investor behavior.

The paper itself is quite interesting, and worth a read. It's not as one-sided as this excerpt suggests. But it does reflect the training and attitude of a generation of financial economists.

Now it's not all that hard to dismiss the rational agent theory. First, we know that investors have nowhere near the computational ability or rationality to act in a normatively acceptable way, and we also know that markets go haywire in a fashion that rationality has a hard time explaining.

An obvious example of the latter is the stock market crash of 1987, a day when the Dow Jones Industrial Average plunged 22.6 percent. The probability of such an event was vanishingly small using conventional theory, and a rational explanation stretches credulity.¹⁰ When asked about it, for instance, Eugene Fama said, "I think the crash in '87 was a mistake."¹¹ He went on to argue that the crash of 1987 was an error that was too big and the crash of 1929 was an error too small.

Now if you ask finance professors about market efficiency, most will fall back on the arbitrage argument, which basically says that we only need a handful of well-capitalized arbitrageurs who will cruise around markets seeking aberrant price-to-value gaps and will buy and sell accordingly.¹² The beauty of this argument is not everyone has to be smart and the rest of us benefit from the work of the arbitrageurs. Arbitrage is based on negative feedback, pushing things that are out of line back to where they should be.

There is a literature on the limits to arbitrage that explains why arbitrageurs can't always do their jobs.¹³ Often these limits are technical. For instance, take the case of 3Com, a networking company, and Palm, a hand-

held computer company wholly owned by 3Com. In early March 2000, 3Com sold 5 percent of Palm in an initial public offering, with the stated intention of spinning off the other 95 percent to shareholders later in the year. Following the offering, each 3Com share would represent 1.5 shares of Palm as well as the proportionate value of the 3Com operations.

On the first day of trading following the offering, Palm shares traded at roughly \$95 per share, representing a market capitalization of \$54 billion, and 3Com shares were at \$82, a \$28 billion valuation. This suggested a value for 3Com of roughly negative \$20 billion. Given that each 3Com share was worth 1.5 Palm shares plus the company's own operations, the obvious trade was to go long 3Com and short Palm. The problem was that there was insufficient Palm stock to borrow. So even though the math of the trade was clear, arbitrageurs could not execute the trade. This allowed the inefficiency to persist until sufficient Palm shares became available to borrow.

Even after taking into consideration the limits to arbitrage, the existence of arbitrageurs is a reasonable assumption. There remain substantial resources dedicated to arbitrage, and arbitrageurs play an essential role in ensuring efficient prices day to day.

But there are a couple more issues with the arbitrage argument that Jack Treynor, president of Treynor Capital Management, suggests in a fine paper on market efficiency published in 1987.¹⁴

First, arbitrageurs themselves are not rational because the risk of their portfolios can rise faster than the reward, inconsistent with the principle of risk aversion and hence expected utility theory.

Second, the theory assumes that investors who know true value expand their positions and those who don't willingly sell. As he says, "Those investors who are right know they are right, while those investors who are wrong know they are wrong" and they all act accordingly. This, he adds flatly, is "an unlikely state of affairs."

Another problem is that the arbitrageurs have failed to show up at critical junctures throughout the history of markets. One well-documented example is that of Long-Term Capital Management (LTCM) and "on-the-run" and "off-the-run" bonds. There's a wonderful chapter about LTCM in "An Engine, Not a Camera: How Financial Models Shape Markets" by Donald MacKenzie, a professor of sociology at the University of Edinburgh.¹⁵

The most recent issue of a bond is called on-the-run. At that time, the 30-year Treasury bond was a bellwether security. The comparable 30-year bond issued, say, six months before, is off-the-run. These bonds have very similar values based on math, but since the newer issue is more liquid it commands a small premium. The trade here is very straightforward: If the off-the-run bond gets unusually cheap versus the on-the-run bond, measured by a wide spread between the yields, you buy the off-the-run and sell the on-the-run until the valuation gap reverts to normal. This is arbitrage 101. And because this is a plain vanilla transaction, arbitrageurs use plenty of debt to supercharge their returns.

The point MacKenzie makes is that as the spread expanded on this trade in 1998, the arbitrageurs were nowhere to be found. He writes:¹⁶

As 'spreads' widened, and thus arbitrage opportunities grew more attractive, arbitrageurs did not move into the market, narrowing spreads and restoring 'normality.' Instead, potential arbitrageurs continued to flee, widening spreads and intensifying the problems of those who remained, such as LTCM.

The trade itself wasn't a problem, as in theory LTCM could have held those securities to maturity and done fine. The problem was leverage, which amplified the impact of small changes in the spread. But the essential point here is that at the time when we most need the arbitrageurs to provide the market with negative feedback—that is, to bring price and value back into line—they fail to do so.

The final path to market efficiency is the wisdom of crowds.¹⁷ To be more formal, we can call the market a complex adaptive system:¹⁸

- **Complex** means there are lots of heterogeneous agents interacting. These can be neurons in your brain, ants in an ant colony, or investors in a market;
- **Adaptive** means that the decision rules of those agents change in response to the environment. Synaptic connections are strengthened or weakened, the ants forage or stay in the nest, or investors buy or sell based on the market's moves. The essential point is that there is feedback between the decision rules and the environment;
- **System** means that the whole is greater than the sum of the parts. Reductionism doesn't work. You can't understand the system solely by analyzing the constituent parts.

Now here's the key: The wisdom of crowds only works under certain conditions, which include diversity, aggregation, and incentives. Here are some definitions:

- **Diversity** means that the agents, whether neurons, ants, or investors, are heterogeneous. In markets, this means investors who have a short-term or a long-term outlook, do fundamental or technical analysis, or even those who trade based on the alignment of the stars;
- **Aggregation** means there's a way to bring information together. That would be synaptic firings in your brain, pheromone trails for ants, and exchanges for investors;
- **Incentives** mean there are rewards for being right and penalties for being wrong. Incentives need not be monetary—they can be represented by fitness for a species or even be reputational. But the important idea is that good results are rewarded and poor performance penalized.

There's an equation that shows the math of how the wisdom of crowds works. Scott E. Page, a professor of economics and political science at the University of Michigan, calls this the "diversity prediction theorem:"¹⁹

$$\text{Collective error} = \text{Average individual error} - \text{Prediction diversity}$$

You can think of "average individual error" as smarts, "prediction diversity" as diversity, and the "collective error" as the wisdom of crowds.

There are two axioms that follow from the diversity prediction theorem. The first is that the collective error is always less than the average individual error. This means the collective is smarter than the average guess within the collective. For those who participate in markets, this is a message that suggests appropriate humility.

Second, the wisdom of the crowd is equal parts smarts and diversity. As Page stresses, "Being different is as important as being good." This highlights the relevance of diversity in multiple settings, including any decisions that groups make.

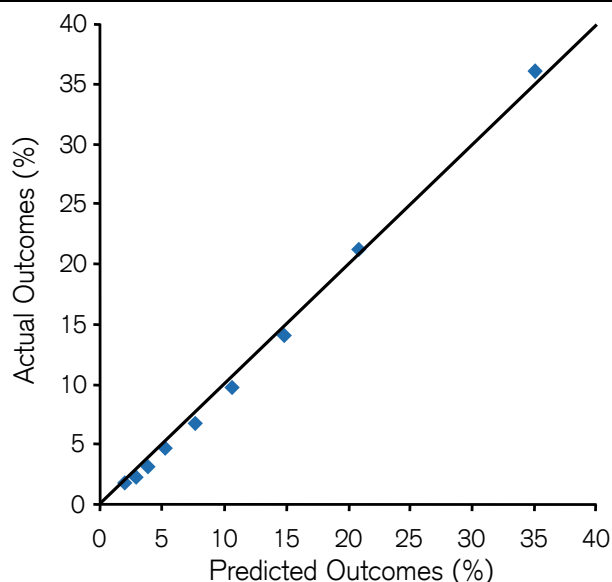
Here's a simple example to show how the wisdom of crowds works. In the summer of 2013, we had a meeting that included 67 interns. We passed around a large jar of jelly beans and asked them to independently make an estimate of the number of beans in the jar. We offered a reward for the best guess and threatened public shame (without follow through) for the worst one. So the conditions for the wisdom of crowds were in place: diversity, aggregation (a spreadsheet), and incentives.

The average estimate of the group was 1,427 beans. The jar contained 1,416 beans. So the collective estimate was within one percent of the actual number. The accuracy was not the result of sharp individual guesses, as the average individual error was 53 percent. Rather, the guesses were sufficiently diverse to get to a very good final result. In this particular exercise, no participant did better than the collective.

While this outcome is interesting and illuminating, it relies on a very contrived setting. But it turns out that collectives can do well in environments closer to markets. One example is pari-mutuel betting in horse racing.

Exhibit 4 shows a plot based on more than 11,000 horse races.²⁰ The horizontal axis is the ordinal finish, as determined by the handicappers, and the vertical axis is the actual outcome. Each dot compares the expected versus the actual result. A line at a 45-degree angle shows how well they match up. If you examine this closely you can see that horse bettors are not perfect, and the results for any particular race can be way off (as we'll see in a moment). But these results are sufficiently accurate to make it really hard to make money after the track withholds a standard percentage of the betting pool (known as a "takeout").

Exhibit 4: Handicappers Are Accurate



Source: Marshall K. Gramm and Douglas H. Owens, "Efficiency in Parimutuel Betting Markets Across Wagering Pools in the Simulcast Era," Southern Economic Journal, Vol. 72, No.4, April 2006, 926-937.

Ben Graham knew about the wisdom of crowds. When posed the question about whether Wall Street professionals are better at forecasting than others, here's what he said:²¹

Well, we've been following that interesting question for a generation or more. And I must say frankly that our studies indicate that you have your choice between tossing coins and taking the consensus of expert opinion and the results are just about the same in each case. Your question as to why they are not more dependable is a very good one and an interesting one and my own explanation for that is

this: Everybody on Wall Street is so smart that their brilliance offsets each other. And that whatever they know is already reflected in the level of stock prices, pretty much, and consequently what happens in the future represents what they don't know.

Now we turn to the heart of the discussion, which is “animating Mr. Market.” The question is: How does Mr. Market go from offering prices that are “plausible and justified” to offering prices that are “little short of silly?”

The answer, we believe, is that one or more of the conditions for the wisdom of crowds is violated and hence we go from the wisdom of crowds to the madness of crowds. Given that we are social beings, it is not surprising that the condition most likely to be violated is diversity. Rather than operating in a diverse fashion, we correlate our behaviors. And stock prices themselves contribute to the process of correlation.

There's a classic experiment in social psychology that explains this well. It was about social conformity and was conceived and conducted by the social psychologist Solomon Asch in the 1940s and 1950s. In one version of the experiment, Asch had eight people seated around a table. Seven of those “participants” were Asch's confederates who were in on the experiment. The eighth was the subject.

Asch showed the participants a reference line (X) and three additional lines (A, B, and C), one of which was the same length as X. The simple task was to identify which line—A, B, or C—was as long as X. They did this for 18 rounds. With no pressure to conform, the answers of the subjects were nearly flawless.

The experiment then started for real. Asch signaled his confederates to give the wrong answer. In these trials, more than one-third of the responses were wrong. Further, three out of the four subjects answered wrong at least once. Even subjects who initially resisted going with the group commonly ended up doing so for a round or more.²² It is also worth noting that about one-quarter of the subjects did remain independent.²³

In writing about the experiments, Asch wondered what was going through the minds of those who conformed.²⁴ He suggested three possible distortions. The first is judgment, where the subject knows the answer, feels conflict when others answer differently, and assumes the group knows better and so rejects his own answer. Second is action, which suggests that the subject knows the answer but feels more comfortable going with the group and being wrong than standing out and being right. As the renowned economist John Maynard Keynes wrote in chapter 12 of *The General Theory*, “Worldly wisdom teaches that it is better for the reputation to fail conventionally than to succeed unconventionally.”²⁵

The final distortion is perception, which suggests the group opinion actually alters how the subject perceives what is going on. Asch died in 1996, so he never had the chance to see which explanation is most likely.

Fast forward 50 years from the time Asch did his experiments to a functional magnetic resonance imaging (fMRI) lab on the campus of Emory University. Greg Berns, a professor of neuroscience, decided to replicate the Asch experiments while subjects were in the fMRI machine. This allowed Berns and his colleagues to peer into the brains of the subjects as they decided.²⁶

Berns selected a different task than that of Asch. He showed a pair of three-dimensional objects that were rotated. In roughly half the instances the object was the same and in the other half the object was a mirror image, hence different. Under control conditions, the subject selected the incorrect answer 14 percent of the time, indicating that the task was somewhat more difficult than matching lines. When the researchers introduced the answers of others, the error rate rose to 41 percent, but about a quarter of the subjects remained independent. Even though the task was different, the scientists successfully replicated Asch's basic findings.

Here's where things got interesting. Berns could not only see the results of the trials but could also observe what parts of the brain were active as the subjects decided. For distortions of judgment and action you would expect activity in the forebrain, whereas a distortion of perception would be in the posterior brain where your visual and perceptual regions reside.

It was the posterior brain that was active for those subjects who conformed. This suggests the group's opinion affected how the subject perceived the situation. As surprising, the researchers did not find a substantial change in activity in the frontal lobe, associated with higher level processing such as a distortion of action.

Now we have all either been in, or can relate to, situations where we allowed the decisions of others to influence us. In other words, we knew the right answer but chose differently. But in a survey following the experiments, only three percent of the subjects admitted to knowing the right answer and going with the majority anyway.

Berns summed up the experiment, "We like to think that seeing is believing," but seeing is believing what the group tells you to believe.²⁷

There's another element of the experiment worth mentioning, and that is what happened inside the brains of those who remained independent. Those subjects experienced increased activity in the amygdala, the part of your brain that cues for immediate action. Fear is a powerful trigger for the amygdala, and it's behind the fight-or-flight response. So while those who stayed independent deserve our admiration, it is important to know that they had to overcome an unpleasant sense to do so.

Throughout chapter 8, Graham stresses the importance of thinking for yourself. Don't get caught up in the notion that the stock market's gyrations are telling you something. Use Mr. Market's prices for information but don't be influenced by them. The experiments by Asch and Berns tell us that this is hard to do.

Diversity breakdowns are crucial to pushing Mr. Market from healthy to manic or depressed. And herein is the critical point: **The very factor that causes market inefficiency—correlated beliefs—makes exploiting that inefficiency difficult.** The desire to be part of the crowd is powerful, and being apart from the crowd is scary for most.

But there's another essential element worth stressing, which is that the loss in diversity and the movement in asset prices have a non-linear relationship. In other words, you can lose diversity for a while and nothing happens. But then there's a sudden shift and you can get big, unexpected changes.

Let's start with a physical example, the Millennium Bridge in London. The Millennium Bridge was the first footbridge built over the River Thames in over a century, and connects St Paul's Cathedral on the north with the Tate Modern and the Globe Theatre on the south. The bridge was designed by the famous architect, Norman Foster, and built by the reputable engineering firm, Arup.

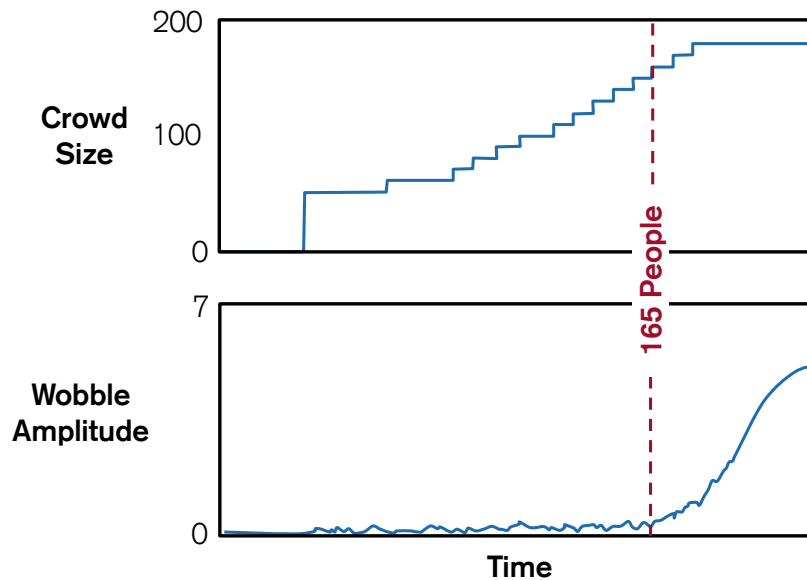
The bridge officially opened at lunchtime on June 10, 2000. Within a few moments, it started swaying from side to side. This is a major problem in the bridge business. If you watch the video of the people crossing the bridge on that day, it looks like a bunch of penguins inching along.²⁸ The bridge closed immediately, to the embarrassment of all involved.

What happened? Naturally, bridge makers know about vertical force and accommodate it in their design. But when you walk you also generate a bit of lateral force. In general, bridges are stiff enough to deal with that and when people walk, the forces tend to cancel out.

But the Millennium Bridge had insufficient lateral dampeners. So once the bridge started to sway, the pedestrians widened their gait to maintain stability. This led them to synchronize their steps, which further amplified the effect.

The essential part of the story for our purpose is that the swaying only happened beyond a certain threshold of pedestrians. As exhibit 5 shows, there is little swaying up to 165 pedestrians. But above 165, and the action kicks in. A small incremental change leads to a large-scale effect.²⁹

Exhibit 5: The Millennium Bridge Wobbled with More Than 165 People

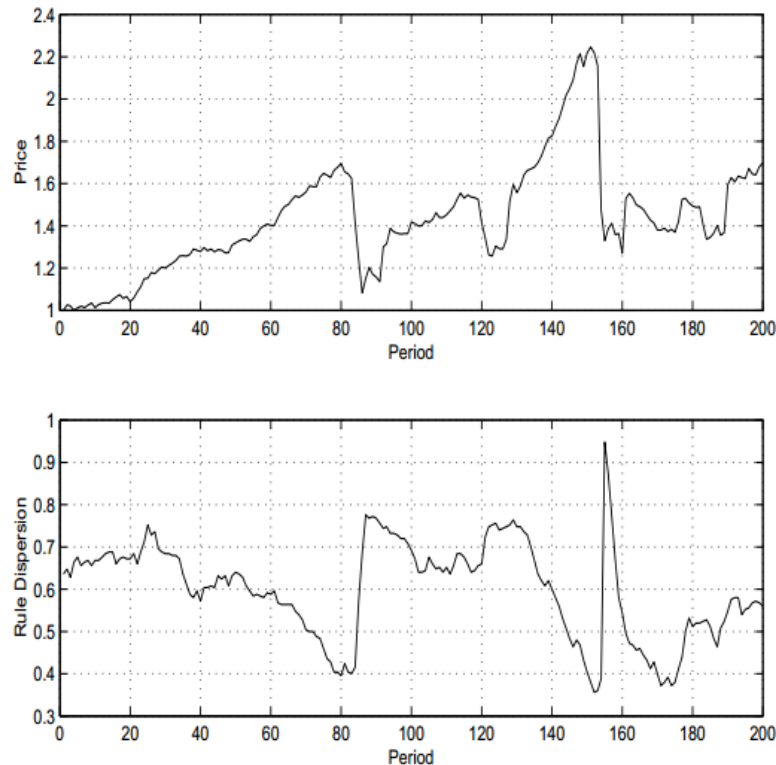


Source: Based on Steven H. Strogatz, Daniel M. Abrams, Allan McRobie, Bruno Eckhardt, and Edward Ott, "Theoretical Mechanics: Crowd Synchrony on the Millennium Bridge," *Nature*, Vol. 438, November 3, 2005.

Note: Wobble amplitude in centimeters.

We believe the same thing is true in markets.³⁰ It's hard to have a clear measure of diversity in real time, but we see these nonlinearities clearly in agent-based models. Blake LeBaron, an economist at Brandeis University, developed such a model.³¹ LeBaron's world has 1,000 agents who trade a stock, know portfolio theory, and use various trading rules. The value of the stock is determined by future dividends, and LeBaron based the numbers on historical results. LeBaron is able to replicate many of the features we see in real markets, including clustered volatility and fat tails. Exhibit 6 shows the results.

Exhibit 6: Agent-Based Model Shows Non-Linear Relationship between Diversity and Price



Source: Blake LeBaron, "Financial Market Efficiency in a Coevolutionary Environment," Proceedings of the Workshop on Simulation of Social Agents: Architectures and Institutions, Argonne National Laboratory and University of Chicago, October 2000, Argonne 2001, 33-51.

For the purpose of our discussion, you can focus on the first 80 periods on the left of the exhibit. On the top you see the stock price, which is in steady ascent. On the bottom you see a measure of diversity. What you can observe is that diversity is dropping even as the stock price rises. This is a crowded trade. Everyone is doing the same thing and making money doing it.

The stock price then drops precipitously as there are no more buyers to bid the stock higher. At the same time, diversity increases in the population and restores some health.

Before we move to the final part of this discussion, let's review the main points:

1. The concept of diversity is essential to animating Mr. Market. When we have diversity we tend to have efficient markets, and Mr. Market's idea of value is plausible. When we lose diversity, the wisdom of crowds flips to the madness of crowds. Mr. Market becomes manic or depressed and prices depart from value.
2. The loss of diversity is not linearly related to asset prices. As diversity declines, the fragility of the market increases but everything seems fine. In fact, it seems better than fine because market participants are generally making money and sometimes even encouraged to use debt to enhance their returns.
3. When nearly everyone adopts a point of view, whether it's bullish or bearish, the psychological pull to conform is powerful. This is the main lesson from the Asch experiment. And when that psychological pull is led by stock prices, Mr. Market is no longer informing you, he is influencing you. You have come under his sway.

These points lead to what may be the most important paragraph in chapter 8. Graham writes:

The true investor scarcely ever *is forced to sell* his shares, and at all other times he is free to disregard the current price quotation. He need pay attention to it and act upon it only to the extent that it suits his book, and no more. Thus the investor who permits himself to be stampeded or unduly worried by unjustified market declines is perversely transforming his basic advantage into a basic disadvantage. That man would be better off if there were no market quotation at all, for he would be spared the mental anguish caused him by *other persons'* mistakes of judgment.

Solomon Asch meets the stock market.

Contrarian Streak + a Calculator

Now let us turn to the final part of the discussion, which is how to use Mr. Market to your benefit. And we don't think you can do better than a line that Seth Klarman, founder of The Baupost Group, shared in 2008: "Value investing is at its core the marriage of a contrarian streak and a calculator."³²

There are two parts to this message, as we interpret it. The first is to be a contrarian. This is fully consistent with everything we have been discussing. As Warren Buffett has said, "Be fearful when others are greedy, and be greedy when others are fearful."³³

However, being a contrarian for the sake of being a contrarian is a bad idea because the consensus *is* right sometimes. When the movie house catches on fire, you should by all means run *out* the door. Positive feedback changes the state, and sometimes the state needs to be changed for advancement or safety.

So the second part of the message is equally crucial. The calculator allows you to assess whether the expectations, as reflected in the price, are out of sync with the fundamentals, a reasonable sense of a company's future financial results.

Klarman grew up near the Pimlico horse race track in Baltimore, Maryland, and spent a lot of time there as a kid. Horse racing is a useful metaphor to make the point about expectations and fundamentals.

In the U.S., winning the Triple Crown puts a horse in the pantheon of racing. It's difficult to do because it entails three races (Kentucky Derby, Preakness Stakes, Belmont Stakes), over three different distances (1.25, 1.1875, and 1.5 miles) all in just five weeks. In the summer of 2014, a beautiful colt named California Chrome came along. He had won 6 of the 10 races he had run prior to the Kentucky Derby and had won 4 in a row leading up to the first leg.

California Chrome won the Kentucky Derby by 1 $\frac{3}{4}$ lengths and went on to win the Preakness by 1 $\frac{1}{2}$ lengths. This put him just one win away from horse racing immortality.

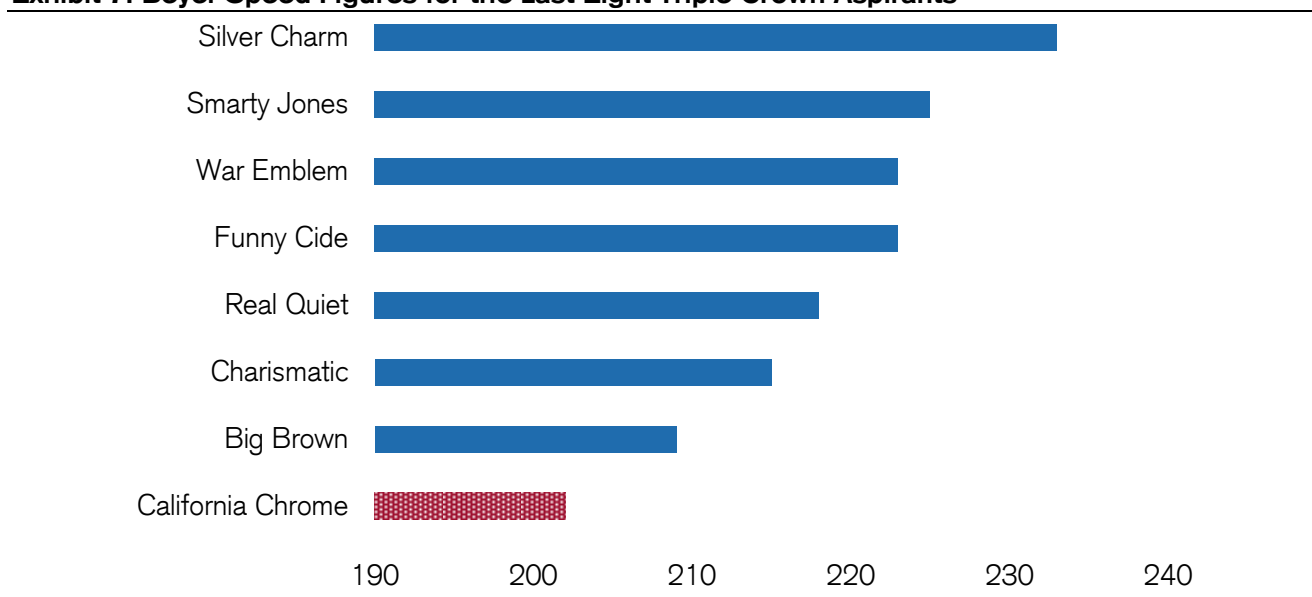
In this case, Mr. Market is the collection of pari-mutuel bettors. Triple Crown contenders are like shiny, sexy growth stocks. Everyone wants to bet on them. Naturally, the horse's handlers were also very bullish on his prospects and were not afraid to share their views with the public. The handicappers were bullish as well, as California Chrome went off at 3-to-5 odds. Those odds suggest a 62.5 percent chance of winning the race.

As a value investor unaffected by the price, you would want to understand whether that probability was a fair representation of the horse's prospects. In other words, would the fundamentals live up to the expectations? There are a couple of ways to look at this.

First is the base rate of success. Since 1875 there have been 30 horses in a position to win the Triple Crown, but only 11 achieved the feat. That's a 37 percent success rate. But there was a marked difference before and after 1950: Before 1950, 8 of the 9 horses that tried were victorious, close to a 90 percent rate. But after 1950 only 3 of 21 won, less than a 15 percent success rate, and none have succeeded since Affirmed did so in 1978. So the 62.5 percent probability sounds a bit rich based on the last 65 years of results.

A reasonable thought is that California Chrome's speed justified his odds. There is a way we can measure that. It's called a Beyer Speed Figure and measures a horse's performance adjusted for track conditions. The details are not important; all you really need to know is higher speed figures equal faster horses. Exhibit 7 shows the last eight Triple Crown aspirants, including California Chrome, and you can see that he's the slowest of the lot.³⁴

Exhibit 7: Beyer Speed Figures for the Last Eight Triple Crown Aspirants



Source: Steven Crist; www.drf.com.

So we now have two fundamental indicators. We have a base rate of low success and a horse that is not particularly fast trying to achieve the feat. In this case, Mr. Market is much too optimistic and you should sell. Indeed, California Chrome finished in 4th place in the Belmont Stakes, disappointing more than 100,000 fans who came to see history made.

It turns out that overinflated odds are common with Triple Crown contenders. Exhibit 8 shows the same eight horses along with their implied probability of winning and their actual finish. Almost all of these horses were among the favorites, but their odds were consistently too optimistic.

Exhibit 8: Probability and Results for Last Eight Triple Crown Aspirants

<u>Probability</u>		<u>Finish</u>	
Silver Charm	50%		2 nd
Real Quiet	56		2 nd
Charismatic	38		3 rd
War Emblem	45  //		8 th
Funny Cide	50 		3 rd
Smarty Jones	71		2 nd
Big Brown	77  *		Last
California Chrome	63		4 th

Source: Barry Bearak, "12 Contenders Who Just Missed Out on a Triple Crown," New York Times, June 6, 2014; belmontstakes.org; Credit Suisse.
 Note: // = Not to scale (finished 19 ½ lengths behind winner); * = Eased.

In this case, the contrarian streak would say "examine betting against the favorite" and the calculator would tell you that the odds overstate the probability of winning.

Horse racing is much simpler than investing because the expectations are explicit and the race reveals the winner. In the stock market, you have to reverse-engineer expectations from stock prices and the market is essentially perpetual. But the mindset remains the same.

To use another metaphor, expectations are where the bar is set for the high jumper, and fundamentals are how high the company can jump. Value investors seek expectations mismatches. Because Mr. Market is erratic in where he sets the bar, opportunities tend to come and go.

Perhaps the single most important question an investor can ask is: "What's priced in?" From there, the issue becomes whether a company's financial results will meet, exceed, or come up shy of what's in the price.

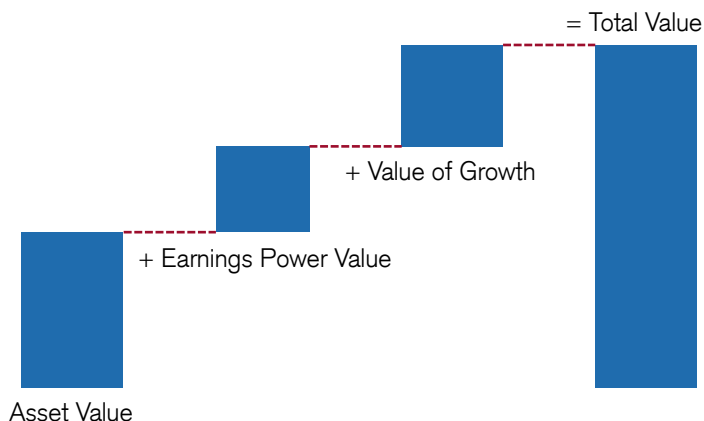
While there may be differences in practice, almost all value investors accept the idea that the value of a financial asset is the present value of future free cash flow. Bruce Greenwald, a professor of finance at Columbia Business School, has laid out a way to think about value that is useful and practical. You can also tie it back to some of the seminal work in valuation.

Here's the basic idea. You start your valuation process with a careful calculation of asset value. This is what the assets are actually worth, net of the appropriate liabilities. You can think of this as the bedrock of value. Most stocks trade at a price above this value.

Next is earnings power, which reflects the normalized earnings of the company capitalized by the cost of capital. This value assumes the level of current earnings, adjusted for unusual items, is sustainable.

The final piece, and the one that demands the most skepticism, is the value of growth, or more accurately, future value creation.³⁵ Exhibit 9 shows these three components of value.

Exhibit 9: The Components of Value



Source: Bruce C.N. Greenwald, Judd Kahn, Paul D. Sonkin, and Michael van Biema, *Value Investing: From Graham to Buffett and Beyond* (New York: John Wiley & Sons, 2001), 35-43.

If you read one of the foundational papers on valuation, that of Merton Miller and Franco Modigliani from 1961, you will see that they suggest the value of a firm is a steady-state value plus the present value of growth opportunities. Miller and Modigliani suggest that this approach “has a number of revealing features and deserves to be more widely used in discussions of valuation.” This matches quite closely with the model that Greenwald has advocated for over the years.³⁶

Conclusion

Here’s a summary of this discussion. First, reading chapters 8 and 20 from *The Intelligent Investor*, as well as chapter 12 from Keynes’s *General Theory*, can help shape the proper attitude an investor should have toward markets.

The other main points are as follows:

- To be an active investor, you must believe both Eugene Fama and Robert Shiller are correct, just not at the same time. You need inefficiency to get opportunities and efficiency for those opportunities to turn into returns.
- Mr. Market remains a very powerful metaphor for thinking about markets. Anthropomorphizing the market makes the story less abstract and more concrete.
- One way to animate Mr. Market is to understand the market as a complex adaptive system, or to apply the wisdom of crowds. What’s key is that crowds are wise under some conditions and mad when any of those conditions are violated.
- Diversity breakdowns, which can happen for sociological as well as technical reasons, lead to extremes and hence opportunity.
- Remember the line from Seth Klarman: You are looking for cases where uniform belief has led to a mispricing of expectations and thus a way to make money. The Triple Crown contenders show this vividly.

The preceding is based on a presentation at the Columbia Student Investment Management Association Conference delivered on January 30, 2015.

Endnotes

¹ Quoted from an interview with one of Ben Graham's students, Marshall Weinberg, in the video "The Legacy of Ben Graham," produced by the Heilbrunn Center for Graham and Dodd Investing. See <https://www.youtube.com/watch?v=m1WLoNEqkV4>. Graham was quoting Spinoza's *Ethics*, published in 1677. The phrase, in Latin, is "sub specie aeternitatis" and is generally taken to mean "what is universally and eternally true."

² See <http://www.businesswire.com/news/home/20111115006090/en/Warren-Buffett-Remarks-European-Debt-Crisis-%E2%80%9CBuffett#.VM-dOCyJLd4>. Buffett said, "If you understand chapters 8 and 20 of *The Intelligent Investor* (Benjamin Graham, 1949) and chapter 12 of the *General Theory* (John Maynard Keynes, 1936), you don't need to read anything else and you can turn off your TV."

³ Distinguishing between investors and speculators is tricky. In *Security Analysis*, Graham and Dodd suggested that, "An investment operation is one which, upon thorough analysis, promises safety of principal and a satisfactory return. Operations not meeting these requirements are speculative." See Benjamin Graham and David L. Dodd, *Security Analysis* (New York: McGraw-Hill, 1934). But as Jason Zweig, a journalist at the *Wall Street Journal* demonstrates, this definition is lacking. See

<http://blogs.wsj.com/totalreturn/2013/02/28/are-you-an-investor-or-a-speculator-part-one/> and <http://blogs.wsj.com/totalreturn/2013/02/28/are-you-an-investor-or-a-speculator-part-two/>.

⁴ See <http://edge.org/conversation/how-to-win-at-forecasting>.

⁵ Warren E. Buffett, "Letter to Shareholders," *Berkshire Hathaway Annual Report, 1987*. See www.berkshirehathaway.com/letters/1987.html.

⁶ In an exchange with some investors, Jason Zweig, a journalist with the *Wall Street Journal*, wrote the following about this famous phrase: "I called Warren Buffett and asked him. He, who knows Graham's writings better than anyone else alive, was surprised when I walked him through the same two passages you cited. He had presumed, like many of us, that Graham had written these words. After a few minutes of thinking it through aloud, he realized that he might never have read the maxim after all, but rather that he had heard Graham say these words many times in class and around the office. Even if Graham never wrote them down in canonical form, he stated this view many times to those who were closest to him.

In its most commonly cited form, I think the short-run-voting-machine-long-run-weighing-machine apothegm comes from Buffett, not Graham. In one of the Berkshire Hathaway annual reports (1987? I don't remember which one, to be honest), Buffett attributes the maxim to Graham, in quotation marks. That's the closest to their original form that I believe anyone will find them in. The only other possibility is that one of Graham's students captured these words in some of the lecture notes that are preserved from Graham's value-investing classes from the early 1930s. I haven't read through them all to see if this saying can be found there. But I don't think it's likely. I regard Warren Buffett as an unimpeachable source in this case and, in my opinion, the case is closed: Graham said it, even if he never wrote it."

See <http://www.bogleheads.org/forum/viewtopic.php?t=77840>.

⁷ Josef Lakonishok, Andrei Shleifer, and Robert Vishny, "Contrarian Investment, Extrapolation, and Risk," *Journal of Finance*, Vol. 49, No. 5, December 1994, 1541-1578; Chi F. Ling and Simon G. M. Koo, "On Value Premium, Part II: The Explanations," *Journal of Mathematical Finance*, Vol. 2, No. 1, February 2012, 66-74.

⁸ Andrei Shleifer, *Inefficient Markets: An Introduction to Behavioral Finance* (Oxford, UK: Oxford University Press, 2000).

⁹ Mark Rubinstein, "Rational Markets: Yes or No? The Affirmative Case," *Financial Analysts Journal*, Vol. 57, No. 3, May/June 2001, 15-29.

¹⁰ Jens Carsten Jackwerth and Mark Rubinstein, "Recovering Probability Distributions from Option Prices," *Journal of Finance*, Vol. 51, No. 5, December 1996, 1611-1631. Astute (and probably older) readers will make some connections here. First, Rubinstein was a principal at a firm called Leland O'Brien Rubinstein Associates, Incorporated that provided portfolio insurance in the 1980s. Some have argued that portfolio

insurance exacerbated the crash of 1987. Second, Rubinstein documented how unlikely a crash would be under standard theory. And finally, Rubinstein took up the case for rational markets.

¹¹ Peter J. Tanous, *Investment Gurus: A Road Map to Wealth from the World's Best Money Managers* (New York: New York Institute of Finance, 1997), 174.

¹² Steven A. Ross, "Neoclassical Finance, Alternative Finance, and the Closed End Fund Puzzle," *European Financial Management*, Vol. 8, No. 2, June 2002, 129-137.

¹³ Andrei Shleifer and Robert W. Vishny, "The Limits to Arbitrage," *Journal of Finance*, Vol. 52, No. 1, March 1997, 35-55.

¹⁴ Jack L. Treynor, "Market Efficiency and the Bean Jar Experiment," *Financial Analysts Journal*, Vol. 43, No. 3, May/June 1987, 50-53.

¹⁵ Donald MacKenzie, *An Engine, Not a Camera: How Financial Models Shape Markets* (Cambridge, MA: MIT Press, 2006), 211-242.

¹⁶ Donald MacKenzie, "Models of Markets: Finance Theory and the Historical Sociology of Arbitrage," *Revue d'histoire des Sciences*, Vol. 57, No. 2, 2004, 407-431.

¹⁷ James Surowiecki, *The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies, and Nations* (New York: Doubleday, 2004).

¹⁸ John H. Miller and Scott E. Page, *Complex Adaptive Systems: An Introduction to Computational Models of Social Life* (Princeton, NJ: Princeton University Press, 2007).

¹⁹ Scott E. Page, *The Difference: How the Power of Diversity Creates Better Groups, Firms, Schools, and Societies* (Princeton, NJ: Princeton University Press, 2007), 208.

²⁰ Marshall K. Gramm and Douglas H. Owens, "Efficiency in Parimutuel Betting Markets Across Wagering Pools in the Simulcast Era," *Southern Economic Journal*, Vol. 72, No. 4, April 2006, 926-937.

²¹ "The Legacy of Ben Graham" at <https://www.youtube.com/watch?v=m1WLoNEqkV4>.

²² Solomon E. Asch, "Opinions and Social Pressure," *Scientific American*, Vol. 193, No. 5, November 1955, 31-35.

²³ Here's a side story for endnote readers. Asch ran some of these experiments when he was a professor at Swarthmore College, and recruited students from nearby Haverford College to participate as well. One of those students was Jack Treynor, who was studying mathematics. Treynor recalls having no problem remaining independent.

²⁴ S.E. Asch, "Effects of Group Pressure Upon the Modification and Distortion of Judgments," in Harold Guetzkow (ed.), *Groups, Leadership and Men* (Pittsburgh, PA: Carnegie Press, 1951), 177-190.

²⁵ John Maynard Keynes, *The General Theory of Employment, Interest, and Money* (New York: Harcourt, Brace and Company, 1936).

²⁶ Gregory S. Berns, Jonathan Chappelow, Caroline F. Zink, Giuseppe Pagnoni, Megan E. Martin-Skurski, and Jim Richards, "Neurobiological Correlates of Social Conformity and Independence During Mental Rotation," *Biological Psychiatry*, Vol. 58, No. 3, August 2005, 245-253.

²⁷ Sandra Blakeslee, "What Other People Say May Change What You See," *New York Times*, June 28, 2005.

²⁸ See https://www.youtube.com/watch?v=eAXVa_XWZ8.

²⁹ Steven H. Strogatz, Daniel M. Abrams, Allan McRobie, Bruno Eckhardt, and Edward Ott, "Theoretical Mechanics: Crowd Synchrony on the Millennium Bridge," *Nature*, Vol. 438, November 3, 2005.

³⁰ For example, see Momtchil Pojarliev, CFA, and Richard M. Levich, "Detecting Crowded Trades in Currency Funds," *Financial Analysts Journal*, Vol. 67, No. 1, January/February 2011, 26-39.

³¹ Blake LeBaron, "Financial Market Efficiency in a Coevolutionary Environment," *Proceedings of the Workshop on Simulation of Social Agents: Architectures and Institutions, Argonne National Laboratory and University of Chicago*, October 2000, Argonne 2001, 33-51.

³² From Seth Klarman's speech at Columbia Business School on October 2, 2008. Reproduced in *Outstanding Investor Digest*, Vol. 22, Nos. 1 & 2, March 17, 2009, 3.

³³ Warren E. Buffett, "Buy American. I Am." *New York Times*, October 16, 2008.

³⁴ This analysis comes from Steven Crist, who wrote about Triple Crown contenders in his blog, *Cristblog with Steve Crist*. His first entry was "Triple Crown Bids" (May 19, 2008) and the second, "Triple Crown Figs," (May 21, 2008). We updated the results to include Big Brown and California Chrome. Crist contributed a chapter to the book, "Bet with the Best," that may be worthy of the three chapters mentioned by Buffett. It's called "Crist on Value," and very clearly spells out the distinction between price and value.

³⁵ Bruce C.N. Greenwald, Judd Kahn, Paul D. Sonkin, and Michael van Biema, *Value Investing: From Graham to Buffett and Beyond* (New York: John Wiley & Sons, 2001), 35-43.

³⁶ Merton H. Miller and Franco Modigliani, "Dividend Policy, Growth, and the Valuation of Shares," *Journal of Business*, Vol. 34, No. 4, October 1961, 411-433.

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Min(d)ing the Opportunity

Excess Returns Require the Chance to Apply Skill

March 17, 2015

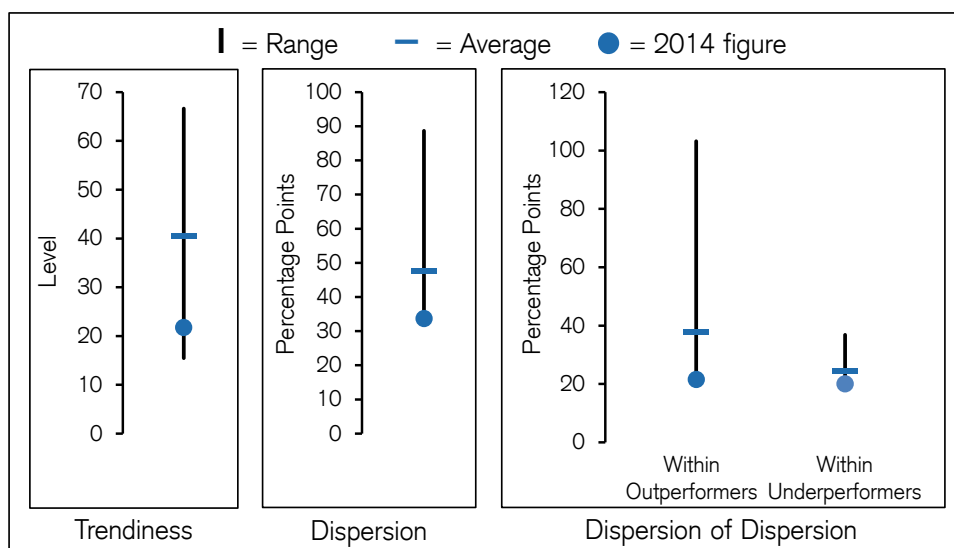
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“Ability is nothing without opportunity.”

Napoleon¹

- The fundamental law of active management separates the sources of excess return into two parts: skill and opportunity.
- While the investment industry is in constant pursuit of skill, having lots of skill doesn't pay off if opportunity is poor, and modest skill can yield attractive results if opportunity is rich.
- We examine three ways that investors can express skill: market timing, security selection, and portfolio construction.
- There is a strong correlation between years when active managers do well, measured as the percentage that beat their benchmark, and the relative performance of small versus large capitalization stocks. This reflects exposure to the factor “Small Minus Big.”
- Measures of opportunity show that 2014 was a particularly challenging year. For example, the dispersion of stock returns was unusually narrow, creating a very inhospitable environment for active managers.
- Pockets of inefficiency always exist in markets and investors should be explicit in seeking them.

Introduction

In the quest for market-beating returns, investors seek money managers who are skillful. But what if skill isn't the only key to success?

More than 25 years ago, Richard Grinold, the former global director of research at Barclays Global Investors, developed what he called "the fundamental law of active management."²

$$IR = IC * \sqrt{BR}$$

In words, it says that the information ratio equals the information coefficient times the square root of breadth.³ If you are not a quant, don't worry, there's an even simpler way to convey the law:

$$\text{Excess returns} = \text{skill} * \text{opportunity}$$

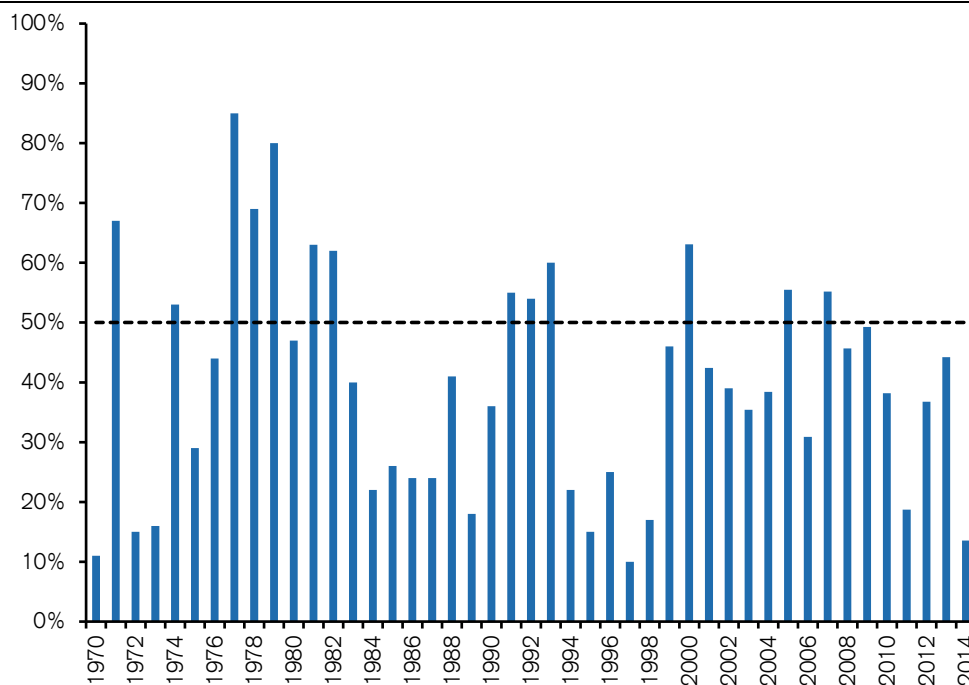
The point of this report is that all of the skill in the world is for naught if you don't have attractive opportunities. While the investment industry is focused on ways to ferret out skill, there is less discussion about where and how investors should apply their skill.

There are two basic conditions that present a challenge for skillful investors. The first is where the payoffs are potentially attractive but all of the competitors are very skillful. In this case, the skills of the players are offsetting and luck plays a large role in determining the outcome.⁴ For example, a good poker player who wants to make money should seek games with weaker players. Playing in highly competitive events may reveal prowess but is a tough way to make a living.

The second condition is when the payoffs are meager. You can be the most skillful person playing, but there's not much to play for. Consider the draft in sports, the primary way that professional sports leagues assign amateur players to its teams. In some years the draft is rich with great players. But in other years there is a dearth of talented players. You can have the most skillful scouting and draft strategy around but your skill won't pay off if the pool of players is poor.

In assessing the results of investment managers, it is useful to consider both skill and opportunity. In 2014, the opportunities were particularly limited, contributing to the relatively poor performance of active mutual fund and hedge fund managers.⁵

Exhibit 1 shows the percentage of equity mutual funds that have beat the S&P 500 Index in each year since 1970. The average rate of outperformance during this 45-year period was 40 percent (less than 50 percent because of fees), and the standard deviation was 19 percent. Only one in seven of U.S. large capitalization equity managers beat their benchmark in 2014.

Exhibit 1: Percentage of Equity Mutual Funds Beating the S&P 500, 1970-2014

Source: John C. Bogle (1970-1999) and "SPIVA® U.S. Scorecard: Year End 2014," S&P Dow Jones Indices Research (2000-2014).

Note: U.S. general equity funds (1970-1999) and U.S. large capitalization equity funds (2000-2014).

We now examine some measures of opportunity and briefly offer ideas about how to find attractive opportunities.

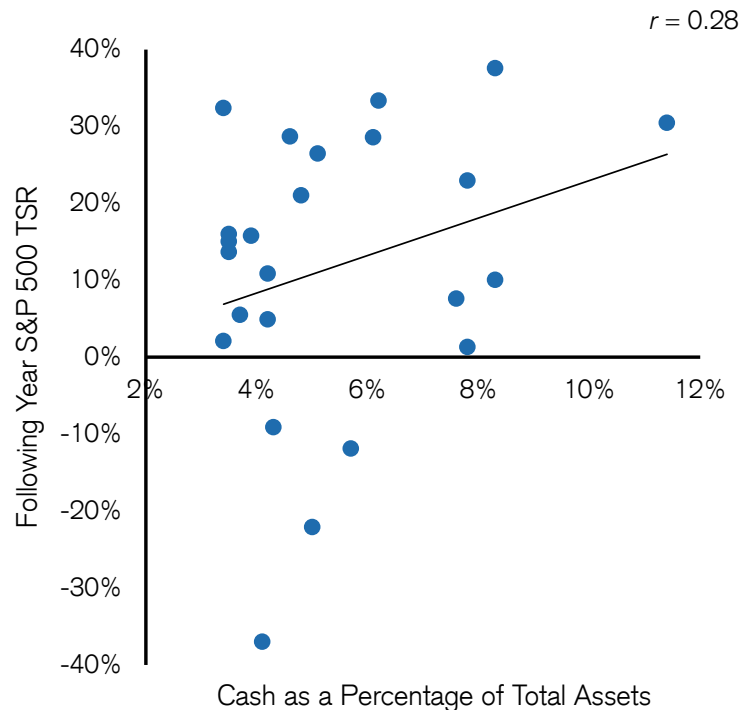
How Portfolio Managers Express Skill

There are three ways that a portfolio manager can express skill. The first is through market timing, the ability to buy low and sell high. The second is through security selection, a talent for identifying securities that generate returns that beat the market after adjusting for risk. The final way is through portfolio construction, the aptitude to make each holding the proper size so as to earn the highest excess returns possible for a given level of risk.

Market timing. There is little evidence that mutual fund and hedge fund managers can time the market. That said, it is hard to directly measure that ability. For mutual funds, a logical approach is to compare the level of cash as a percentage of assets to subsequent market returns.⁶ For hedge funds, we can examine the exposure to the market and future market moves.

The idea is when the market's valuation is high and hence the expected return on equities is low, mutual funds should hold substantial cash. And when the market is cheap, funds should deploy that available cash to buy bargains.

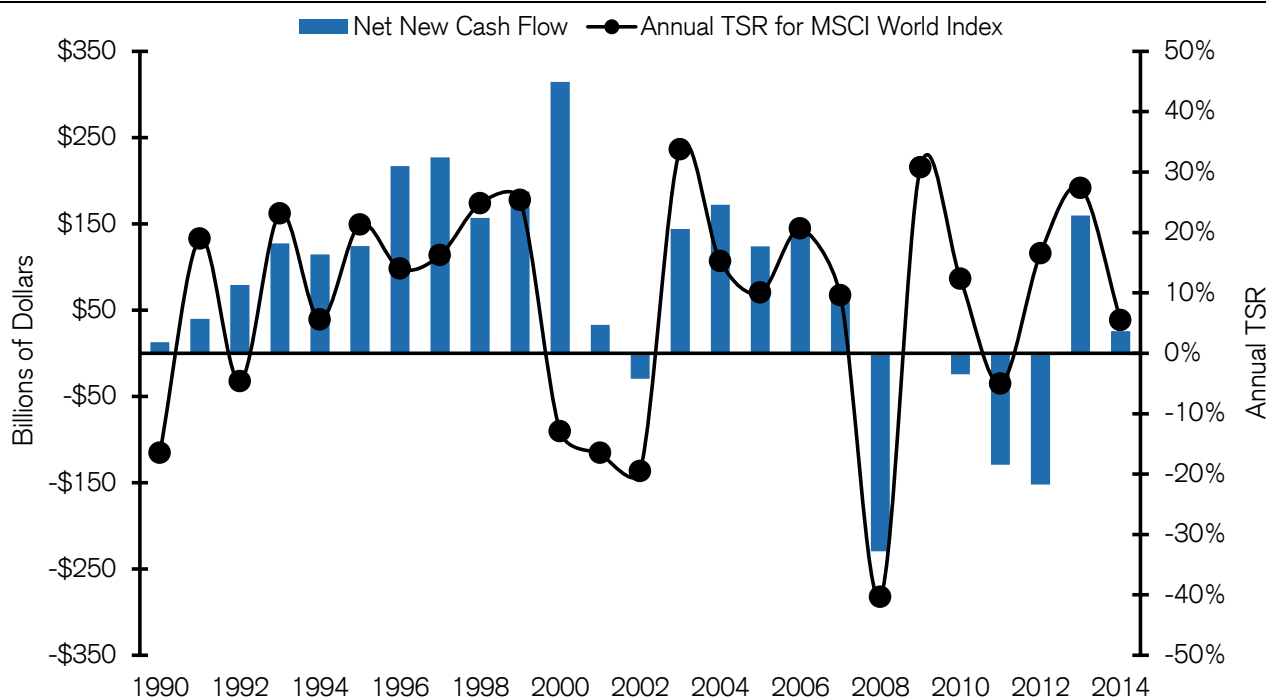
Exhibit 2 compares the average level of cash for equity mutual funds from 1990-2013 to the total shareholder return (TSR) for the S&P 500 in the subsequent year. Were mutual funds good at timing, you would expect to see high returns following periods of low cash balances, and low returns following high cash balances. We see the opposite pattern. One academic researcher studying the issue concluded that "equity funds as a whole do not have market timing skills."⁷

Exhibit 2: Mutual Fund Cash Balances and Total Shareholder Return for the S&P 500, 1990-2014

Source: Investment Company Institute and Credit Suisse.

Cash as a percentage of assets may not reveal an ability to time the market because factors other than a view of the market play a large part in determining cash holdings. For example, funds that hold small capitalization or volatile stocks tend to hold more cash than average to compensate for liquidity or to dampen risk.

Fund flows, the sum that investors add or withdraw from mutual funds, also have a large impact on the levels of cash. Fund flows are highly correlated with the results of the market. Exhibit 3 shows that investors tend to withdraw funds in down markets and add funds in up markets. As a result, high cash balances may simply reflect substantial flows. For instance, funds that anticipate outflows keep cash balances high to accommodate the expected requests, and funds receiving inflows invest the cash with a lag.

Exhibit 3: Buy High and Sell Low: Mutual Fund Flows and Market Returns, 1990-2014

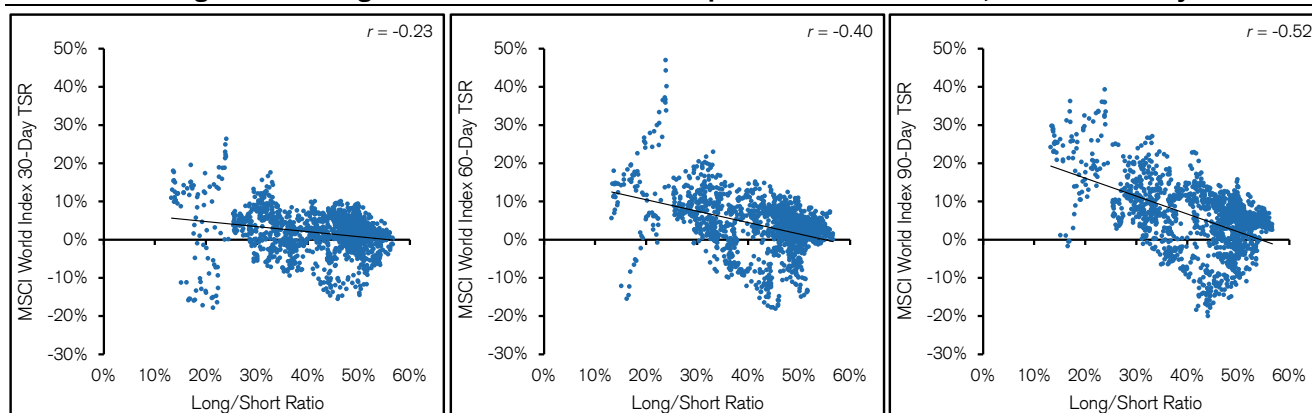
Source: Investment Company Institute.

The average cash balance was 5.4 percent from 1990-2014, and was 3.6 percent at the end of 2014. The median cash balance was closer to 3.5 percent for the full period, suggesting that the distribution is substantially skewed. Since index funds are basically fully invested and the market tends to go up over time, holding cash creates a modest performance drag for active managers.⁸

The results for equity hedge funds that use a long-short strategy are no more encouraging. These funds go long stocks (own them) and simultaneously go short stocks (sell them for repurchase in the future). One measure of a fund's exposure to the market is the long/short ratio, which is the total long exposure divided by the short exposure. For example, a fund that is long \$400 million in equities and short \$285 million will have a long/short ratio of 1.4. We translate the ratio into a percentage by subtracting one. So in this case, the long/short ratio is 40 percent.⁹

The long/short ratio reflects how much the market will influence a fund's results. If hedge funds are good at market timing, a low long/short ratio should precede poor returns and a high long/short ratio should foreshadow stronger markets.

Exhibit 4 shows the long/short ratio (five-day moving average) of global long-short equity hedge funds and the TSR for the MSCI World Index for the subsequent 30, 60, and 90 trading days. These data are from January 2009 through February 2015 and represent more than 1,500 data points. None of the correlations are very strong, and for each period the relationship is the opposite of what you would expect if the managers were skillful at timing.

Exhibit 4: Hedge Fund Long/Short Ratios and Subsequent Market Returns, 2009-February 2015

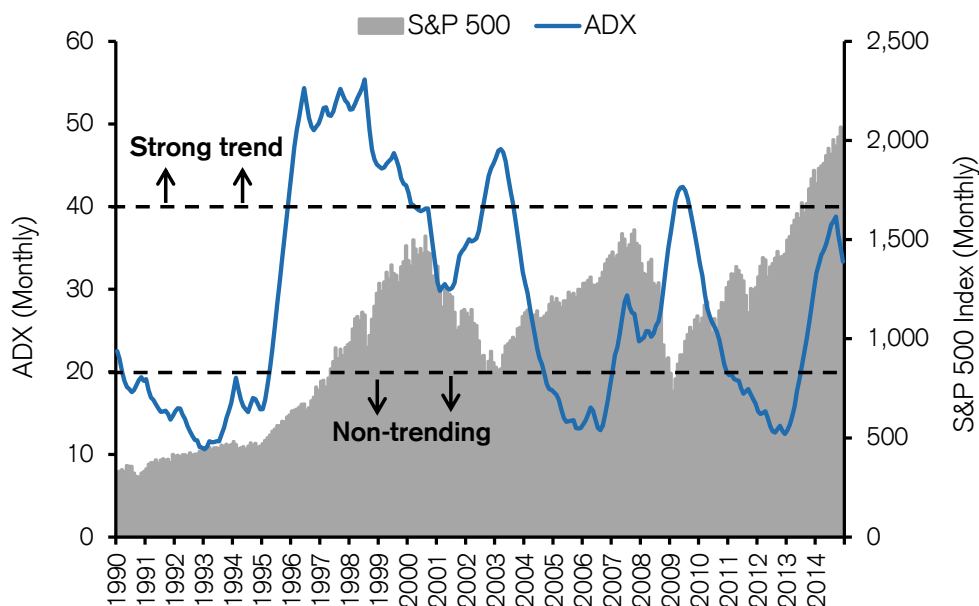
Source: Credit Suisse.

There is limited evidence that investors have skill in timing the market or that rules exist allowing one to do so.¹⁰ But some evidence does exist. For instance, there is research that shows that equity funds with above-average levels of cash outperform the funds with below-average levels of cash as the result of superior stock picking.¹¹ Further, some fund managers appear to have the ability to pick stocks in good economic environments and time effectively when recessions strike.¹²

The opportunity to time the market is to some degree related to how much the market moves in trends. Think of it this way: If stocks go higher in a zigzag pattern, it is very difficult to move in and out successfully and outwit the market. On the other hand, it's a lot easier to make money if stocks move in a long upward or downward trend.

One measure of the market's trendiness is the average directional movement index, or ADX.¹³ The ADX does not specify direction, only trend strength. The index has a range from 0 to 100. Readings below 20 indicate trend weakness, and readings above 40 indicate a strong trend.

Exhibit 5 shows monthly ADX readings for the S&P 500 from 1990 through 2014 along with the index's price. Note the very strong trends in the late 1990s, coming out of the bear market in the early 2000s, and for a brief period during the financial crisis in 2008-2009. Non-trending markets have characterized most of the rally following the financial crisis, making timing a challenge.

Exhibit 5: Monthly Average Directional Movement Index (ADX) and S&P 500 Price, 1990-2014

Source: Credit Suisse.

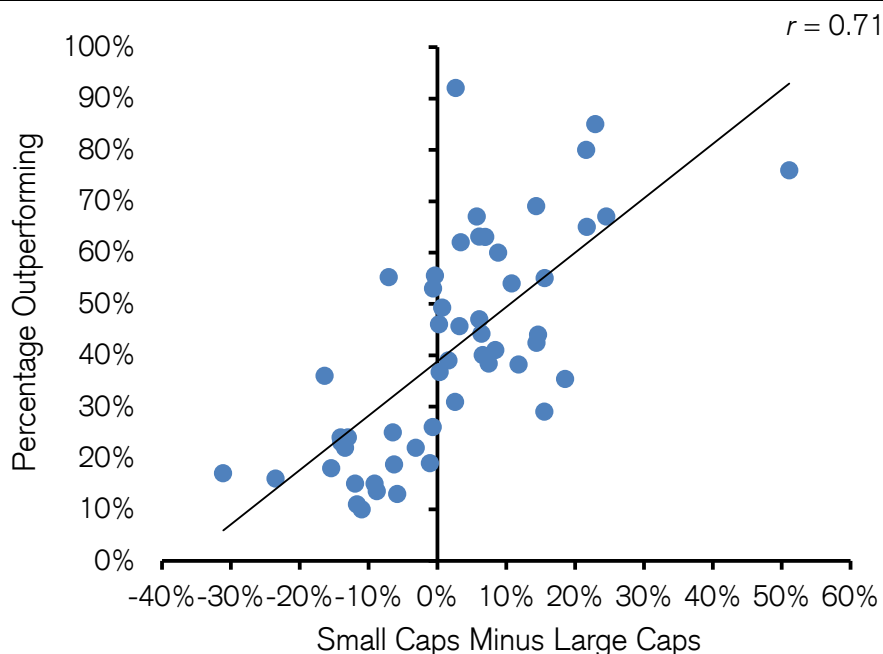
While some fund managers may have skill in market timing, that skill is not pervasive. George Soros, chairman of Soros Fund Management, used his theory of reflexivity to time markets and skillfully generate excess returns.¹⁴ But without some trendiness in the market, opportunity is limited.

Security Selection. Fund managers can show skill by selecting stocks that outperform the benchmark index. Before we turn to the topic of measuring opportunity with regard to security selection, here's a quiz: Measured as the percentage of funds that beat the market, which decades—of the 1970s, 1980s, 1990s, and 2000s—were the two best and the two worst for active management?

The best decades were the 1970s and 2000s. In the 1970s, 47 percent of active funds beat the market and in the 2000s, 45 percent did so. The worst decades were the 1990s, with 34 percent beating the benchmark, and the 1980s at 37 percent. Many investors get the answer wrong because the 1980s and 1990s were good decades for the market overall, whereas the 1970s and 2000s were poor. What's going on?

The explanation is that funds using the S&P 500 as a benchmark generally hold stocks with an average market capitalization that is less than that of the benchmark.¹⁵ Exhibit 6 shows the relationship between the difference in small and large capitalization results (x-axis) and the percentage of funds that beat the benchmark (y-axis) from 1963 through 2014. When large capitalization stocks outperform small capitalization stocks, as they did in the 1980s and 1990s, active managers do relatively poorly. In contrast, when small caps beat large caps, active management does well.

In other words, part of the explanation for mutual fund results is that portfolio managers own more small cap stocks than the index does, and over time small cap stocks have earned higher returns than large cap stocks have.¹⁶

Exhibit 6: Small Minus Large Cap Stocks and Percentage of Funds Beating the Market, 1963-2014

Source: Credit Suisse.

Note: Small Minus Big Fama/French Factor (1963-1979) and Russell 2000 TSR minus S&P 500 TSR (1980-2014).

Another way to look at opportunity for stock selection is market diversity, a measure of the distribution of market capitalizations in an index. If a large percentage of the market capitalization is in a handful of stocks, the diversity of the index is low. If the capitalizations are spread evenly, diversity is high.

Research shows that changes in market diversity correlate highly with the relative returns for large capitalization investment strategies. For example, 58 stocks represented 50 percent of the market capitalization of the S&P 500 at year-end 1995 versus just 33 stocks at the peak of the market in March 2000. Consistent with the notion that falling diversity creates a headwind for active managers, the late 1990s were a very trying period for the relative results of active managers.¹⁷ Diversity rebounded through 2005, with 54 stocks making up half the market, and active management fared relatively well.¹⁸

Dispersion is the main way to measure how much skill a portfolio manager can reveal through stock selection. Stated simply, dispersion captures the range of returns for a given group of stocks. The link between dispersion and opportunity is intuitive. Say you are examining 20 stocks. During the year the average return for the group is 10 percent, with the best stock up 12 percent, the worst stock down 8 percent, and the rest with returns in between. Call this the boring group. It is hard to build a portfolio that does much better than that collective group of stocks.

Now imagine 20 stocks where the best one doubles, the worst one goes to zero, and the others fall in between those extremes. The average return is also 10 percent. Call this the exciting group. The exciting group has the same average return as the boring group, but it's easy to see that stock selection is going to be a lot more important.

Here's one way to measure dispersion.¹⁹ Start with the median return for the stocks within the index for a given year. For the S&P 500 in 2014, that number was 15.6 percent. You then calculate the average total shareholder returns (TSR) of the top half, which was 32.1 percent, and the average return for the bottom half,

which was -1.6 percent. The difference between the two, 33.7 percentage points (32.1 minus -1.6), is a measure of dispersion. Dispersion is similar to the standard deviation of returns within the index. Exhibit 7 summarizes the figures for 2014.

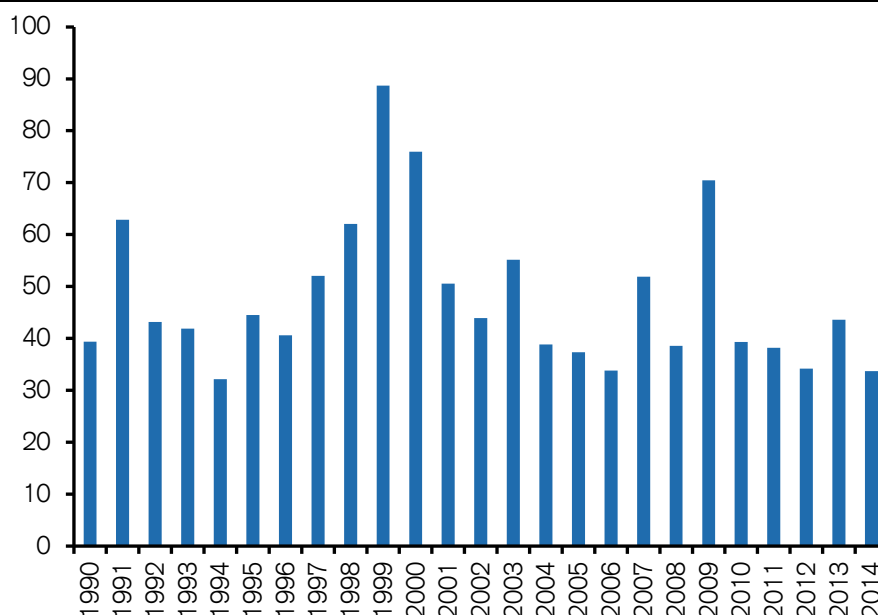
Exhibit 7: Dispersion of Returns for the S&P 500 in 2014

	TSR (%)
Median return	15.6
Average return of outperformers	32.1
Average return of underperformers	-1.6
Average outperformer minus average underperformer	33.7

Source: Credit Suisse.

Exhibit 8 shows the dispersion of returns for the S&P 500 from 1990-2014. Academic research shows that dispersion is a reasonable proxy for breadth.²⁰ And since the fundamental law of active management says that excess returns are a function of skill and breadth, more breadth leads to higher returns for a given level of skill. The research supports this conclusion.²¹

Exhibit 8: Dispersion of Returns for the S&P 500, 1990-2014



Source: Credit Suisse.

The point of this discussion is your skill in security selection only shines if there is a wide range of outcomes across the securities you are selecting. Low dispersion limits breadth, which blunts the opportunity for excess return even in the presence of skill.

Portfolio Construction. The final way that portfolio managers can demonstrate skill is through position sizing. The basic idea is straightforward: You want your best ideas, those with the highest risk-adjusted expected returns, to have the greatest weights in the portfolio.

Here's a simple example of the importance of position sizing. Say you have three securities—A, B, and C—that you expect to have a positive excess return. But, in fact, after one year security A is up 50 percent, security B is flat, and security C is down 20 percent.

If you had given each security an equal weight at the beginning of the year, your portfolio would be up 10 percent. This is simply the average return of the securities. Now consider the case where you put 10 percent into securities A and B and 80 percent into C. This portfolio would be down 11 percent for the year.

Alternatively, if you placed 80 percent of the portfolio into A and split the balance between B and C, the portfolio would be up 38 percent. The returns of the portfolio reflect not just the securities you select but also the way you weight them.

We have already seen that dispersion is a useful way to gauge opportunity for security selection. We can now extend the analysis of dispersion to assess the opportunity for portfolio construction. The idea is to examine the dispersion of the dispersion.²²

Think about it this way: Say that all stocks in a given year were evenly split between outperformers (up 20 percent) and underperformers (down 10 percent). If your portfolio is filled with mostly outperformers, you have skill in security selection. But if every outperformer is up the exact same amount, there's no way to add value through portfolio construction.

So for opportunity to exist, you need dispersion of dispersion. Your security selection directs you to good excess returns, and your portfolio construction leads you to make the securities with the highest excess return the largest positions in your portfolio.

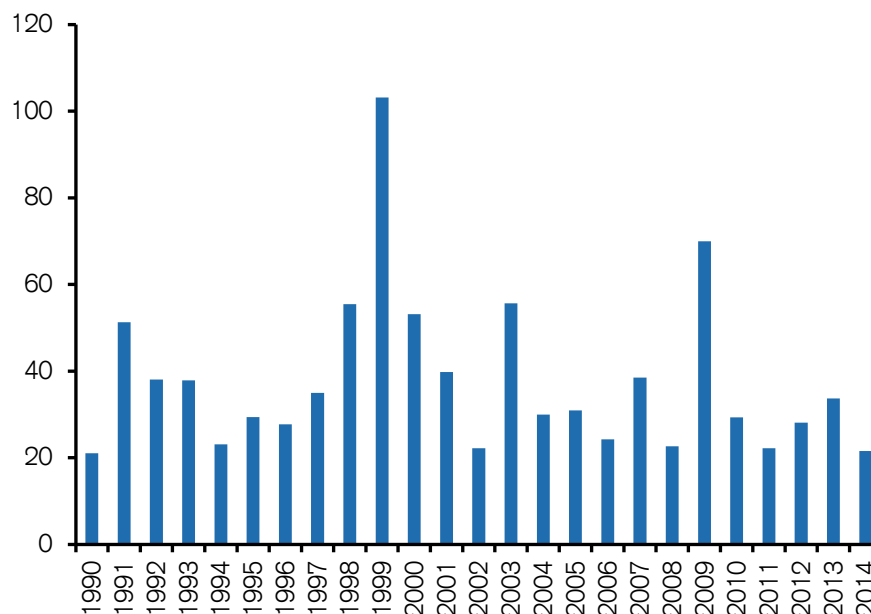
Let's look at some numbers to make this more concrete. In 2014, the top half of the stocks in the S&P 500 had an average TSR of 32.1 percent. The average return of the top half of this group (in other words, the top quarter within the S&P 500), had a TSR of 42.9 percent while the bottom half earned a TSR of 21.3 percent. So the spread between the top half and the bottom half was 21.6 percentage points. Exhibit 9 shows these figures. Lower numbers for the dispersion of dispersion mean less opportunity to express skill through portfolio construction.

Exhibit 9: Dispersion of Dispersion for S&P 500 Winners in 2014

Outperformers	TSR (%)
Average return	32.1
Average return of top half of outperformers	42.9
Average return of bottom half of outperformers	21.3
Top half minus bottom half	21.6

Source: Credit Suisse.

Exhibit 10 shows the dispersion of dispersion for the winners from 1990 through 2014. The most extreme year in recent history was 1999, which coincides with the largest standard deviation of excess returns for mutual funds during the same time period.

Exhibit 10: Dispersion of Dispersion for S&P 500 Winners, 1990-2014

Source: Credit Suisse.

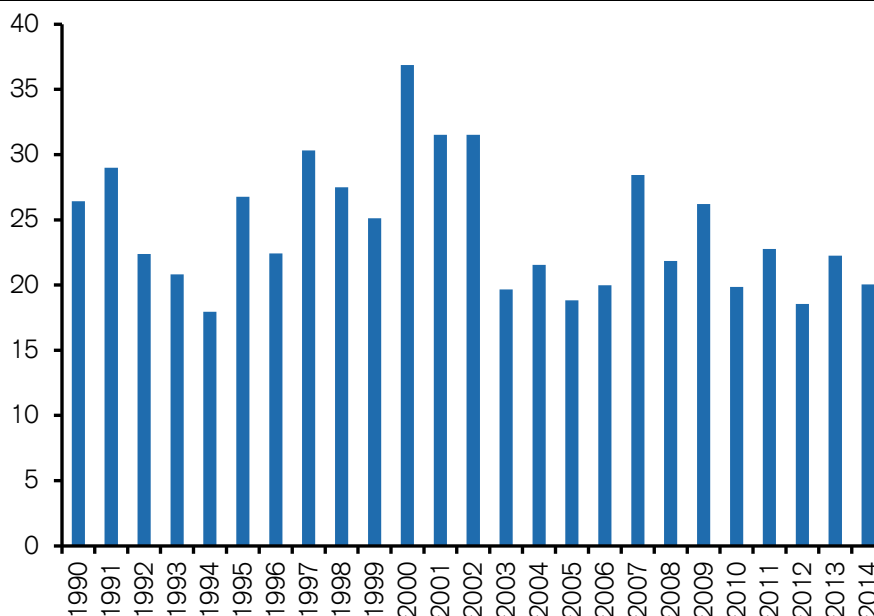
We can do the same exercise for the losers in the S&P. (See Exhibit 11.) The average loser was down 1.6 percent, while the worse half of that group declined 11.6 percent and the better half was up 8.4 percent. That spread was 20.0 percentage points.

Exhibit 11: Dispersion of Dispersion for S&P 500 Losers in 2014

Underperformers	TSR (%)
Average return	-1.6
Average return of top half of underperformers	8.4
Average return of bottom half of underperformers	-11.6
Top half minus bottom half	20.0

Source: Credit Suisse.

Exhibit 12 shows the dispersion of dispersion for the losers from 1990 through 2014. This dispersion is very important for short sellers. Again, the peak was around the dot-com era and the numbers remained elevated through the bear market of 2000-2002. The scale for underperformers is shorter than that for outperformers because stocks can't go down more than 100 percent.

Exhibit 12: Dispersion of Dispersion for S&P 500 Losers, 1990-2014

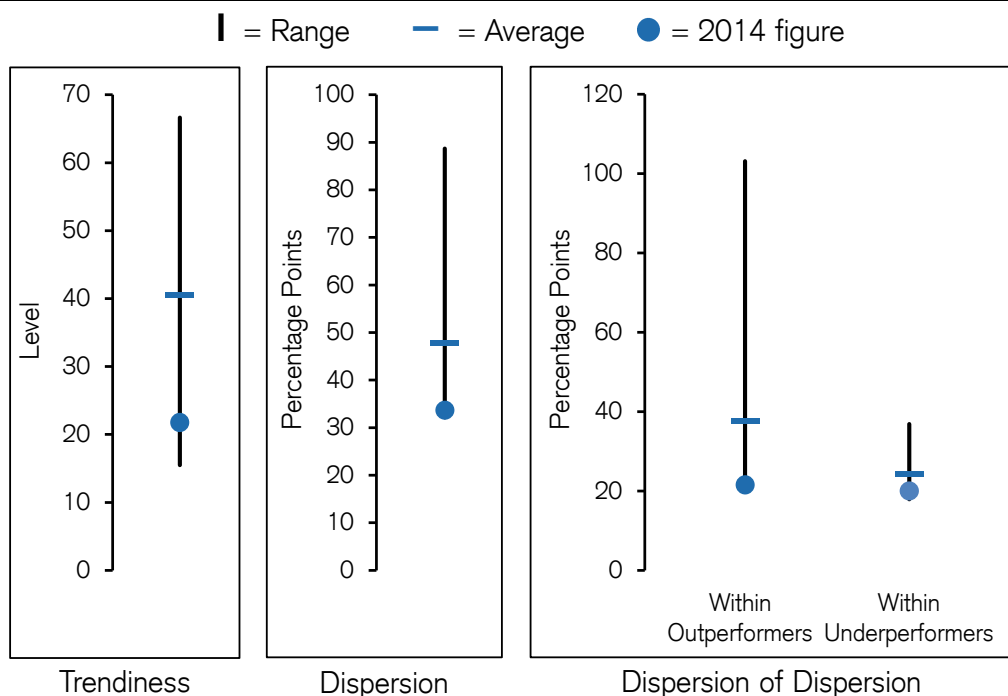
Source: Credit Suisse.

Why 2014 Was a Tough Year

Mutual fund and hedge fund managers struggled versus popular benchmarks such as the S&P 500 in 2014. Was that because of a lack of skill or a lack of opportunity? Certainly, absolute skill in the investment industry continues to rise while relative skill continues to decline. In other words, it's harder to find markets or securities that are mispriced.

But by the metrics we used here, opportunities in 2014 were unusually limited. Exhibit 13 shows the proxies we used to measure market timing, security selection, and portfolio construction.

On the left, we see that the "trendiness" of the S&P 500, as measured by the average quarterly ADX, was below average. This made market timing particularly hard. In the middle, we see that dispersion was at a 25-year low, creating a substantial challenge for security selection. Finally, on the right we look at dispersion of dispersion for winners and losers. Again, the figures for 2014 were near quarter-century lows, which created difficulty in constructing portfolios on both the long and short side.

Exhibit 13: Limited Opportunities in 2014

Source: Credit Suisse.

Further, in 2014 large capitalization stocks delivered much higher returns than small capitalization stocks, creating a challenging environment for active managers. For instance, the TSR for the S&P 500 was 13.7 percent versus 4.9 percent for the Russell 2000, a proxy for small capitalization stocks. This was the largest gap of underperformance for the Russell 2000 since 1998. Given the bias for small capitalization stocks in the portfolios of most active managers who use the S&P 500 as a benchmark, the relatively weak results for small capitalization stocks provided a stiff headwind.

Opportunities do exist, and they tend to lie in pockets of market inefficiency. In the past, we have discussed three broad areas where you might look for these inefficiencies. They include:²³

- **Diversity breakdowns.** Markets tend to arrive at efficient prices when investors hold diverse views.²⁴ However, when the views of investors correlate to be either bullish or bearish, market efficiency is compromised and opportunity arises. The key is to be a contrarian in cases when the market reflects unrealistic expectations about future results.
- **Institutions versus individuals.** For the most part, institutions trade with other institutions. But in cases when institutions can compete with individual investors, institutions have been shown to generate superior results. Frenzied retail activity at the top of the dot-com bubble is one example.
- **Forced selling or buying.** There are times when portfolio managers buy or sell for reasons that are not fundamental. Examples include spin-offs, sales to accommodate margin calls, or even portfolio adjustments to hew to new regulations. It's frequently an opportunity if the person on the other side of the trade is doing something he or she doesn't want to do.

Summary

The fundamental law of active management reminds us that success requires both skill and opportunity. While researchers have spent a great deal of time dwelling on assessing skill, they have paid less attention to opportunity. Skill does not pay off unless it is paired with opportunity.

Investment results were particularly challenging in 2014. Part of this, no doubt, reflects the steady rise in skill of active managers. But part of it also reflects a dearth of opportunity for active managers to show their skill. As history shows that opportunity ebbs and flows, it is reasonable to expect that we will see better opportunity in the future. One interesting line of inquiry is whether the rise in passive investing, through index funds and exchange-traded funds, is having an impact on opportunity. Early evidence suggests that after a stock enters the S&P 500, its correlation with the index rises. This dampens dispersion and limits opportunity.²⁵

Appendix

Here's the fundamental law of active management again:

$$IR = IC * \sqrt{BR}$$

The law solves for the information ratio (IR), which is a measure of the return of a portfolio adjusted for risk.

More formally, the information ratio reflects the portfolio's return in excess of the benchmark return, divided by the tracking error. A measure of how closely the portfolio follows the benchmark, tracking error is the standard deviation of the difference between the portfolio and benchmark returns. Here is the equation for the expected information ratio:

$$IR = \frac{E[Rp - Rb]}{\sigma} = \frac{\alpha}{\omega} = \frac{E[Rp - Rb]}{\sqrt{var[Rp - Rb]}}$$

The numerator captures how well the portfolio does versus its benchmark, and the denominator suggests how much risk the manager took to achieve those returns. So industry experts generally consider high information ratios to be an indication of skill.

The information coefficient (IC) is the average correlation between forecasts and outcomes. A high correlation (something near 1.0) indicates skill, and a low correlation (something close to zero) indicates no skill.

Here's a simple way to think about it. Say you are shooting free throws in a basketball game. When you shoot, you predict the shot will go in. That's the forecast. Whether it's a make or a miss is the outcome. You are skillful if lots of your shots go in (forecast matches outcome) and you are unskillful if they don't.

The final part of the equation is breadth (BR). Breadth is the number of independent, excess-return opportunities predicted to be available during some period of time, usually one year.

So for a given level of skill, the information ratio rises as a function of the square root of breadth. More opportunities lead to more excess return. To show the relationship between breadth and the information ratio, Grinold and Kahn offer the example of a casino with a roulette wheel that has 18 red slots, 18 black slots, and 1 green slot. (American roulette wheels commonly have two green slots.)

Assume a player places \$1 on black. The casino's expected return, or "skill," is 2.7 percent ($19/37 * 100\% + 18/37 * -100\%$). But the information ratio is only 0.027 since the standard deviation is very large, 99.96 percent, as the result of spinning the wheel only once. We can solve for the information ratio using the equation: $0.027 (IR) = 0.027 (IC) * \sqrt{1 (BR)}$.

Now assume 1 million bets of \$1, closer to what casinos experience in the real world. The expected return remains the same, but the standard deviation plummets to 0.09996 percent. This drives the information ratio up to 27.027. We can also determine for the information ratio using these assumptions: $27.027 (IR) = 0.027 (IC) * \sqrt{1,000,000 (BR)}$.

Other researchers have refined and augmented the fundamental law of active management. For example, some academics have added the idea of constraints, suggesting that there is slippage between theory and practice.²⁶ But the central notion for our purpose is the distinction between skill and opportunity.

Endnotes

¹ Attributed to Napoleon Bonaparte. We could not find an original source. The quotation has also appeared on the paper label of Salada tea bags.

² Richard C. Grinold, "The Fundamental Law of Active Management," *Journal of Portfolio Management*, Vol. 15, No. 3, Spring 1989, 30-37; Richard C. Grinold and Ronald N. Kahn, *Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk, Second Edition* (New York: McGraw Hill, 2000), 147-169; Roger Clarke, Harindra de Silva, and Steven Thorley, "The Fundamental Law of Active Portfolio Management," *Journal of Investment Management*, Vol. 4, No. 3, Third Quarter 2006, 54-72.

³ See the appendix.

⁴ Michael J. Mauboussin, *The Success Equation: Untangling Skill and Luck in Business, Sports, and Investing* (Boston, MA: Harvard Business Review Press, 2012), 53-58.

⁵ Aye M. Soe, "SPIVA® U.S. Scorecard: Year End 2014," *S&P Dow Jones Indices Research*, March 12, 2015. See <http://www.spindices.com/documents/spiva/spiva-us-year-end-2014.pdf>. Also, "A 25% Chance of Success," *Economist - Buttonwood Blog*, February 13, 2015. See www.economist.com/blogs/buttonwood/2015/02/mutual-fund-investing. And, Joe Peta, "The Worst Year Ever for Hedge Funds," *Novus Research*, January 2015.

⁶ What we call cash, the Investment Company Institute calls "liquid assets." Liquid assets are defined as cash, U.S. Treasuries, and other securities with short-term maturities. We examine liquid assets as a percentage of total assets.

⁷ Xuemin (Sterling) Yan, "The Determinants and Implications of Mutual Fund Cash Holdings: Theory and Evidence," *Financial Management*, Vol. 35, No. 2, June 2006, 67-91.

⁸ John C. Bogle, "The Arithmetic of 'All-In' Investment Expenses," *Financial Analysts Journal*, Vol. 70, No. 1, January/February 2014, 13-21.

⁹ "Net exposure" is a related but distinct concept. Net exposure is the percentage difference between a fund's long and short exposure. Say a long-short equity hedge fund has \$100 million in assets. If it owns \$60 million of stocks, it has a long exposure of 60 percent (\$60 million/\$100 million = 60 percent). If it is short \$20 million of stocks it has a short exposure of 20 percent (\$20 million/\$100 million = 20 percent). The fund's net exposure is 40 percent (60 percent – 20 percent = 40 percent).

Net exposure doesn't capture risk because funds can use leverage. For instance, a fund that is 140 percent long and 100 percent short will also have a 40 percent net exposure but would clearly be riskier than the fund above. To better capture risk, you can examine gross exposure, which is the sum of the long and short exposure. So the gross exposure in the first example is 80 percent (60 percent long + 20 percent short) while the gross exposure in the second example is 240 percent (140 percent long and 100 percent short).

¹⁰ Andreas Neuhierl and Bernd Schlusche, "Data Snooping and Market-Timing Rule Performance," *Journal of Financial Econometrics*, Vol. 9, No. 3, Summer 2011, 550-587.

¹¹ Mikhail Simutin, "Cash Holdings and Mutual Fund Performance," *Review of Finance*, Vol. 18, No. 4, July 2014, 1425-1464.

¹² Marcin Kacperczyk, Stijn Van Nieuwerburgh, and Laura Veldkamp, "Time-Varying Fund Manager Skill," *Journal of Finance*, Vol. 69, No. 4, August 2014, 1455-1484.

¹³ J. Welles Wilder, Jr., *New Concepts in Technical Trading Systems* (Greensboro, NC: Trend Research, 1978).

¹⁴ George Soros, "Soros: General Theory of Reflexivity," *Financial Times*, October 26, 2009.

¹⁵ Frank J. Fabozzi, ed., *Active Equity Portfolio Management* (New Hope, PA: Frank J. Fabozzi Associates, 1998), 305.

¹⁶ Fama and French discuss a three-factor model, which includes beta (the slope of the regression of a security's excess return versus that of the market), size, and valuation. See Eugene F. Fama and Kenneth R.

French, "The Cross-Section of Expected Stock Returns," *Journal of Finance*, Vol. 47, No. 2, June 1992, 427-465. Today, academics prefer models with four (momentum) and even five (profitability) factors.

¹⁷ Ernest M. Ankrim and Zhuanxin Ding, "Cross-Sectional Volatility and Return Dispersion," *Financial Analysts Journal*, Vol. 58, No. 5, September/October 2002, 67-73.

¹⁸ Anna Agapova, Robert Ferguson, and Jason Greene, "Market Diversity and the Performance of Actively Managed Portfolios," *Journal of Portfolio Management*, Vol. 38, No. 1, Fall 2011, 48-59.

¹⁹ Peta. For a more in-depth discussion, see David Buckle, "How to Calculate Breadth: An Evolution of the Fundamental Law of Active Portfolio Management," *Journal of Asset Management*, Vol. 4, No. 6, April 2004, 393-405.

²⁰ Richard C. Grinold and Mark P. Taylor, "The Opportunity Set: Market Opportunities and the Effective Breadth of a Portfolio," *Journal of Portfolio Management*, Vol. 35, No. 2, Winter 2009, 12-24.

²¹ Larry R. Gorman, Steven G. Saprà, and Robert A. Weigand, "The Role of Cross-Sectional Dispersion in Active Portfolio Management," *Investment Management and Financial Innovations*, Vol. 7, No. 3, October 2010, 58-68; Larry R. Gorman, Steven G. Saprà, and Robert A. Weigand, "The Cross-Sectional Dispersion of Stock Returns, Alpha, and the Information Ratio," *Journal of Investing*, Vol. 19, No. 3, Fall 2010, 113-127; Robert C. Jones and Russ Wermers, "Active Management in Mostly Efficient Markets," *Financial Analysts Journal*, Vol. 67, No. 6, November/December 2011, 29-45; Joop Huij and Simon Lansdorp, "Explaining Differences in Mutual Fund Performance Persistence," *Working Paper*, 2011; Harindra de Silva, Steven Saprà, and Steven Thorley, "Return Dispersion and Active Management," *Financial Analysts Journal*, Vol. 57, No. 5, September/October 2001, 29-42.

²² Peta.

²³ Michael J. Mauboussin and Dan Callahan, "Alpha and the Paradox of Skill: Results Reflect Your Skill and the Game You Are Playing," *Credit Suisse Global Financial Strategies*, July 15, 2013.

²⁴ Michael J. Mauboussin and Dan Callahan, "Animating Mr. Market: Adopting a Proper Psychological Attitude," *Credit Suisse Global Financial Strategies*, February 10, 2015.

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IQ versus RQ

Differentiating Smarts from Decision-Making Skills

May 12, 2015

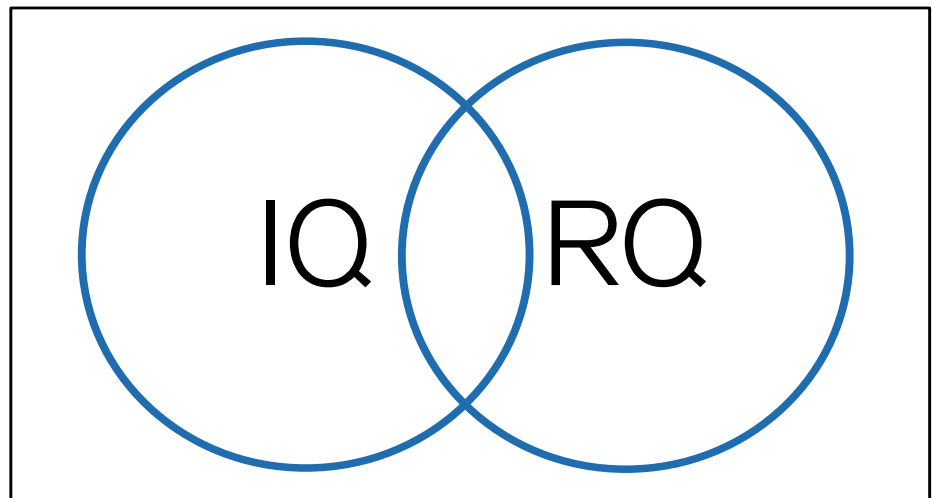
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“Being rational is a moral imperative.”

Charlie Munger¹

- Intelligence quotient (IQ) and rationality quotient (RQ) are distinct. Think of IQ as the horsepower of an engine and RQ as the output.
- We share the results of a classic test of calibration, which is an important facet of rationality. Well calibrated people know what they know and know what they don't know.
- Consistent with past research, we find that participants overestimate their accuracy as their subjective probability estimates tend to be higher than the actual percent correct.
- Investors and executives can improve their rationality by keeping score, asking about others, using base rates, and updating probabilities.
- A large-scale forecasting project has shown that the best forecasters use inductive and numerical reasoning, have cognitive control and a growth mindset, and are open-minded and effective working as part of a team.

Introduction

Keith Stanovich, a professor of applied psychology at the University of Toronto, distinguishes between intelligence quotient (IQ) and rationality quotient (RQ).² Psychologists measure IQ through specific tests, including the Wechsler Adult Intelligence Scale, and it correlates highly with standardized tests such as the SAT.³

IQ measures something real, and it is associated with certain outcomes. For example, thirteen-year-old children who scored in the top decile of the top percent (99.9th percentile) on the math section of the SAT were eighteen times more likely to earn a doctorate degree in math or science than children who scored in the bottom decile of the top percent (99.1st percentile).⁴

RQ is the ability to think rationally and, as a consequence, to make good decisions. Whereas we generally think of intelligence and rationality as going together, Stanovich's work shows that the correlation coefficient between IQ and RQ is relatively low at .20 to .35.⁵ IQ tests are not designed to capture the thinking that leads to judicious decisions.

Stanovich laments that almost all societies are focused on intelligence when the costs of irrational behavior are so high. But you can pick out the signatures of rational thinking if you are alert to them. According to Stanovich, they include adaptive behavioral acts, efficient behavioral regulation, sensible goal prioritization, reflectivity, and the proper treatment of evidence.⁶

Your SAT scores shed little light on any of these qualities. So the first lesson in assessing your own decisions or those of others is to consider IQ and RQ separately. Warren Buffett, chairman and chief executive officer (CEO) of Berkshire Hathaway, equates IQ to the horsepower of an engine and RQ to the output. We all know people who are high on IQ but average or low on RQ. Their efficiency is poor. There are others without dazzling IQs but who consistently make sound decisions. They are highly efficient.

Warren Buffett has plenty of horsepower and output. But when asked about his success, Buffett emphasized that it was RQ that made the big difference, not IQ:⁷

How I got here is pretty simple in my case. It's not IQ, I'm sure you'll be glad to hear. The big thing is rationality. I always look at IQ and talent as representing the horsepower of the motor, but that the output—the efficiency with which that motor works—depends on rationality. A lot of people start out with 400-horsepower motors but only get a hundred horsepower of output. It's way better to have a 200-horsepower motor and get it all into output.

Stanovich's psychological research supports Buffett's observation. While there is not yet a comprehensive test to measure RQ—Stanovich is working on it—we will look at calibration, one of the important facets of rationality.⁸ As part of this research, we measured the calibration of thousands of people. And part of the fun is that you, too, can participate in the exercise and see how you stack up versus others.

Measuring Rationality

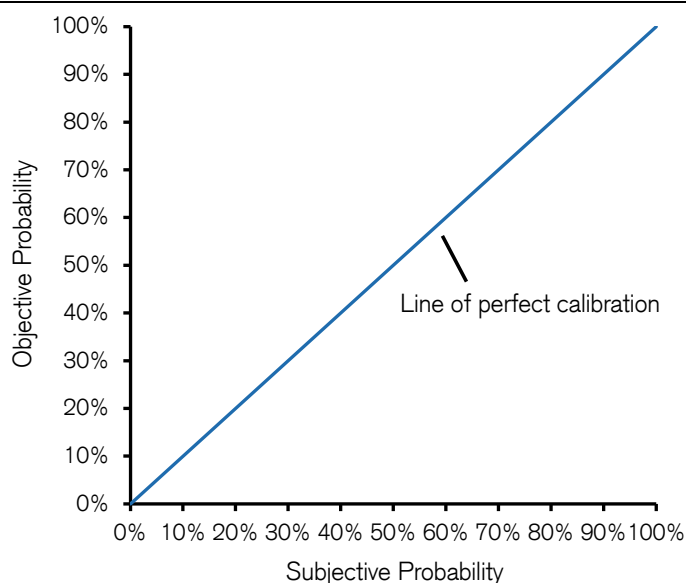
Cognitive scientists and philosophers talk about “instrumental” and “epistemic” rationality. Instrumental rationality is behaving in such a way that you get what you want the most, subject to constraints. Expected utility theory, which is based on a series of axioms, provides a normative framework for how to do this. You’ll be instrumentally rational if you follow the axioms.⁹

Epistemic rationality describes how well a person’s beliefs map onto the world. If you believe in the tooth fairy, for instance, you are showing a lack of epistemic rationality. Here’s a catchier way to remember the two terms: instrumental rationality is “what to do” and epistemic rationality is “what is true.”¹⁰

We will focus on observations about epistemic rationality. One way to assess this form of rationality is through a test of calibration. Think of a weather forecaster. If it actually rains 70 percent of the time on the days she predicts a 70 percent chance of rain, she is well calibrated. She is poorly calibrated, on the other hand, if it only rains on 30 percent of those days.

Exhibit 1 shows one approach to keeping score. The horizontal axis measures an individual’s subjective forecast (“there’s a 70 percent chance of rain tomorrow”) and the vertical axis captures the actual outcome (“it rained”). You know that someone is well calibrated if their results fall close to the line at a 45-degree angle.

Exhibit 1: Measure of Calibration

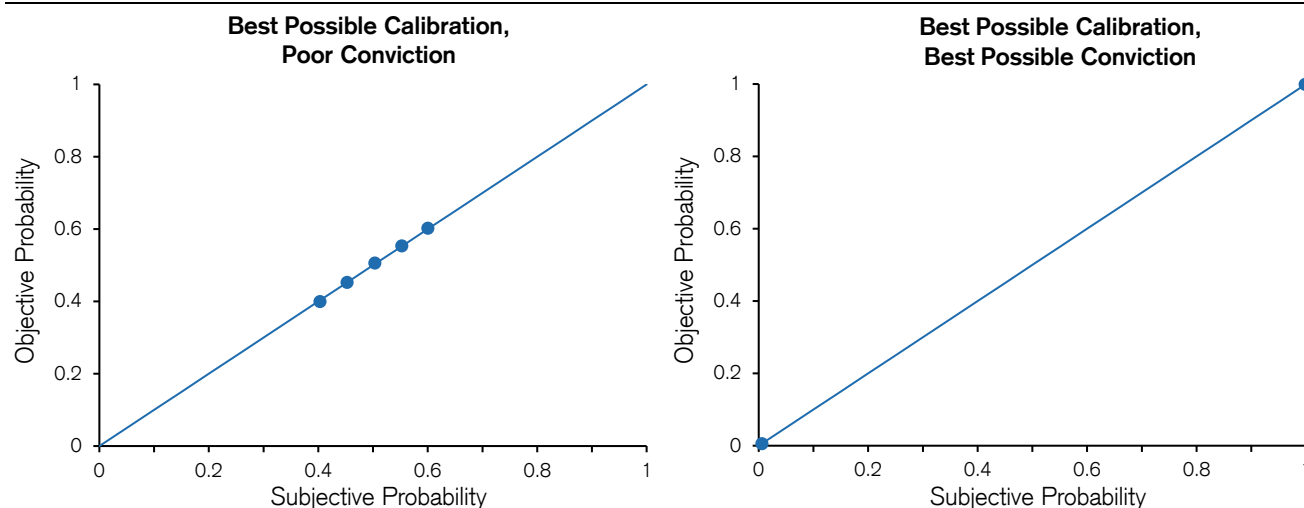


Source: Credit Suisse.

Conviction is another important consideration. Conviction measures how well people do when they assign extreme probabilities.¹¹ Calibration and conviction are related but distinct. For example, it rains about half of the days in an average year in London. So if you wake up every morning, flip a fair coin, and mark your outcome, you will appear well calibrated over one year.

But that doesn’t help you plan picnics. What you want are a series of predictions for sun or rain that correspond with the actual weather that day. Those predictions require higher conviction than what the toss of a coin can offer. Exhibit 2 shows perfect calibration but poor conviction on the left, and perfect calibration and conviction on the right.

Exhibit 2: Calibration and Conviction



Source: Philip E. Tetlock, *Expert Political Judgment: How Good Is It? How Can We Know?* (Princeton, NJ: Princeton University Press, 2005), 48.

Here we present the results of a classic calibration test. Subjects who participated went to the website, <http://confidence.success-equation.com>, and saw 50 true-false questions. Exhibit 3 is a screenshot of the site.

The subjects then answered either true or false and were asked to register a probability of correctness, from 50 to 100 percent, in increments of 10 percentage points. If you have no idea whether the answer is true or false you should select an answer at random and enter “50%” as your probability of correctness. If you are certain of the answer you provide, you click “100%.”

At the end, the subjects submit their answers and receive their results, which include:

- Mean, or average, confidence and percent correct for all questions
- Mean confidence for correct and incorrect answers
- Number correct and answered for low confidence (50-60 percent, medium confidence (70-80 percent) and high confidence (90-100 percent) submissions
- A calibration graph similar to exhibit 1

We accessed the results of 1,985 participants, all of whom were anonymous.¹²

Exhibit 3: Calibration Questions and Probability of Correctness

confidence.success-equation.com

Do you know what you know?

A Confidence Calibration Exercise

After answering each of the true/false questions below, indicate how confident you are in your answer using the corresponding slider. A value of 50% means you have no idea what the right answer is (the same probability as a random guess between the two choices); a value of 100% means you are completely confident in your answer.

English is the top language used on the Internet

☐ True ☐ False

Probability of correctness: 50%

The ferrule connects the bristles to the handle on a

☐ True ☐ False

Probability of correctness: 50%

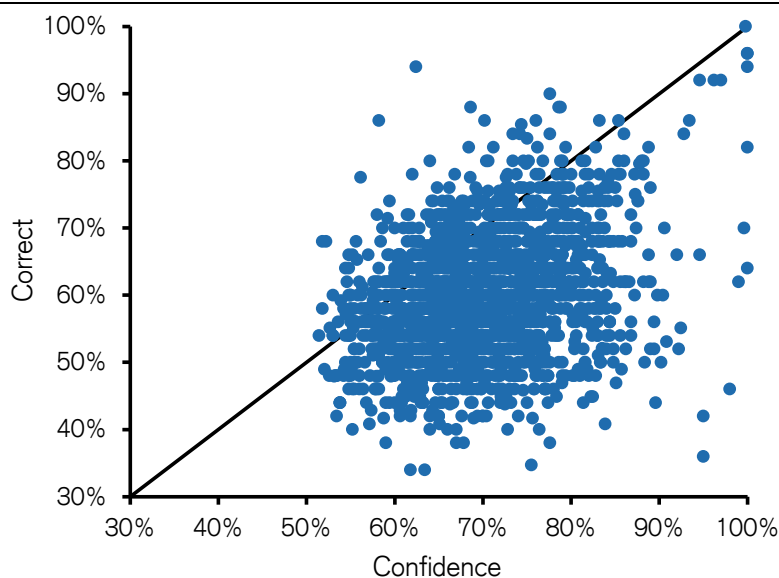
Neutrons are the particles in an atom that have positive charge

☐ True ☐ False

Probability of correctness: 50%

Source: <http://confidence.success-equation.com>.

Exhibit 4 shows the results. The pattern is consistent with what researchers have found for decades: Subjective probability estimates are substantially higher, on average, than the actual percent correct. For the whole population, the average subjective probability was 70 percent and the actual percent correct was just under 60 percent.

Exhibit 4: Calibration for 1,985 Participants

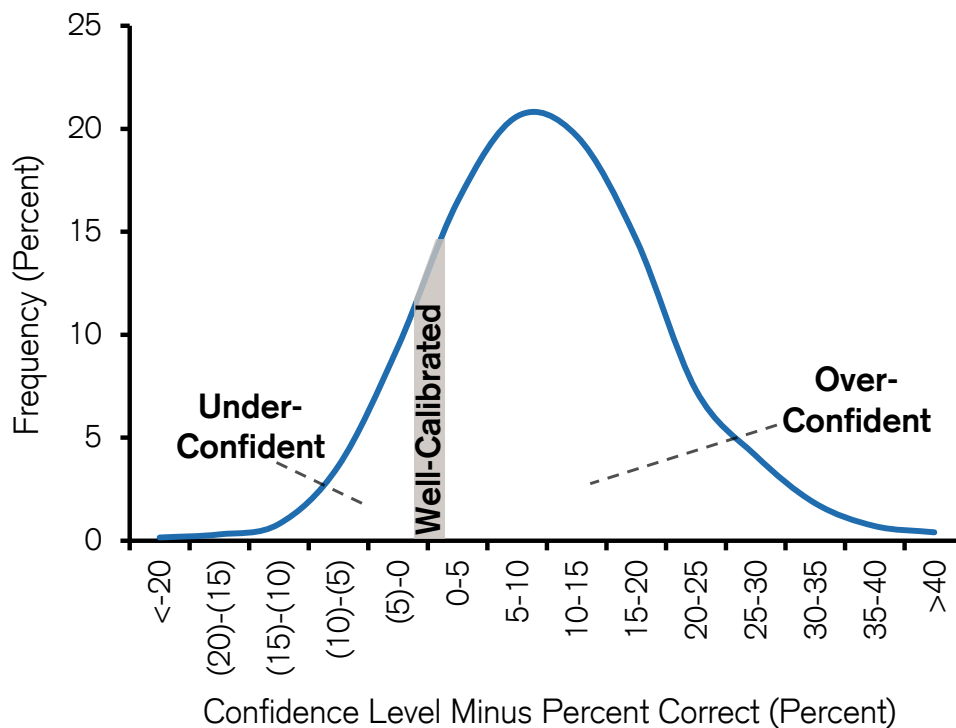
Source: <http://confidence.success-equation.com>.

Note that proper calibration does not require being right all of the time (the dot in the upper right-hand corner indicates that either someone cheated or a deity took the test) but rather being close to the 45 degree line. It's knowing what you know and knowing what you don't know.

Exhibit 5 shows the distribution of responses, with the horizontal axis representing the confidence level minus the percent correct and the vertical axis the frequency. A normal distribution, or bell curve, describes the data well, with a mean and standard deviation of about 10 percent.

This distribution allows us to segregate the participants into three groups: those who are overconfident, underconfident, and well calibrated. We define well calibrated as a subjective probability within 1 percentage point of the percent correct.

Based on that criterion, 82.7 percent of the participants were overconfident (subjective confidence exceeded actual percent correct), 11.7 percent were underconfident (subjective confidence less than actual percent correct), and only 5.6 percent were well calibrated.

Exhibit 5: Most Participants Are Overconfident

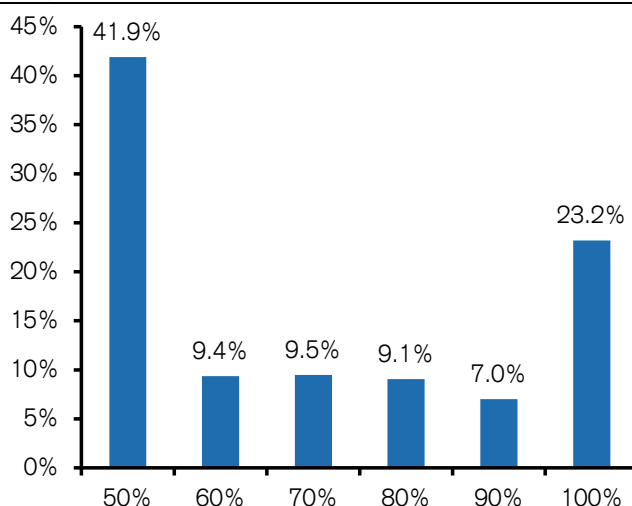
Source: <http://confidence.success-equation.com>.

Amos Tversky, the renowned psychologist, is reported to have said that humans can only distinguish between three levels of probability: “it’s gonna happen,” “it’s not gonna happen,” and “maybe.”¹³ Exhibit 6 shows the distribution of subjective probabilities of correctness.

Forty-two percent of the responses were 50 percent, which is the equivalent of saying, “I have no idea what the answer is.” This corresponds to Tversky’s “maybe.” Note that there is likely an additional effect here because 50 percent is the default setting on the site. So if the participant doesn’t change the assigned subjective probability, it registers 50 percent automatically.

The next most popular response, nearly one-quarter of the total, was 100 percent. This is Tversky’s “it’s gonna happen” or “it’s not gonna happen.” So nearly two-thirds of the responses were either “I don’t know” or “I do know” with the balance split between the four choices in between those extremes.

Exhibit 6: Distribution of Subjective Probabilities of Correctness

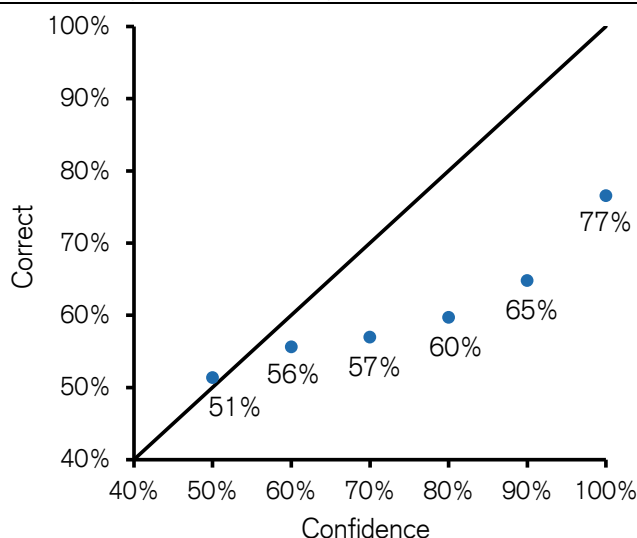


Source: <http://confidence.success-equation.com>.

This leads to a logical follow up question: How good were the results for each assigned probability of correctness? Exhibit 7 shows the answer. When the subjects selected 50 percent, their probability of being correct was random. This means they were well calibrated. They didn't know, knew they didn't know, and answered as if they didn't know.

However, as the assigned probability of correctness rose, the subjects became less calibrated. For instance, when the subjects selected 100 percent, they were only correct 77 percent of the time. At 90 percent, they were only correct 65 percent of the time. Overestimation of ability was greatest at the high levels of assigned probability of correctness.¹⁴

Exhibit 7: Calibration for Each Assigned Probability of Correctness



Source: <http://confidence.success-equation.com>.

Overconfidence can be a problem for a couple of reasons. The first obvious one is if you are highly confident of an outcome and are wrong a relatively high percentage of the time, you will fail to consider alternatives and ultimately make poor decisions.¹⁵ One recent example is Ron Johnson's tenure as CEO of J.C. Penney.

Johnson, relying on his intuition, quickly repositioned the retailer to poor effect. Following his ouster, the retailer returned to many of its past practices.¹⁶

Another problem is that people who think that they know more than they do are less motivated to learn and improve than those who understand their limitations.¹⁷ Indeed, one study showed that the least capable people have the largest gap between what they think they can do and what they actually achieve.¹⁸

Lessons for Investors and Executives

The good news in all of this is that we can train ourselves to be more rational. Here are some ideas:

- **Keep score.** To the degree to which you can pose questions that will have a definite answer within a known period of time, you have a basis for keeping score. The classic way to do this is through a Brier score, which we discuss in detail in the appendix. Brier scores were originally developed to help give meteorologists feedback on their predictions for the weather. Through improvements in weather modeling techniques and sharper feedback, meteorologists today are vastly more accurate than they were a generation or two ago.¹⁹
- **Ask about others.** Emily Pronin, a professor of psychology at Princeton University, has found that while people recognize biases in the thinking of others, they somehow think that they suffer less from the same biases.²⁰ For example, physicians know that gifts from pharmaceutical companies have biasing effects for other doctors but believe they are immune from the effect.

Here's a technique to deal with this. Say you are an investor interviewing a company's management team, and you are considering buying the stock. You should know that the management team will have an optimism bias, and so you have to take what they say with a grain of salt. But their views about other companies are more likely to be accurate. In other words, don't ask people about themselves, ask them about others.

- **Use base rates.** Perhaps the single most effective de-biasing tool is the use of base rates.²¹ While we all like to think of ourselves as unique, asking what happened when others were in the same situation can be very helpful. Larry Summers, the former president of Harvard University and Secretary of the Treasury of the U.S., had a rule he used with his research assistants. He would ask how long a project would take. And then he would take the assistant's answer, double the estimate, and move up to the next unit of time.²² So "two hours" would be translated as "four days." Perhaps this was simply a mechanism to avoid disappointment, but the direction of the new estimate was no doubt correct.
- **Update probabilities.** The test we shared with the participants was static. In the real world, probabilities shift all of the time. One of the key challenges in rational thinking is to accurately update probabilities as new information arrives. It turns out that the very best forecasters do this very well and use very granular increments of probability.²³ Most of us fall into the trap of confirmation bias, preferring to disregard or discount new information than to properly incorporate it into our assessment.

Limitations to This Project

While this project was fun and revealed results that are consistent with past research, we want to be quick to note that this work does not meet the standard of academic research for a few reasons.

To begin, we can define overconfidence in multiple ways.²⁴ The primary form of overconfidence that this test captures is overestimation—you think you're right 70 percent of the time but you're only right 60 percent—but overprecision, the tendency to provide ranges of outcomes that are too narrow, also plays a role. Suffice it to say that overconfidence has no simple definition and hence there's no uniform way to test it.

How our participants answered also reflected the questions we posed. We attempted to have questions that were varied, but it is likely that an individual may have a different result for a separate set of questions. In other words, an individual's results might vary from test to test based on the nature of the questions.

Our default percentages were in increments of 10 percentage points, which limited the ability of the participants to provide greater subtlety in their responses. This may have also encouraged the result of the extremes—lots of 50 and 100 percent answers.

Finally, we may have a biased sample of test takers. Most entered the site after having seen it mentioned in social media communication. Participants from four countries constituted more than three-fourths of the sample, including 37 percent from the U.S., 21 percent from Australia, 15 percent from the Netherlands, and 5 percent from the U.K. Nearly all participants took the test on one of four operating systems, including 40 percent on Windows, 27 percent on iOS, 15 percent on Mac OS, and 14 percent on Android.

Characteristics of People with High RQ

As part of a large-scale forecasting project, researchers have identified the characteristics of the very best forecasters.²⁵ They break down the skills into three variables: dispositional, situational, and behavioral. We believe these are consistent with high RQ. Here are some highlights:

■ Dispositional

- Engage in inductive reasoning
- Exhibit cognitive control²⁶
- Comfortable with numerical reasoning
- Actively open-minded
- Have a limited need for closure

■ Situational

- Trained in probabilistic reasoning (understand base rates)
- Effective working as part of a team

■ Behavioral

- Growth (versus fixed) mindset²⁷

Appendix: Keeping Score with Brier

Psychologists commonly use the Brier score as a method for gauging the accuracy of probabilistic forecasts. Glenn Brier, a meteorologist, developed the score in the 1950s.²⁸ In its simplest form, the Brier score measures the square of the forecast error, or $(\text{forecast} - \text{outcome})^2$. For binary events, the value of the outcome is 1 if the event occurs and 0 if it does not. As in golf, a lower score is better.

You can express a Brier score either on a scale of 0 to 1, or 0 to 2, depending on the calculation. We follow Brier's original approach and place our results on a scale of 0 to 2. When calculating the Brier score this way, you consider the squared forecast error for both the event and the non-event.

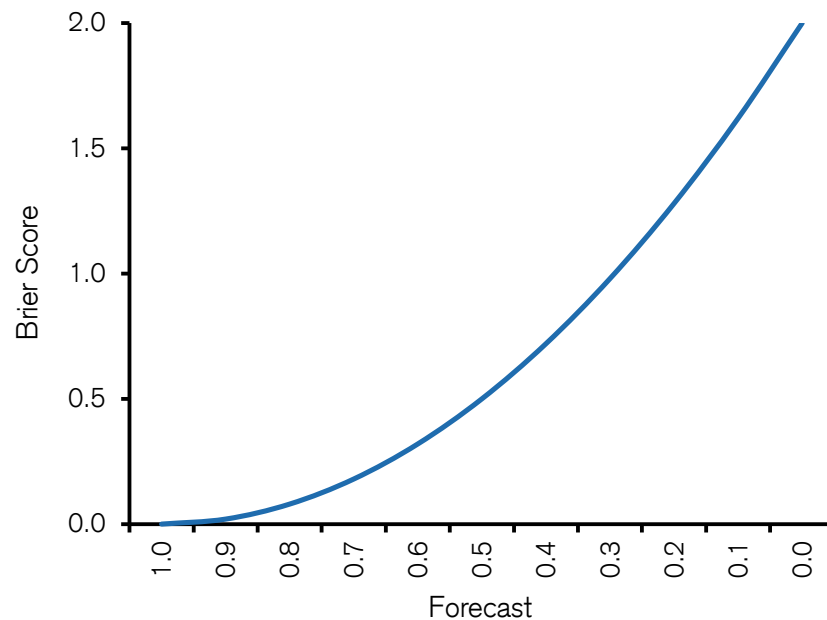
Exhibit 8 shows a meteorologist's probabilistic forecasts for whether it will rain over the next four days. For example, on Day 2, she forecasts an 80 percent probability that it will rain. Likewise, we can say she forecasts a 20 percent probability that it will *not* rain. Because it did rain, we place a 1 in the outcome column below "Rain" and a 0 in the "No Rain" column. Her Brier score for that day was 0.08. For multiple forecasts, the overall Brier score is the mean of the scores for each forecast. The meteorologist's overall Brier score comes to 0.25.

Exhibit 8: Distribution of Subjective Probability of Correctness

Day	<u>Rain</u>		<u>No Rain</u>		<u>Brier Score</u>	
	Forecast	Outcome	Forecast	Outcome	Calculation	Result
1	30%	0	70%	1	$= (0.3-0)^2 + (0.7-1)^2$	0.18
2	80%	1	20%	0	$= (0.8-1)^2 + (0.2-0)^2$	0.08
3	60%	0	40%	1	$= (0.6-0)^2 + (0.4-1)^2$	0.72
4	100%	1	0%	0	$= (1.0-1)^2 + (0.0-0)^2$	0.00
Mean						0.25

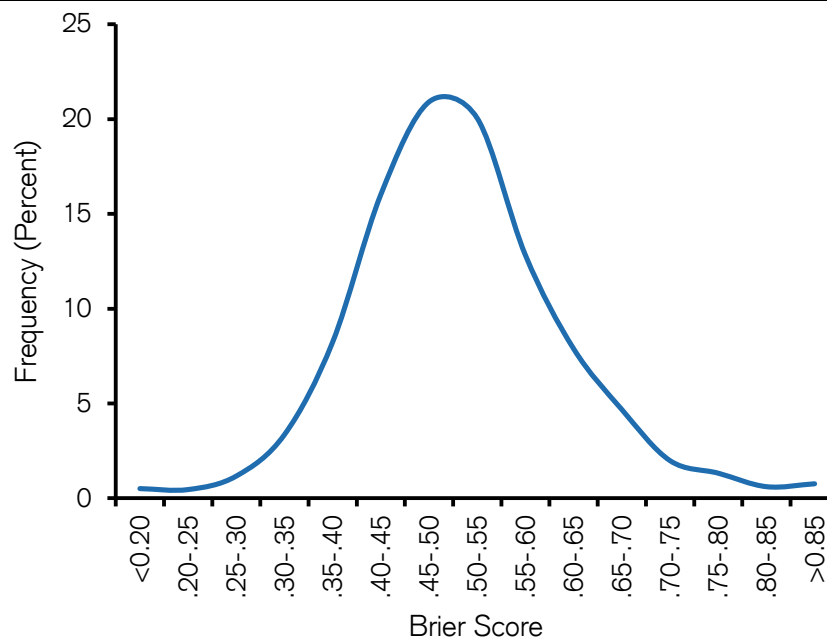
Source: Credit Suisse.

The scale from 0 to 2 has a nice feature. Random guesses have a Brier score of exactly 0.50. Exhibit 9 shows the Brier scores for an event that occurs ("Rain") for subjective probabilities from 0 to 100 percent.

Exhibit 9: Brier Scores of Event That Occurs for Various Subjective Probabilities

Source: Credit Suisse.

Exhibit 10 shows the distribution of the Brier scores for the nearly 2,000 people who took the test. Using this scale, Brier scores below 0.25 are very impressive. But as we can see, the percentage of the population that can operate at that level is small.

Exhibit 10: Brier Scores of 1,985 Participants

Source: Credit Suisse.

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¹¹ Philip E. Tetlock, *Expert Political Judgment: How Good Is It? How Can We Know?* (Princeton, NJ: Princeton University Press, 2006), 47-48. What we call "conviction," Tetlock calls "discrimination."

¹² Thanks to Andrew Mauboussin for building the site and gathering the results.

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¹⁷ Stanovich, 108.

¹⁸ Justin Kruger and David Dunning, "Unskilled and Unaware of It: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments," *Journal of Personality and Social Psychology*, Vol. 77, No. 6, December 1999, 1121-1134.

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Capital Allocation – Updated

Evidence, Analytical Methods, and Assessment Guidance

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- Capital allocation is a senior management team's most fundamental responsibility. The problem is that many CEOs don't know how to allocate capital effectively. The objective of capital allocation is to build long-term value per share.
- Capital allocation is always important but is especially pertinent today because return on invested capital is high, growth is modest, and corporate balance sheets in the U.S. have substantial cash.
- Internal financing represented more than 90 percent of the source of total capital for U.S. companies from 1980-2014.
- M&A, capital expenditures, and R&D are the largest uses of capital for operations, and companies now spend more on buybacks than dividends.
- This report discusses each use of capital, shows how to analyze that use, reviews the academic findings, and offers a near-term outlook.
- We provide a framework for assessing a company's capital allocation skills, which includes examining past behaviors, understanding incentives, and considering the five principles of capital allocation.

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Executive Summary

- Capital allocation is the most fundamental responsibility of a senior management team of a public corporation. The problem is that many CEOs, while almost universally well intentioned, don't know how to allocate capital effectively. The proper goal of capital allocation is to build long-term value per share. The emphasis is on building value and letting the stock market reflect that value. Companies that dwell on boosting their short-term stock price frequently make decisions that are at odds with building value.
- Capital allocation is always important but is especially pertinent in the United States today given the high return on invested capital, modest growth, and substantial cash on corporate balance sheets. Companies that deploy capital judiciously have a significant opportunity to build value.
- Internal financing represented more than 90 percent of the source of total capital for U.S. companies from 1980-2014. This is a higher percentage than that of other developed countries including the United Kingdom, Germany, France, and Japan.
- Mergers and acquisitions (M&A), capital expenditures, and research and development (R&D) are the largest uses of capital for operations. In the past 35 years, capital expenditures are down, and R&D is up, as a percentage of sales. This reflects a shift in the underlying economy. M&A is the largest use of capital but follows the stock market closely. More deals happen when the stock market is up.
- The amount companies have spent on buybacks has exceeded dividends for the past decade, except for 2009. Buybacks did not become relevant in the U.S. until 1982, so you should treat comparisons of yields before and after 1982 with caution. Research shows that the overall proclivity to return cash has not changed much over the decades, but the means by which the payout occurs has shifted.
- Academic research shows that rapid asset growth is associated with poor total shareholder returns. Further, companies that contract their assets often create substantial value per share. Ultimately, the answer to all capital allocation questions is, "It depends." Most actions are either foolish or smart based on the price and value.
- Divestitures are substantial and generally create value. If the buyers tend to lose value, it stands to reason that the sellers gain value. Selling or spinning off poor performing businesses can lead to addition by subtraction.
- Past spending patterns are often a good starting point for assessing future spending plans. Once you know how a company spends money, you can dig deeper into management's decision-making process. Further, it is useful to calculate return on invested capital and return on incremental invested capital. These metrics can provide a sense of the absolute and relative effectiveness of management's spending.
- Understanding incentives for management is crucial. Assess the degree to which management is focused on building value and addressing agency costs.
- The five principles of value creation include: zero-based capital allocation; fund strategies, not projects; no capital rationing; zero tolerance for bad growth; and know the value of assets and be prepared to take action.

Introduction

Capital allocation is the most fundamental responsibility of a senior management team of a public corporation. Successful capital allocation means converting inputs, including money, things, ideas, and people, into something more valuable than they would be otherwise. The net present value (NPV) test is a simple, appropriate, and classic way to determine whether management is living up to this responsibility. Passing the NPV test means that \$1 invested in the business is worth more than \$1 in the market. This occurs when the present value of the long-term cash flow from an investment exceeds the initial cost.

Why should value determine whether a management team is living up to its responsibility? There are two reasons. The first is that companies must compete. A company that is allocating its resources wisely will ultimately prevail over a competitor that is allocating its resources foolishly. The second is that inputs have an opportunity cost, or the value of the next best alternative. Unless an input is going to its best and highest use, it is underperforming relative to its opportunity cost.

The process of making inputs more valuable has a number of aspects. A logical starting point is a strategy. Properly conceived, a strategy requires a company to specify the trade-offs it will make to establish a position in the marketplace that creates value. A strategy also requires a company to align its activities with its positioning and to execute effectively.¹

Since a company's strategy is often already in place when a new chief executive officer (CEO) takes over, capital allocation generally becomes his or her main responsibility. While a proper and comprehensive discussion of capital allocation requires a consideration of intangible and human resources, our focus here is on how companies spend money.

The problem is that many CEOs, while almost universally well intentioned, don't know how to allocate capital effectively. Warren Buffett, chairman and CEO of Berkshire Hathaway, describes this reality in his 1987 letter to shareholders. He discusses the point of why it is beneficial for Berkshire Hathaway's corporate office to allocate the capital of the companies it controls. Buffett is worth quoting at length:²

This point can be important because the heads of many companies are not skilled in capital allocation. Their inadequacy is not surprising. Most bosses rise to the top because they have excelled in an area such as marketing, production, engineering, administration or, sometimes, institutional politics.

Once they become CEOs, they face new responsibilities. They now must make capital allocation decisions, a critical job that they may have never tackled and that is not easily mastered. To stretch the point, it's as if the final step for a highly-talented musician was not to perform at Carnegie Hall but, instead, to be named Chairman of the Federal Reserve.

The lack of skill that many CEOs have at capital allocation is no small matter: After ten years on the job, a CEO whose company annually retains earnings equal to 10% of net worth will have been responsible for the deployment of more than 60% of all the capital at work in the business.

CEOs who recognize their lack of capital-allocation skills (which not all do) will often try to compensate by turning to their staffs, management consultants, or investment bankers. Charlie [Munger] and I have frequently observed the consequences of such "help." On balance, we feel it is more likely to accentuate the capital-allocation problem than to solve it.

In the end, plenty of unintelligent capital allocation takes place in corporate America. (That's why you hear so much about "restructuring.")

Intelligent capital allocation requires understanding the long-term value of an array of opportunities and spending money accordingly. It also includes knowing the value of a firm's individual assets and being willing to sell them when they are worth more to others.

We believe that long-term growth in value per share should guide capital allocation decisions. A necessary corollary is that there is a time when shrinking the business is the most beneficial course for ongoing shareholders. In some cases, for instance, buying back shares is a wiser choice than expanding by means of capital expenditures or acquisition.

Capital allocation is a dynamic process, so the correct answer to most questions is, "It depends." Sometimes acquiring makes sense and other times divesting is the better alternative. There are times to issue equity and times to retire it. Because the components that determine price and value are changing constantly, so too must the assessments that a CEO makes. As Buffett says, "The first law of capital allocation—whether the money is slated for acquisitions or share repurchases—is that what is smart at one price is dumb at another."³

Buffett also discusses what he calls the "institutional imperative," a force that is also pertinent.⁴ The force has multiple aspects as he describes it, but a pair of them are relevant here. One is that subordinates will readily create spreadsheets and studies to support the business craving of the leader. Another is that companies will "mindlessly" imitate one another, whether in M&A or executive compensation.

The message here should be clear. A decision isn't good just because someone in the organization can justify it or because some other company is doing it. Proper capital allocation requires a sharp analytical framework and independence of mind.

In our experience, very few CEOs, and chief financial officers for that matter, have what we call the "North Star of value." The North Star is not the brightest star, but it doesn't move much throughout the night or year. As a result, it provides a reliable sense of direction. Likewise, companies that have a North Star of value have an unwavering view of value no matter what is going on. It is common for executives to solicit input from a range of stakeholders, hear varying points of view, and walk away confused and unsure about the proper course of action. This doesn't happen to executives with the North Star of value, especially since they may have better information about their company's prospects than the market does.

Incentives are another barrier to proper capital allocation. An executive who is paid to deliver a target based on short-term earnings per share may well act very differently than an executive who is focused on building long-term value per share. In assessing management, ask a fundamental question: If there is a conflict between maximizing a reward based on the incentive plan and creating long-term value per share, which route will the executive select?

William Thorndike's excellent book, *The Outsiders: Eight Unconventional CEOs and Their Radically Rational Blueprint for Success*, deeply inspired this report.⁵ Thorndike shares the stories of eight CEOs who created tremendous value per share during their tenures. One theme that comes out clearly in the book, and is explicit in the subtitle, is that these CEOs appeared out of step with conventional wisdom as they were building value. The North Star of value guided their decisions, and they had the independence of mind to make the best choices.

This report has three parts:

1. **Groundwork.** This part starts by showing the sources of capital. It then specifies capital allocation options, shows how companies have allocated capital in the past 35 years, and explains why this issue of capital allocation is particularly relevant today.
2. **Capital allocation alternatives.** This section documents how much money companies have allocated to each alternative over time, offers an analytical framework for judging value creation, summarizes the academic research on the payoffs to such investments, and provides a brief outlook for spending.
3. **Assessing a company's capital allocation skills.** This part discusses methods to assess past capital allocation choices, how to evaluate incentives, and the five principles of capital allocation.

Groundwork: Where Does the Money Come From and Where Has It Gone?

If the job of management is to deploy capital so as to add value, it makes sense to start with a discussion of where capital comes from and how management teams have spent it in the past. The sources of capital include the cash the business generates and access to the capital of claimholders, including debtors and shareholders. A company can also sell an asset, which is a one-time realization of the cash flow the asset is expected to generate over its life.

Businesses that grow rapidly generally require a sizable amount of investment. For example, imagine a restaurant concept that is highly successful. To satiate demand that firm must build lots of restaurants and hence invest a substantial sum in expansion. The rate of return on incremental capital is the maximum growth rate in operating profit a business can reach without external financing. By extension, a company with a return on invested capital (ROIC) greater than its growth rate will generate surplus capital.⁶

Companies that cannot fund their growth internally must access cash externally, either by borrowing or selling equity. The pecking order theory is an idea in corporate finance that says that managers of companies will typically choose to fund investments first with cash that the company generates internally, next with debt, and finally with equity.⁷ One essential tenet of thoughtful capital allocation is that all capital has an opportunity cost, whether the source is internal or external.

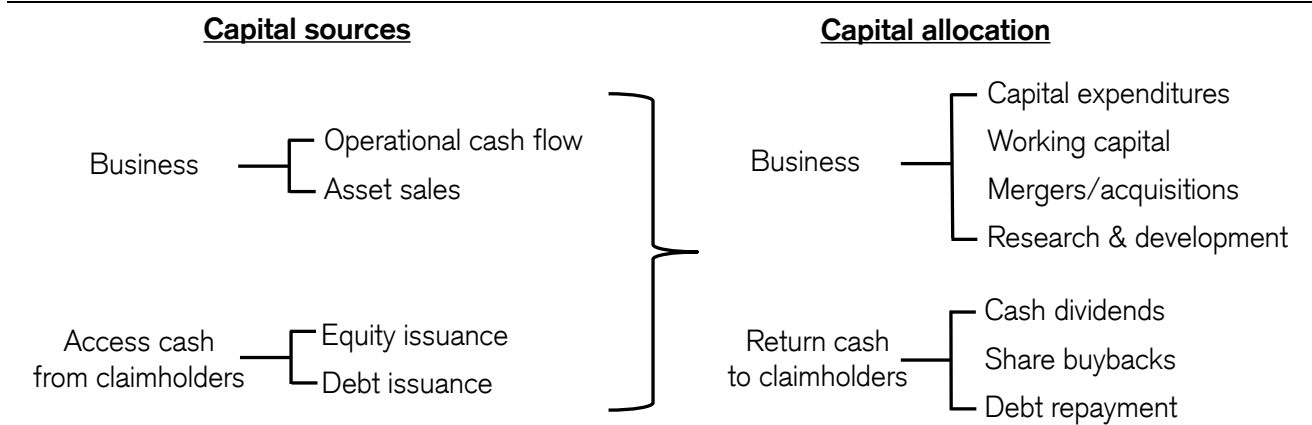
The uses of capital are where money goes. Executives can invest in the business through capital expenditures, increases in working capital, research and development, or mergers and acquisitions. These investments allow a company to grow. But growth, in and of itself, is never the goal of a thoughtful capital allocator. The proper metric of success is an increase in long-term value per share.

A company can also return cash to debt and equity holders. Debt repayment, a return of some or all principal and interest a company owes, is straightforward. A company can return cash to shareholders either by paying a dividend, where all holders receive the same amount, or by buying back stock. In a buyback, shareholders sort themselves. Those who want cash sell their shares and those who want to increase their stake in the company hold their shares. A dividend treats all shareholders the same no matter what the stock price.

In a buyback, selling shareholders benefit at the expense of ongoing shareholders if the stock is overvalued, and ongoing shareholders benefit at the expense of selling shareholders if the stock is undervalued. All shareholders are treated uniformly only if the stock price is at fair value.⁸

Exhibit 1 summarizes the sources and uses of financial capital. These follow closely the alternatives and choices that Thorndike specifies in *The Outsiders*.

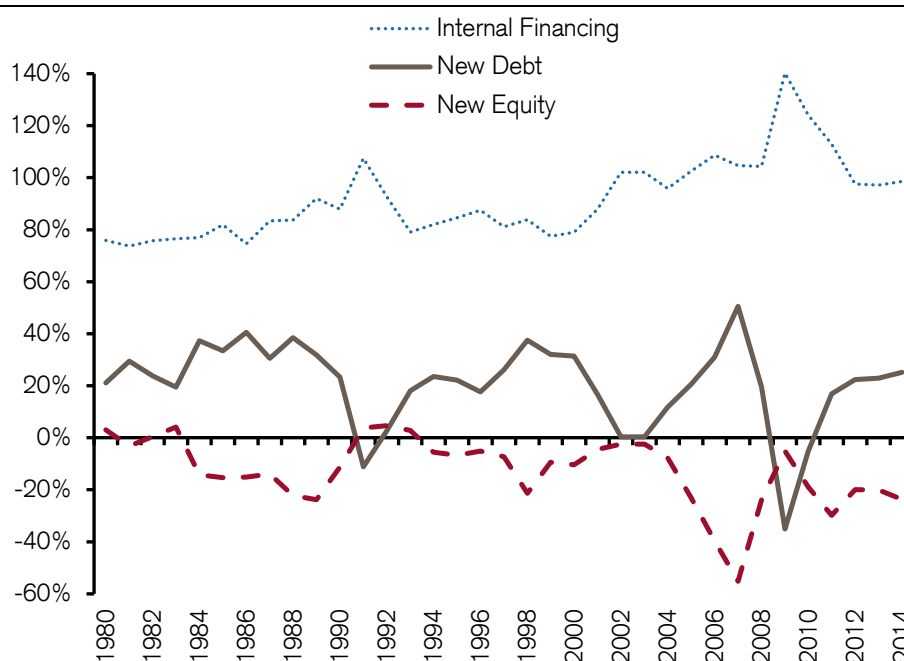
Exhibit 1: Sources and Uses of Financial Capital



Source: Credit Suisse.

Sources of Capital. Exhibit 2 shows the sources of capital for companies in the U.S. from 1980 through 2014. Internal financing, or the cash generated by the businesses, represented more than 90 percent of the total source of capital during this period. If we extend this analysis back to include all of the years following World War II, internal funding is still more than 80 percent of the total source of capital. Issuance of new debt is the next most significant source of capital. Equity has been a negative source of capital, which means that companies have bought back more shares than they have issued. This analysis does not reflect equity issuance for compensation.

Exhibit 2: U.S. Sources of Capital, 1980-2014



Source: Board of Governors of the Federal Reserve System, Division of Research and Statistics, Flow of Funds Accounts Table F.103.

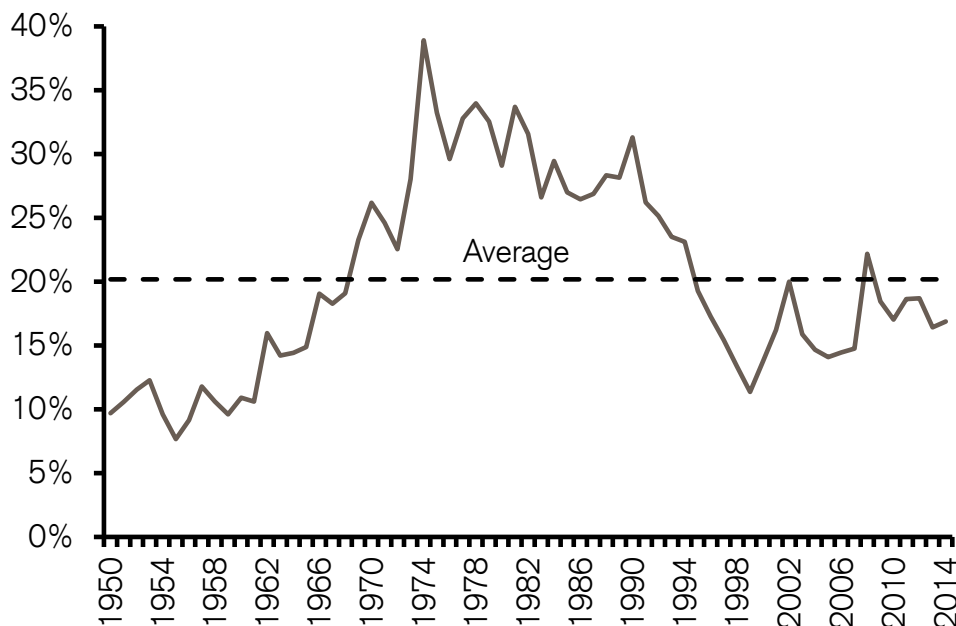
Internal financing represents a larger percentage of the total source of capital for companies in the U.S. than for companies in other developed countries. For example, internal financing has been about 70 percent of the total source for the United Kingdom, 66 percent for Germany, 55 percent for France, and 50 percent for Japan.⁹ The ratio of internal financing to the total source of capital tends to correlate with the underlying return on invested capital. A country with a high ROIC can fund a greater percentage of its investments with internally generated cash than a country with a low ROIC.

There are pros and cons to having internal financing represent a high percentage of investment funding. The pro is that companies are earning high returns on capital in general and need not rely on capital markets to fund their growth. The con is that companies can deploy internally generated funds into value-destroying investments. The need to raise money from the capital markets creates a check on management's spending plans.

Indeed, Peter Bernstein, the renowned financial historian and economist, once suggested that all companies should be required to pay out 100 percent of their earnings and then appeal to the markets when they want funds for investment. He argued that markets are more effective than companies at allocating capital, and as a result the overall effectiveness of capital allocation would improve if left to the devices of the market.¹⁰

The choice of debt or equity as a source of funding also determines capital structure. Exhibit 3 shows the debt-to-total capital ratio for the largest companies in the U.S. from 1950 through 2014. We define the debt-to-total capital ratio as the book value of debt divided by the sum of the book value of debt and the market value of equity. The ratio is currently 17 percent, below the long-term average of about 20 percent. The availability and cost of debt, along with the appetite for debt and the general level of stock prices, determine this ratio.

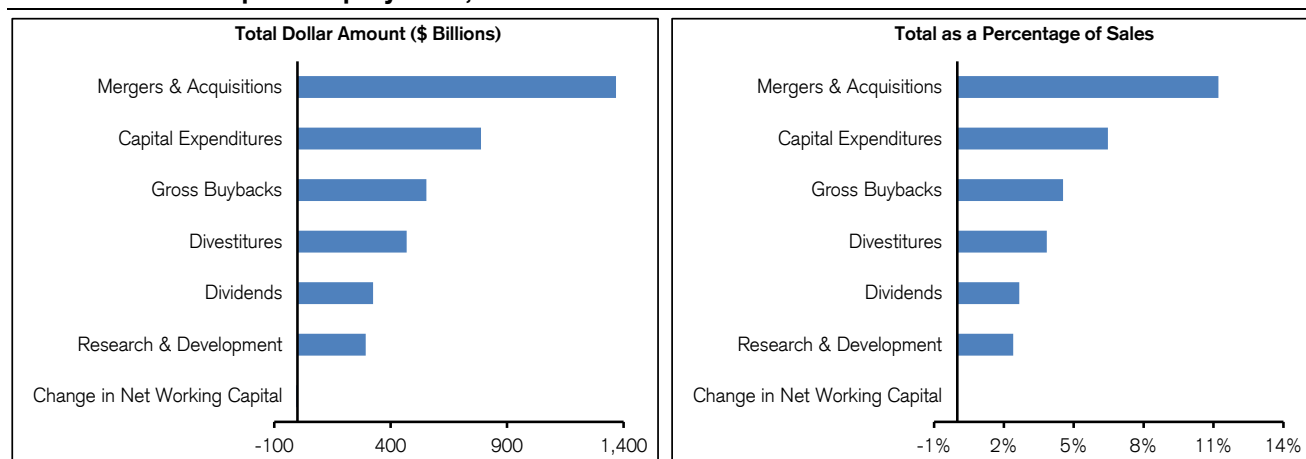
Exhibit 3: U.S. Debt-to-Total Capital, 1950-2014



Source: Credit Suisse HOLT®.

Uses of Capital. Exhibit 4 shows how the top 1,500 companies in the U.S., excluding companies in the financial services and regulated utility industries, deployed capital in 2014. While just a snapshot for a particular year, the ranking reasonably reflects how companies in the U.S. have allocated capital over time.

Exhibit 4: U.S. Capital Deployment, 2014

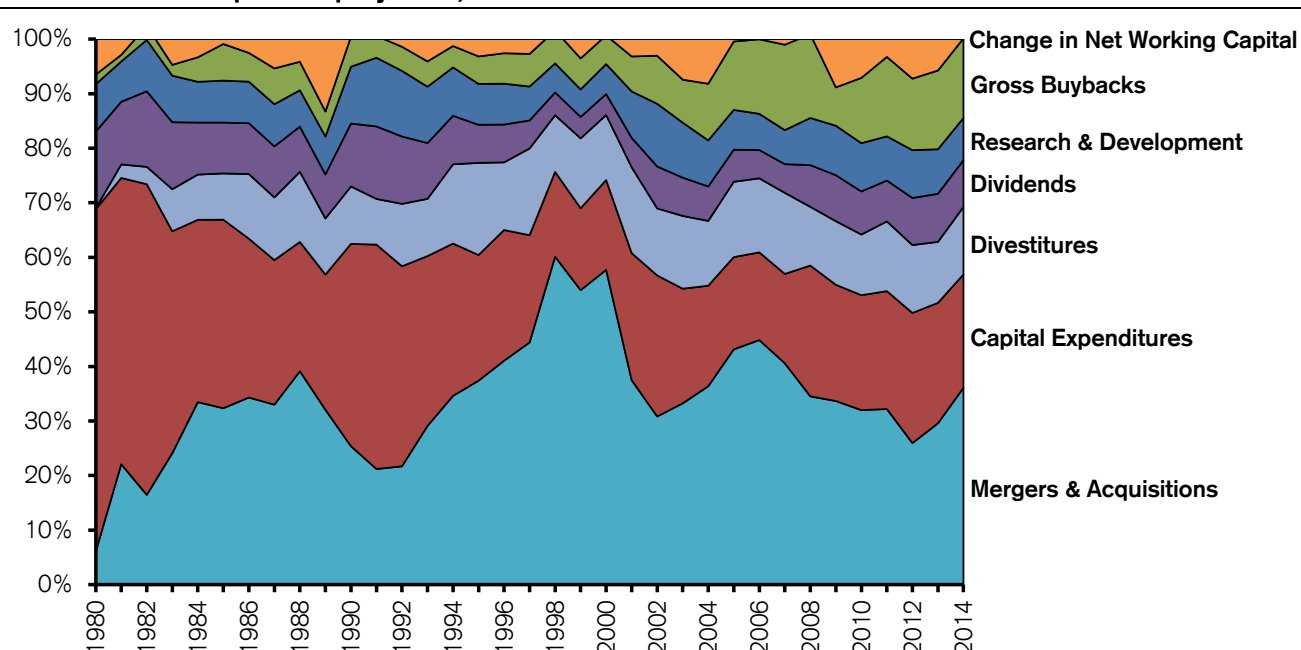


Source: Credit Suisse HOLT, Thomson Reuters DataStream.

Note: Data for R&D, capital expenditures, working capital, buybacks, and dividends exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Exhibit 5 shows the breakdown of spending by source from 1980-2014.

Exhibit 5: U.S. Capital Deployment, 1980-2014

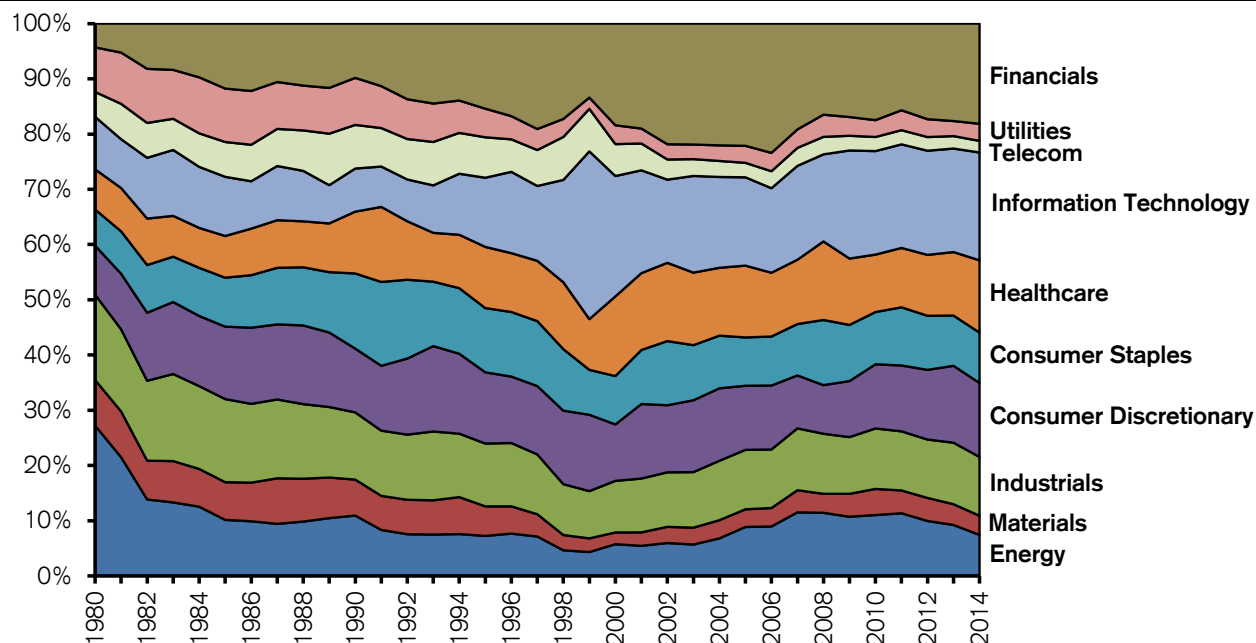


Source: Credit Suisse HOLT, Thomson Reuters DataStream.

Note: Data for R&D, capital expenditures, working capital, buybacks, and dividends exclude financial companies and regulated utilities; data for mergers & acquisitions and divestitures include all industries.

Similar to 2014, mergers and acquisitions (M&A) and capital expenditures are the largest uses of capital over time. An examination of the changes from 1980 through 2014 reveals some noteworthy patterns:

- M&A is by far the largest use of capital, but it is very cyclical, ranging from a low of less than 1 percent of sales in 1980 to almost 30 percent at the peak in the late 1990s. M&A activity tends to be greatest when the economy is doing well, the stock market is up, and access to capital is easy. As a result, companies frequently do deals when they can, rather than when they should.
- Capital expenditures went from roughly 10 percent of sales to approximately 6 percent over this period. The simplest explanation is that the composition of the economy has changed, with businesses that require less capital investment replacing those that require more. (See Exhibit 6.) For example, the energy, materials, and industrial sectors represented 51 percent of the market capitalization of the top 1,500 companies in the U.S. market in 1980 but just 22 percent in 2014. During the same time, the healthcare and technology sectors went from 17 to 33 percent of the market capitalization. This shift also helps explain the increase in cash holdings.¹¹ Another possible cause of the dip in capital expenditures is that public companies are now investing too little. Academic research suggests that public companies invest less than comparable private companies because they want to maximize short-term earnings.¹²
- Share buybacks went from virtually nonexistent in 1980 to a large use of capital in the last decade. In 1982, the Securities and Exchange Commission defined rules that created a safe harbor for companies to repurchase shares, eliminating the threat of stock manipulation and opening the floodgates for buybacks. Over the past 30 years, companies have shifted their payouts from mostly dividends to a combination of dividends and buybacks. Research shows that the propensity to distribute cash to shareholders has held remarkably steady after accounting for firm characteristics including size, age, and profitability.¹³
- Research and development (R&D) expenditures have risen steadily, growing from 1.3 percent of sales in 1980 to 2.4 percent in 2014. The shift in the composition of the economy that accounts for the decline in capital expenditures also explains the rise in R&D. Further, companies that rely on R&D tend to hold more cash than companies that are less reliant on R&D. This partially accounts for the swell of cash on corporate balance sheets.

Exhibit 6: U.S. Sector Composition, 1980-2014

Source: Credit Suisse HOLT.

Exhibit 7 shows a detailed history of capital deployment from 1980-2014, adjusted for inflation. It is worth noting that the standard deviations of the growth rates, which appear in the bottom row, are small for R&D, dividends, and capital spending relative to those of buybacks, M&A, and divestitures. Standard deviation is a measure of how much something varies from an average. These standard deviations provide a glimpse into how managers think about each use of capital. The lower the standard deviation, the more sacrosanct management deems that investment. Exhibit 8 represents the same deployment numbers as a percentage of sales.

Exhibit 7: U.S. Capital Deployment, 1980-2014

	Total Amount (2014 U.S. Dollars)						
	Mergers & Acquisitions	Capital Expenditures	Research & Development	Net Working Capital	Gross Buybacks	Divestitures	Dividends
1980	52,679	545,190	75,468	56,490	15,529	1,595	122,267
1981	233,275	554,433	78,029	30,568	12,839	26,187	121,334
1982	142,915	494,516	81,629	-21,204	22,597	27,594	120,282
1983	247,242	417,178	87,485	48,374	20,410	79,159	125,975
1984	439,218	438,737	98,068	43,746	59,009	108,910	125,158
1985	427,989	457,396	101,774	11,922	88,740	112,208	123,454
1986	482,501	409,495	107,079	35,554	74,214	166,622	131,102
1987	468,858	376,422	109,871	76,374	93,200	163,289	132,879
1988	696,598	421,953	118,788	73,887	93,085	229,074	147,368
1989	563,619	435,891	122,430	233,353	80,634	180,977	141,727
1990	302,659	442,001	124,246	-5,339	65,635	125,474	137,441
1991	215,289	417,563	127,848	-5,966	40,661	85,051	134,868
1992	240,312	406,178	133,182	15,573	48,976	126,795	136,758
1993	382,374	409,035	135,689	53,687	60,984	137,821	134,368
1994	529,164	426,602	135,553	19,407	60,080	222,265	135,673
1995	772,710	475,980	154,960	65,592	104,181	349,061	144,252
1996	889,032	518,682	161,926	56,103	121,034	268,734	150,193
1997	1,296,276	574,003	181,533	79,352	174,524	463,918	149,899
1998	2,226,042	575,183	197,217	-58,829	223,856	384,681	154,348
1999	2,119,992	589,479	198,143	138,922	223,351	503,365	154,034
2000	2,276,017	649,814	216,489	-26,813	207,652	470,321	151,468
2001	983,792	610,772	223,038	83,476	168,113	413,029	141,624
2002	571,319	479,180	213,018	56,526	163,152	227,726	142,480
2003	713,614	451,235	216,346	159,695	169,151	286,403	150,778
2004	954,442	483,209	221,502	214,839	272,375	311,643	165,559
2005	1,341,396	526,067	226,864	13,434	390,244	429,527	182,831
2006	1,709,025	612,582	252,885	1,290	520,614	517,309	197,789
2007	1,635,825	660,062	251,306	41,606	630,879	599,056	212,008
2008	970,602	673,922	243,013	-24,912	431,401	302,901	214,836
2009	819,688	518,753	220,547	215,444	171,339	283,942	205,393
2010	871,346	573,506	240,977	193,682	325,846	302,751	214,991
2011	1,014,023	680,524	254,957	102,819	458,677	402,742	235,956
2012	792,239	728,243	267,579	221,226	400,265	380,108	263,382
2013	995,250	742,856	274,546	193,728	485,708	376,279	296,802
2014	1,367,540	788,216	292,748	-5,176	553,829	468,952	324,983
CAGR	10.1%	1.1%	4.1%		11.1%	18.2%	2.9%
St. Dev.	67.2%	9.9%	4.9%	593.2%	45.4%	265.3%	5.2%

Source: Credit Suisse HOLT, Thomson Reuters DataStream, and Credit Suisse.

Note: All figures in 2014 U.S. dollars (millions); R&D, capital expenditures, working capital, buybacks, and dividends is the top 1,500 "industrials" (ex-financials and regulated utilities), whereas M&A and divestitures include all industries.

Exhibit 8: U.S. Capital Deployment, 1980-2014

	As a Percentage of Sales						
	Mergers & Acquisitions	Capital Expenditures	Research & Development	Net Working Capital	Gross Buybacks	Divestitures	Dividends
1980	0.9%	9.7%	1.3%	1.0%	0.3%	0.0%	2.2%
1981	4.2%	10.1%	1.4%	0.6%	0.2%	0.5%	2.2%
1982	2.8%	9.7%	1.6%	-0.4%	0.4%	0.5%	2.4%
1983	4.8%	8.2%	1.7%	0.9%	0.4%	1.5%	2.5%
1984	8.4%	8.4%	1.9%	0.8%	1.1%	2.1%	2.4%
1985	8.3%	8.9%	2.0%	0.2%	1.7%	2.2%	2.4%
1986	9.8%	8.3%	2.2%	0.7%	1.5%	3.4%	2.7%
1987	9.2%	7.4%	2.2%	1.5%	1.8%	3.2%	2.6%
1988	12.9%	7.8%	2.2%	1.4%	1.7%	4.2%	2.7%
1989	10.2%	7.9%	2.2%	4.2%	1.5%	3.3%	2.6%
1990	5.3%	7.7%	2.2%	-0.1%	1.2%	2.2%	2.4%
1991	3.8%	7.4%	2.3%	-0.1%	0.7%	1.5%	2.4%
1992	4.2%	7.1%	2.3%	0.3%	0.9%	2.2%	2.4%
1993	6.5%	6.9%	2.3%	0.9%	1.0%	2.3%	2.3%
1994	8.5%	6.8%	2.2%	0.3%	1.0%	3.6%	2.2%
1995	11.7%	7.2%	2.3%	1.0%	1.6%	5.3%	2.2%
1996	12.6%	7.4%	2.3%	0.8%	1.7%	3.8%	2.1%
1997	17.3%	7.6%	2.4%	1.1%	2.3%	6.2%	2.0%
1998	29.6%	7.7%	2.6%	-0.8%	3.0%	5.1%	2.1%
1999	26.8%	7.4%	2.5%	1.8%	2.8%	6.4%	1.9%
2000	26.7%	7.6%	2.5%	-0.3%	2.4%	5.5%	1.8%
2001	11.7%	7.3%	2.7%	1.0%	2.0%	4.9%	1.7%
2002	7.0%	5.8%	2.6%	0.7%	2.0%	2.8%	1.7%
2003	8.2%	5.2%	2.5%	1.8%	1.9%	3.3%	1.7%
2004	9.9%	5.0%	2.3%	2.2%	2.8%	3.2%	1.7%
2005	13.3%	5.2%	2.2%	0.1%	3.9%	4.3%	1.8%
2006	16.1%	5.8%	2.4%	0.0%	4.9%	4.9%	1.9%
2007	15.2%	6.1%	2.3%	0.4%	5.9%	5.6%	2.0%
2008	9.0%	6.2%	2.2%	-0.2%	4.0%	2.8%	2.0%
2009	8.4%	5.3%	2.3%	2.2%	1.8%	2.9%	2.1%
2010	8.2%	5.4%	2.3%	1.8%	3.1%	2.8%	2.0%
2011	8.7%	5.9%	2.2%	0.9%	4.0%	3.5%	2.0%
2012	6.8%	6.2%	2.3%	1.9%	3.4%	3.2%	2.2%
2013	8.4%	6.3%	2.3%	1.6%	4.1%	3.2%	2.5%
2014	11.2%	6.5%	2.4%	0.0%	4.5%	3.8%	2.7%

Source: Credit Suisse HOLT, Thomson Reuters DataStream, and Credit Suisse.

Note: R&D, capital expenditures, working capital, buybacks, and dividends is the top 1,500 "industrials" (ex-financials and regulated utilities), whereas M&A and divestitures include all industries.

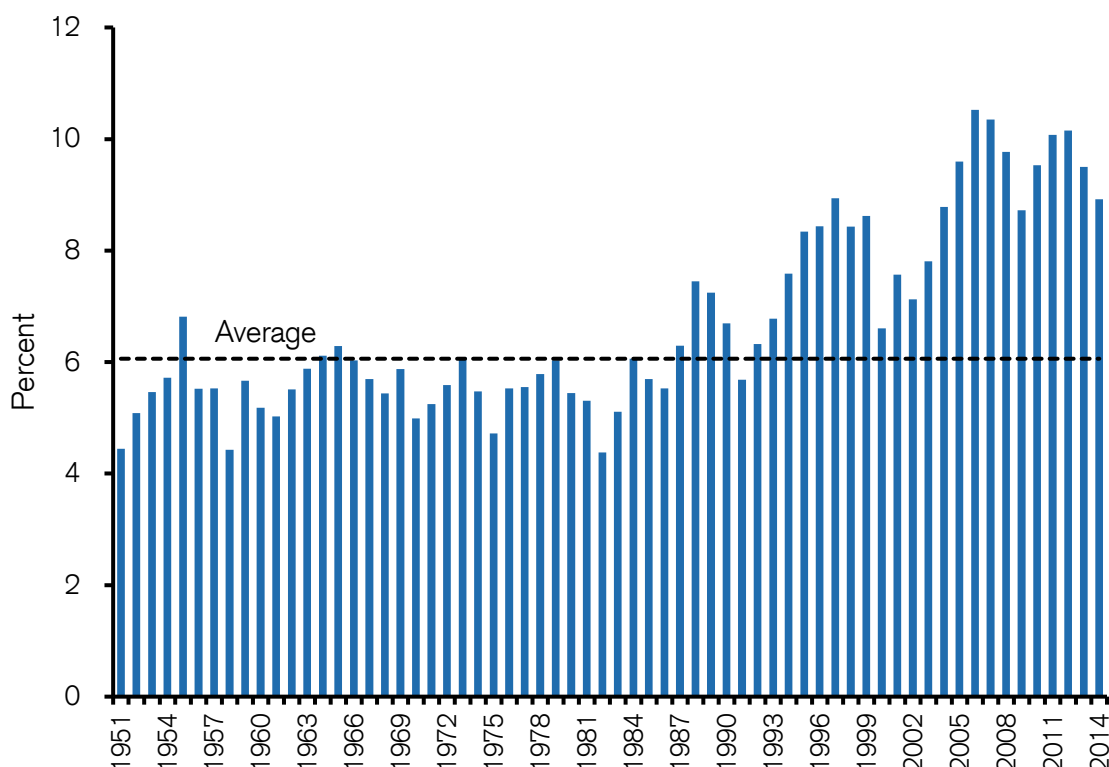
The issue of judicious capital allocation is certainly nothing new. Henry Singleton, the CEO whom William Thorndike holds up as the standard for excellence, started his company, Teledyne, more than 50 years ago. And Buffett's quote about capital allocation is more than a quarter century old. Still, the issue feels particularly pressing today.

Recent Trends in Cash Flow Return on Investment and Asset Growth. Larry Fink, the CEO of BlackRock, Inc., an investment firm with more than \$4.5 trillion in assets under management, captured the current zeitgeist in a letter dated March 2014. Addressed to the leaders of U.S. corporations, the letter argued that many companies are shying away from investments with long-term payoffs in favor of returning cash to shareholders via dividends and buybacks. In effect, Fink argued that the chiefs of U.S. industry are misallocating capital.¹⁴

Let's turn to some concepts and numbers to quantify Fink's assertion. The maximum earnings growth rate a company can achieve through internal funding is a function of its ROIC and payout ratio. High ROICs and low payout ratios allow for higher achievable growth rates than low ROICs and high payout ratios. Low ROIC or high payout businesses can certainly grow but need to access debt or equity capital to do so.

Here are the numbers. Cash flow return on investment (CFROI®) remains high in the U.S. (see Exhibit 9). CFROI measures the cash returns a business earns on the investments it makes. Since CFROI is also adjusted for inflation, it is an ideal tool for comparing results over time. The current level of 9 percent is well above the historical average of approximately 6 percent from 1951-2014. The number is even higher excluding the excess cash parked on the balance sheets of many companies. The current levels of ROIC and CFROI suggest that companies today can fund substantial growth through internally-generated funds.

Exhibit 9: U.S. CFROI, 1951-2014



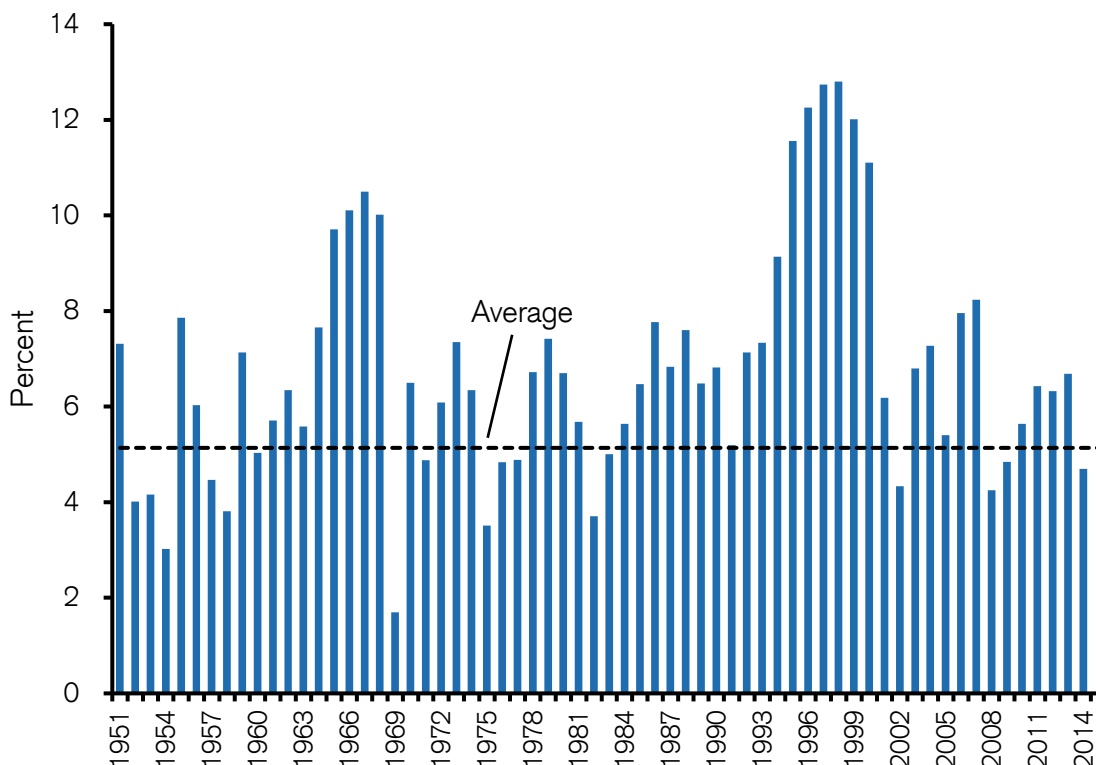
Source: Credit Suisse HOLT.

Note: All U.S. industrial firms with a market capitalization of more than \$250 million scaled through time.

* CFROI® is a registered trademark in the United States and other countries (excluding the United Kingdom) of Credit Suisse Group AG or its affiliates.

Exhibit 10 shows the annual rate of asset growth, adjusted for inflation, from 1951-2014. In 2014, spending was weak relative to the long-term average, a point that is particularly pronounced given that CFROIs are high. It's hard to know exactly why companies remain so reticent to invest, but executives commonly point to political and economic uncertainty.¹⁵

Exhibit 10: U.S. Real Asset Growth Rate, 1951-2014

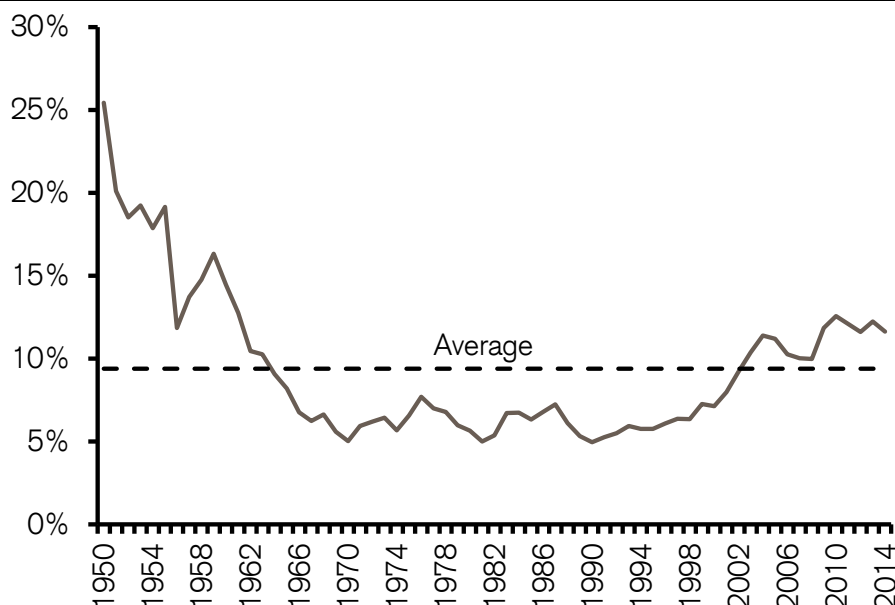


Source: Credit Suisse HOLT.

Note: All U.S. industrial firms with a market capitalization of more than \$250 million scaled through time.

The combination of high return on investment and modest growth means that businesses are generating sizable sums of cash. For example, companies in the S&P 500, excluding the financial services sector, had a balance of cash and marketable securities in excess of \$1.4 trillion at the end of 2014, roughly 8 percent of the market capitalization of the index. This cash balance is even more remarkable considering that companies in the S&P 500 disbursed close to \$900 billion to their shareholders through buybacks and dividends in 2014.

Cash balances are high today, and it is common to hear market commentators say that we are at all-time highs. But we are by no means in uncharted waters if you measure cash as a percentage of assets. Exhibit 11 shows that at 12 percent, today's cash as a percentage of assets is well below the levels in the post-World War II period. Further, a sizable sum of today's cash balance is offshore, and companies cannot repatriate it without incurring an additional tax burden. So between the shift in the composition of the economy and tax policy, some increase in cash holdings should come as no surprise.

Exhibit 11: U.S. Cash as a Percentage of Total Assets, 1950-2014

Source: Credit Suisse HOLT.

Note: Top 1,500 U.S. industrial firms.

We can summarize the discussion so far as follows:

- Internal financing represents the vast majority of the source of capital for companies in the U.S. Internal financing supplies less capital to companies in other developed countries, in part because those countries have lower ROICs.
- The primary uses of capital include M&A and capital expenditures, although M&A is very cyclical. Over the last 35 years spending on capital expenditures and dividends has declined as a percentage of sales, while R&D and share buybacks have increased as a percentage of sales. These changes reflect the shift in the structure of the underlying economy.
- ROIC is high in the U.S., and the rate of investment is middling. As a consequence, companies are generating strong free cash flow, and capital allocation is more important than ever.

Before delving into each of the specific uses of capital, it is worth considering what the academic research says about capital allocation. The findings are easy to condense: "Asset growth rates are strong predictors of future abnormal returns." This is true in both U.S. and international markets.¹⁶

More specifically, firms with low asset growth rates earn substantially higher shareholder returns, after adjusting for risk, than firms with high asset growth rates. Further, companies that contract their assets tend to generate higher shareholder returns than companies that expand their assets.

High returns to shareholders tend to follow events such as spin-offs, dividend initiations, share buybacks, and debt prepayments, whereas low returns to shareholders generally follow events such as acquisitions and stock and debt issuance.

The academic research supports the notion that capital allocation is challenging and that growth is not inherently good. But we must keep in mind that context is very important. Recall that the correct answer to almost every capital allocation question is, "It depends." We need to look beyond base rates, as informative as they are, to understand what truly drives or impedes value creation. We now turn to the details of the major uses of capital.

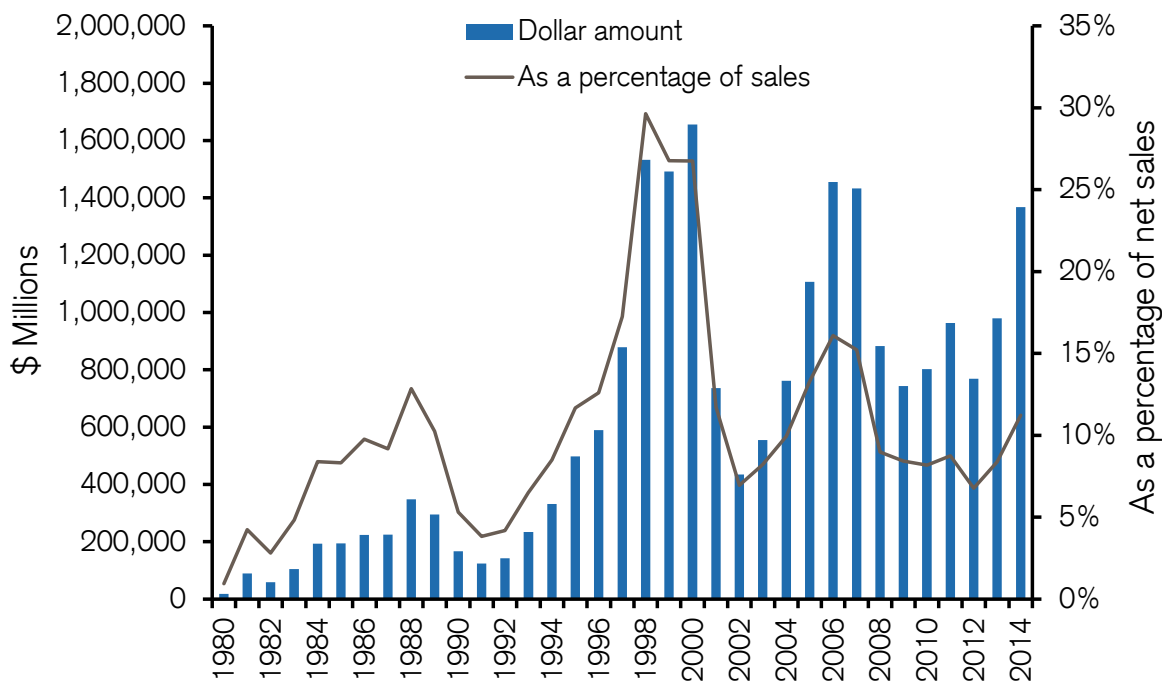
Capital Allocation Alternatives

For each alternative, we will consider four aspects: the trend in spending, how to think about the alternative from an economic standpoint, the empirical research, and the outlook for future spending.

Mergers and Acquisitions. M&A is by far the largest source of redistribution of corporate resources of all the alternatives. For many companies, M&A is the most significant means to pursue strategic goals and the most costly way to do so. And if M&A volume continues to average 9 percent of the equity market capitalization of the U.S., as it has since 1980, nearly all companies and investment portfolios will feel the effect of M&A at some point.

Exhibit 12 shows the dollar amount of M&A as well as M&A as a percentage of sales from 1980 to 2014. M&A tends to follow the stock market closely, with more M&A activity when the stock market is up.¹⁷ It comes as no surprise that companies that act early in an M&A cycle tend to generate higher returns than those that act later. The first movers in an M&A wave enjoy the benefits of a larger pool of acquisition targets and cheaper valuations than companies that acquire later in the cycle. Later acquirers are encouraged to act based on bandwagon effects, or what Buffett calls the institutional imperative, and an accommodating environment for financing.¹⁸

Exhibit 12: U.S. Mergers and Acquisitions, 1980-2014

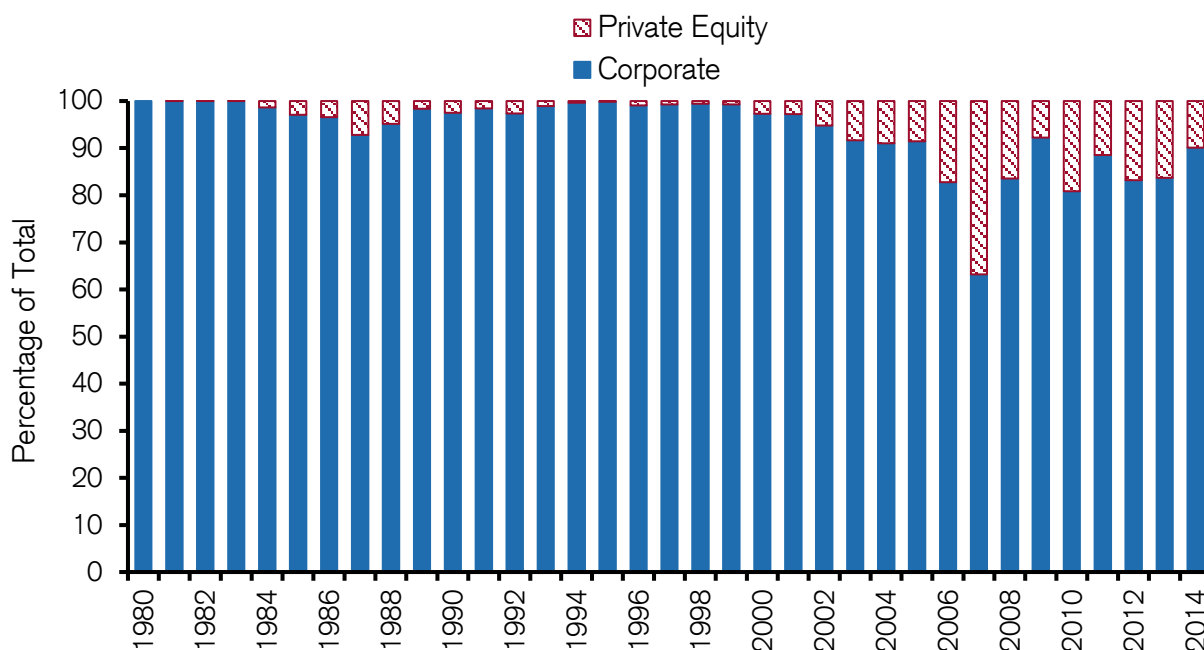


Source: Thomson Reuters DataStream, Credit Suisse HOLT, Credit Suisse.

Note: Dollar amounts are not inflated. U.S. announced domestic mergers; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases.

Private equity has also played an increasingly prominent role in M&A (see Exhibit 13). Private equity rose from essentially nothing to seven percent of deal volume at the peak of the leveraged buyout boom in the 1980s. In the early 2000s, private equity's percentage of M&A rose steadily, reaching a peak in 2007 at 37 percent of the volume. There was a substantial drop-off in participation through the financial crisis, but private equity is back to an average of about 15 percent of volume in recent years.

Exhibit 13: Private Equity Percentage of M&A Volume, 1980-2014



Source: Thomson Reuters DataStream, Credit Suisse HOLT, Credit Suisse.

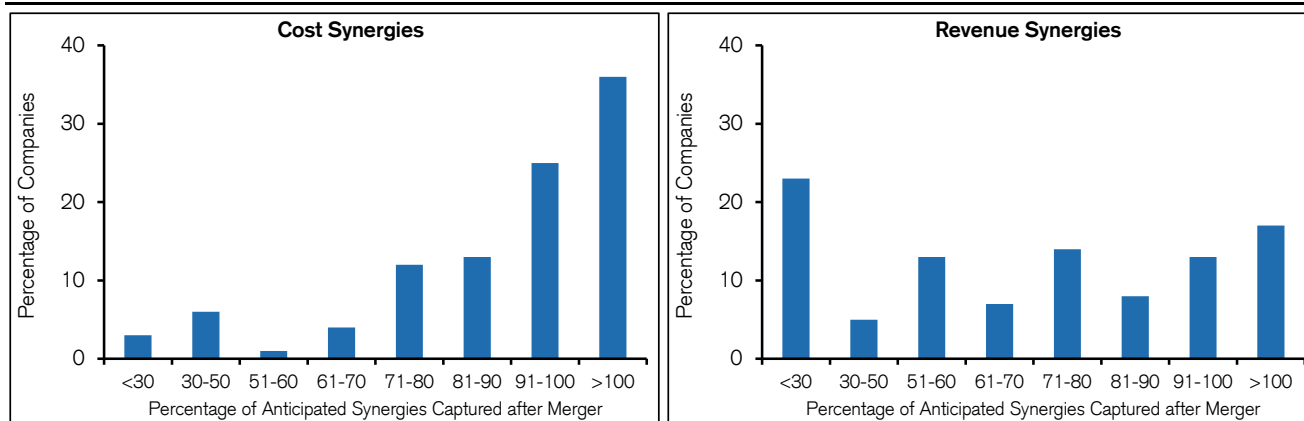
Note: U.S. deal activity; corporate M&A includes announced domestic mergers and excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases.

How should companies assess the merit of an M&A deal? Mark Sirower, a consultant at Deloitte, suggests that acquirers use the following formula:¹⁹

$$\text{Net present value of the deal} = \text{present value of the synergies} - \text{premium}$$

Simply stated, the formula says that a deal is good if the acquirer gets more than it pays for. The underlying premise is that the target's stock price, pre-deal, accurately reflects the present value of the company's future free cash flow. So the deal only creates value for the buyer if the synergy from putting the businesses together exceeds the premium for control the acquirer must pay to close the deal. This equation is more fundamental than superficial metrics such as accretion to earnings per share, which doesn't appear to factor into the market's reaction.²⁰ As a result, the formula provides much more insight into a deal's economic virtue.

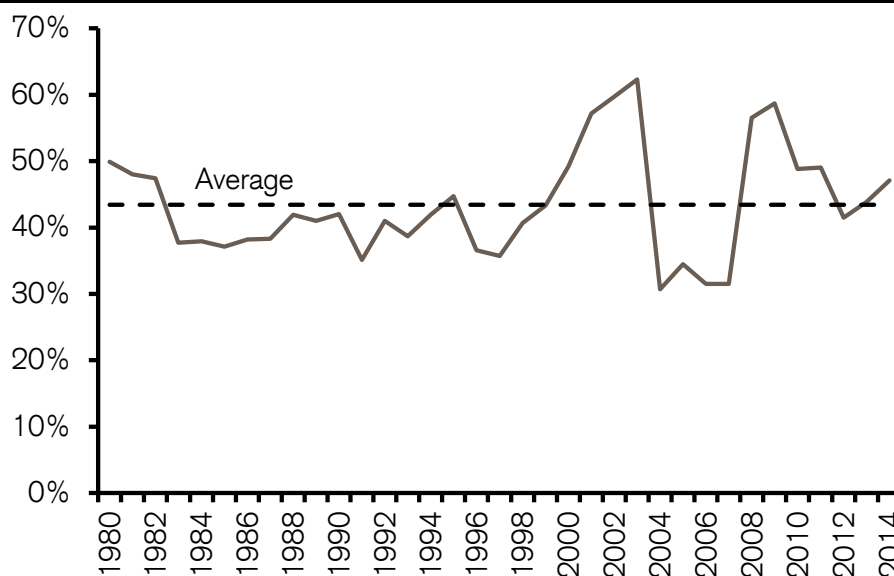
Let's take a closer look at the terms in the equation. Exhibit 14 shows the results of a survey of corporate executives that McKinsey, a consulting firm, conducted regarding synergy. There is a clear difference between cost synergies, the cost the companies can save by removing redundancies, and revenue synergies, the anticipated increase in sales from combining businesses. Other forms of synergies have historically played a less substantial role.²¹

Exhibit 14: Cost Synergies Are More Reliable than Revenue Synergies

Source: Scott A. Christofferson, Robert S. McNish, and Diane L. Sias, "Where Mergers Go Wrong," McKinsey on Finance, Winter 2004, 1-6.

Cost synergies are much more reliable than revenue synergies. About one-third of the executives surveyed said that their company achieved all or more of the anticipated cost synergy, while one-quarter of the companies overestimated their cost synergy by 25 percent or more. But roughly 70 percent of mergers fail to deliver the anticipated revenue synergy. The most common challenges companies cite for synergy realization include delays in implementing planned actions, underestimation of costs and complexities, and flat-out overestimation of synergies.²²

Exhibit 15 shows the average deal premium, with each deal receiving an equal weight. The premium is the difference between the price a buyer is willing to pay and the prevailing market price prior to any anticipation of a deal. For example, if a stock is trading at \$100 and a buyer offers \$140, the premium is 40 percent (\$40/\$100). While the premium is generally straightforward to calculate for a particular transaction, the series of premiums over time is difficult to aggregate. The current average premium is 47 percent, not far from the long-term norm.

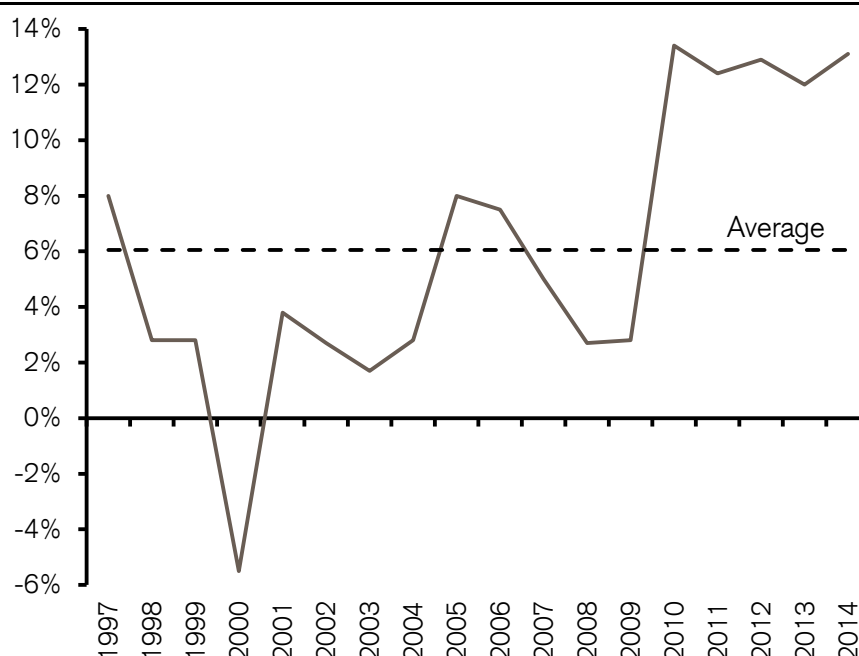
Exhibit 15: U.S. Average Deal Premium, 1980-2014

Source: Patrick A. Gaughan, Mergers, Acquisitions, and Corporate Restructurings-5th Ed. (Hoboken, NJ: John Wiley & Sons, 2011), 572; FactSet; Credit Suisse.

Any analysis of M&A should focus on the difference between the synergy and the premium. Succeeding at M&A is not easy for a number of reasons. First, if the premium is too large a company cannot recoup its investment, no matter how strategic the deal. Second, often competitors can replicate the benefits of a deal or take advantage of a company's lack of focus as it goes through an integration process. Third, M&A requires payment up front for benefits down the road, which creates legitimate skepticism for investors. Finally, M&A deals are generally costly to reverse.²³

The empirical evidence on M&A underscores the challenges that buyers face.²⁴ Over time, it appears that a majority of acquirers see their stock prices decline following the announcement of a deal. Research by McKinsey concluded that about one-third of deals create value for acquirers, and the other two-thirds are value neutral or value destructive.²⁵ That said, you must recognize that M&A creates value when you consider both the buyer and the seller. Exhibit 16 shows a measure that McKinsey calls "deal value added," which is the percentage increase in the combined market capitalizations of the buyer and seller. This has averaged about 6 percent in the past 18 years, with the only negative year in 2000 at the peak of the dot-com bubble. M&A creates substantial value but most of that value goes to the sellers, not the buyers.

Exhibit 16: Average Deal Value Added, 1997-2014



Source: Richard Dobbs, Marc Goedhart, and Hannu Suonio, "Are Companies Getting Better at M&A?" McKinsey on Finance, Winter 2007, 7-11; David Cogman, "Global M&A: Fewer Deals, Better Quality," McKinsey on Finance, Spring 2014, 23-25; David Cogman, McKinsey & Company.

One comment we hear consistently from management is that the market is short-term oriented and fails to recognize the virtue of the announced deal. Mark Sirower and his colleague, Sumit Sahni, studied this assertion. Exhibit 17 summarizes their findings, which are based on a detailed analysis of more than 300 deals.²⁶

The first observation is that about one-third of the deals (103/302) result in a stock price for the buyer that is initially higher, net of the market's change. This is consistent with past studies. Next, there is a clear correlation between the premium the buyer paid (the column on the right) and the announcement return (the column in the middle). Smaller premiums yielded positive returns, and higher premiums generated negative returns. This is consistent with Sirower's formula to determine a deal's net present value for the buyer.

Exhibit 17: The Stock Market Takes a Long-Term View When It Judges M&A

<u>Stock Reaction</u>	<u># of Deals</u>	<u>Announcement Return</u>	<u>One-Year Return</u>	<u>Premium</u>
Persistent positive	52	5.6%	33.1%	25.8%
Initial positive	103	5.7%	4.9%	30.7%
Full sample	302	-4.1%	-4.3%	35.7%
Initial negative	199	-9.2%	-9.0%	38.4%
Persistent negative	133	-10.3%	-24.9%	40.5%

Source: Mark L. Sirower and Sumit Sahni, "Avoiding the 'Synergy Trap': Practical Guidance on M&A Decisions for CEOs and Boards," Journal of Applied Corporate Finance, Vol. 18, No. 3, Summer 2006, 85.

Sirower and Sahni then wanted to see if the market's initial reaction was accurate. So they checked on the deals one year later. Those that were initially positive remained positive overall, with a one-year total shareholder return of 4.9 percent. More than half of the initial positive deals were persistently positive.

Deals that were initially negative remained so on average, with a total shareholder return of -9.0 percent. Two-thirds of the negative deals were persistently negative. This research suggests that while the market's initial read of a deal isn't perfect, there does not appear to be a bias. Indeed, if there is a bias it is that the market is too optimistic, as one-half of the positive deals turned negative but only one-third of the negative deals turned positive.

The story for buyers should not come across as too dour. There are ways to shade the odds of a deal to be more favorable. One empirical finding is that not all types of deals have the same chances of success. Peter Clark and Roger Mills, finance experts who focus on M&A, found substantially different success rates for varying categories of deals. Exhibit 18 summarizes their analysis.

Exhibit 18: Probability of M&A Success Based on Type of Deal

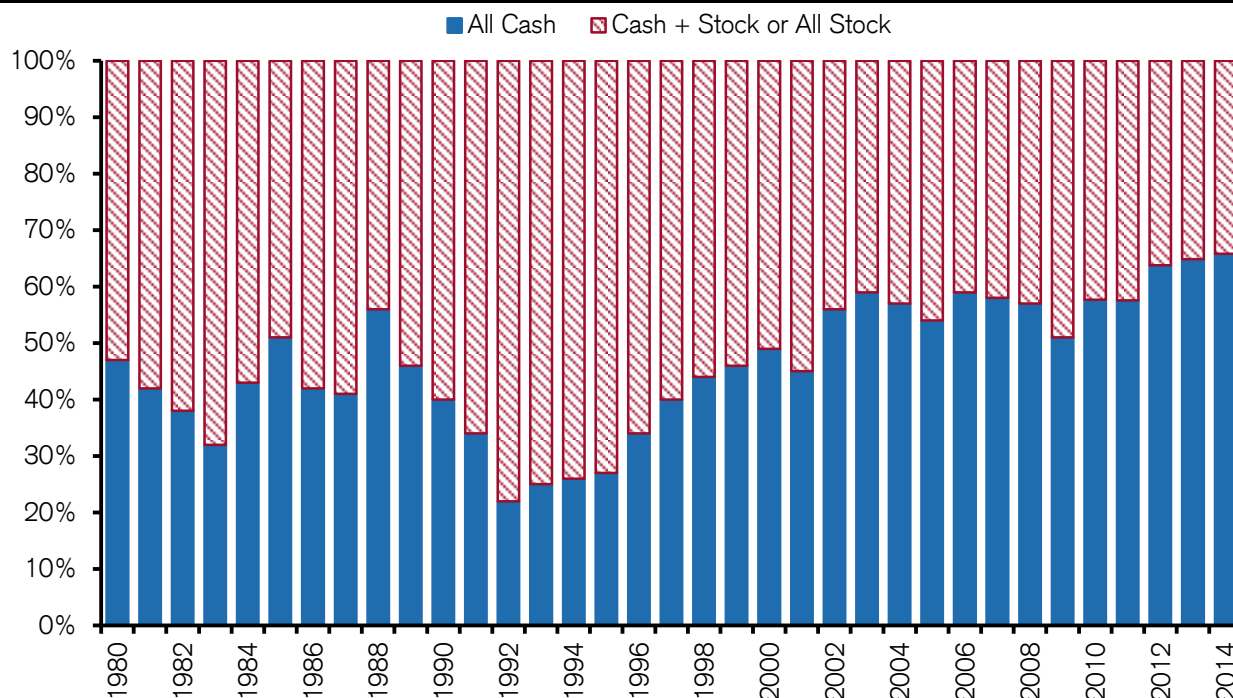
Success Rate	Category	Type	Description	Example(s)	Success Threats (Ex-Pricing, Phase)
87-92	Opportunistic	Bottom-trawlers	Dying competitor signals exit, advantage to fast, cash bidders	Marconi, Palm	Obsolescence, incompatible technologies
80-85	Operational	Bolt-ons	Fills void in acquirer's existing product/service offer, quickly	P&G/Pantene	Hidden integration difficulties cancel timing advantage
65-70	Operational	Line extension equivalents	Next generation/different variant of existing product/service	Volkswagen/Skoda	Actual synergies limited to scale, insufficient to cover APP
55-60	Transitional	Consolidation -- mature	Same industry contraction: scale, overhead synergies	Pharma, telecoms	Overestimation of market share gain importance
40-45	Operational	Multiple core-related complementary	Logical complements to present offer: products/channels/areas Two or more related elements	Disney/ABC; P&G/Gillette; Coty/Avon	Mistaken judgment of development potential (r-synergies)
37-42	Transitional	Consolidation -- emerging	Same industry contraction: Picking winners	ABC Capital Cities/Dumont	Overstated premiums (APP) based on target's prior performance
30-35	Operational	Single core-related complementary	Similar to complementary but one or less related elements	Daimler Chrysler	Exaggerated benefits attributed to target in 'marriage made in heaven'
20-25	Transformational	Lynchpin strategic	Major change in emphasis in acquiring company's business mix and forward strategy	IBM/PwC Consulting	Dependent on extraordinary acquiring company
15-20	Transformational	Speculative strategic	Radical, high-risk experimentation with company's business mix and model	AOL/TW; Vivendi (Messier)	CEO's imagined vision inconsistent with market realities

Based on Peter J. Clark and Roger W. Mills, *Masterminding the Deal: Breakthroughs in M&A Strategy and Analysis* (London: Kogan Page, 2013), 148-149.

For example, deals they call “opportunistic,” where a weak competitor sells out, succeed at a rate of around 90 percent. “Operational” deals, or cases where there are strong operational overlaps, also have an above-average chance of success. The rate of success varies widely for “transitional” deals, which tend to build market share, as the premiums buyers must pay to close those deals can be prohibitive. Finally, the success rate of “transformational” deals, large leaps into different industries, tends to be very low.²⁷

Another factor that can work in favor of acquirers is the source of deal financing. The research suggests the market greets cash deals much more kindly than stock deals.²⁸ There are a number of plausible explanations for this. First, you can consider an acquisition funded with stock as two separate transactions: selling stock to the public, and using the proceeds to buy the target. Management teams generally sell their stock when it's expensive, providing a negative signal to the market. Second, in a cash transaction all of the deal's risk and reward accrues to the buyer. In a stock-for-stock deal, the buyer shares the risk with the seller. This, too, provides a weaker signal of conviction.²⁹

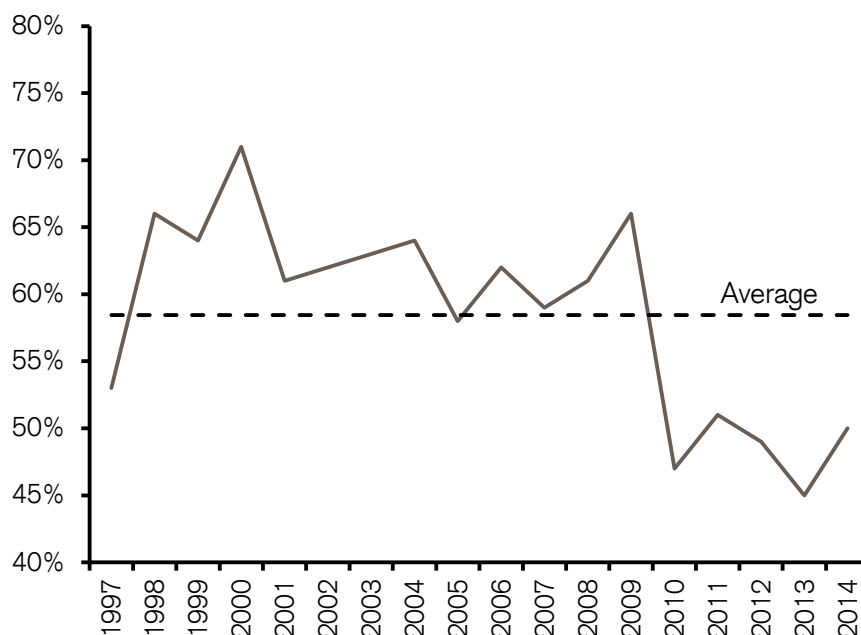
Exhibit 19 shows the mix between all-cash deals and all-stock or blend deals. Cash deals are a much higher percentage of the total than a decade or so ago. This reflects sizable cash balances, good access to the debt markets, and the perception of many executives that the stocks of their companies remain undervalued.

Exhibit 19: All-Cash Deals and All Stock or Blend Deals, 1980-2014

Source: Patrick A. Gaughan, *Mergers, Acquisitions, and Corporate Restructurings*-5th Ed. (Hoboken, NJ: John Wiley & Sons, 2011), 577; FactSet; Credit Suisse.

M&A has been slow to rebound in the current cycle given the stock market's results and low interest rates, but it is now strong. Through May of 2015, global M&A volume is up about 35 percent year over year to a level last seen in 2007. One noteworthy aspect of this M&A cycle is how well the market has received deals. Exhibit 16 shows that the average deal value added is more than double the average since 1997. What is also unusual is how much of that value buyers are capturing.

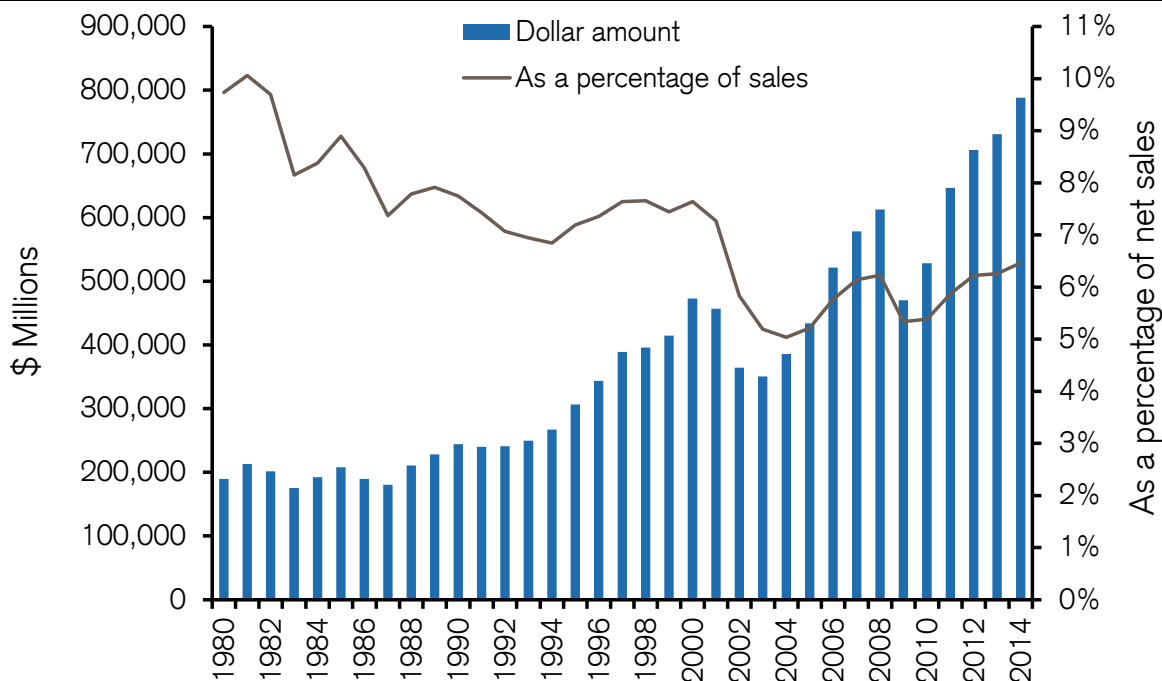
Exhibit 20 shows McKinsey's calculation of the percentage of companies overpaying. A company is judged to overpay if its stock goes down relative to the market. Note that the average of about 58 percent have overpaid for acquisitions since 1997, but the percentage dipped to an average of 48 percent in the past five years. Said differently, a majority of deals now create value for sellers and buyers.

Exhibit 20: Percentage Overpaying for Deals, 1997-2014

Source: Richard Dobbs, Marc Goedhart, and Hannu Suonio, "Are Companies Getting Better at M&A?" McKinsey on Finance, Winter 2007, 7-11; David Cogman, "Global M&A: Fewer Deals, Better Quality," McKinsey on Finance, Spring 2014, 23-25; David Cogman, McKinsey & Company.
 Note: The percentage of overpayers is the percentage of transactions in which the relative price movement of stocks was negative for the acquirer from two days prior to two days after the announcement.

Capital Expenditures. Capital expenditures are the second largest use of capital for companies. In 2014, capital expenditures were about three-fifths of the amount companies spent on M&A. However, capital expenditures have had vastly lower variance than M&A over time. Capital expenditures tend to be steady.

Exhibit 21 shows the dollar amount of capital expenditures since 1980, as well as capital expenditures as a percentage of sales. Spending declined from 10 percent of sales in 1981 to 5 percent of sales in 2004, but rebounded to more than 6 percent of sales in 2014. A substantial part of the pickup in capital spending since 2004 is related to the resurgence in commodity prices, which led to sharp increases in spending in the energy and materials sectors. For instance, capital expenditures of the energy sector went from around 13 percent of the total in the early 2000s to nearly 40 percent in recent years. But as the commodity cycle has cooled, so too has capital spending.

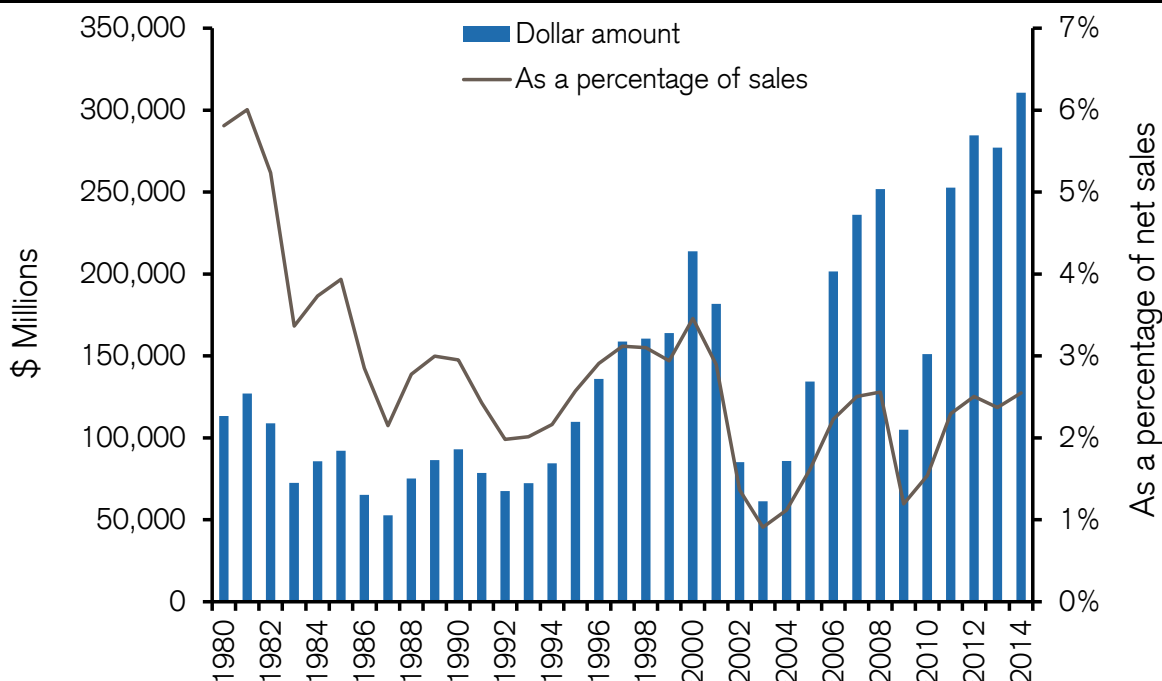
Exhibit 21: U.S. Capital Expenditures, 1980-2014

Source: Credit Suisse HOLT.

Note: Top 1,500 U.S. industrial firms. Dollar amounts are not inflated.

Executives and investors frequently distinguish between “maintenance” capital expenditures and total capital expenditures. Maintenance spending is the minimum required to maintain or replace the long-term assets in place. We can assume that capital expenditures beyond the maintenance level are in pursuit of growth.

Depreciation expense serves as a rough proxy for maintenance capital spending.³⁰ Exhibit 22 shows capital expenditures net of depreciation. Measured as a percentage of sales, growth capital expenditures are roughly 40 percent of overall capital expenditures. That maintenance capital expenditures are essential and a high priority for spending explains a good deal of the stability of spending. Further, it suggests that in assessing the value creation prospects of capital expenditures, you are best served to focus on the component that supports growth.

Exhibit 22: U.S. Capital Expenditures Net of Depreciation, 1980-2014

Source: Credit Suisse HOLT.

Note: Top 1,500 U.S. industrial firms. Dollar amounts are not inflated.

What factors should you consider to judge whether capital expenditures create value? The industry is a good starting point. Companies that invest in industries with a high return on invested capital and good growth prospects are more likely to create value. You can refine this analysis by considering whether the company has a specific competitive advantage as a low-cost producer or through differentiation.³¹

The cyclicity of the industry is another important consideration in assessing capital expenditures. Spending in cyclical industries tends to follow the same pattern as what we have seen in M&A and buybacks: companies spend when things look good and hunker down when they don't. As a consequence, companies tend to add too much capacity at the top of the cycle and suffer when the cycle recedes.

Finally, be mindful that relative comparisons of capital expenditures can be tricky. For example, analysts and executives generally compare the level of a company's spending to its peers. The retail industry is known for this. The crucial question is not whether one company is spending more or less than another, but rather whether a company is spending the proper amount.

The relative game applies on the country level as well. For example, in the early 1990s there was a palpable fear that U.S. companies were investing too little relative to peer companies in countries such as Japan and Germany.³² What received less attention was the possibility that Japanese companies were investing too much and hence failing to create value with many of their investments. We can make a similar distinction between public and private companies. The goal is not to spend more or less than the competitor but rather to spend the correct amount given the economic opportunity at hand.

Academic work on capital expenditures broadly supports the idea that the market rewards value creation and refutes the idea that investors prefer short-term earnings gains at the expense of long-term value creation.³³ The research shows that the stock market rewards companies that invest in high-quality projects, which is

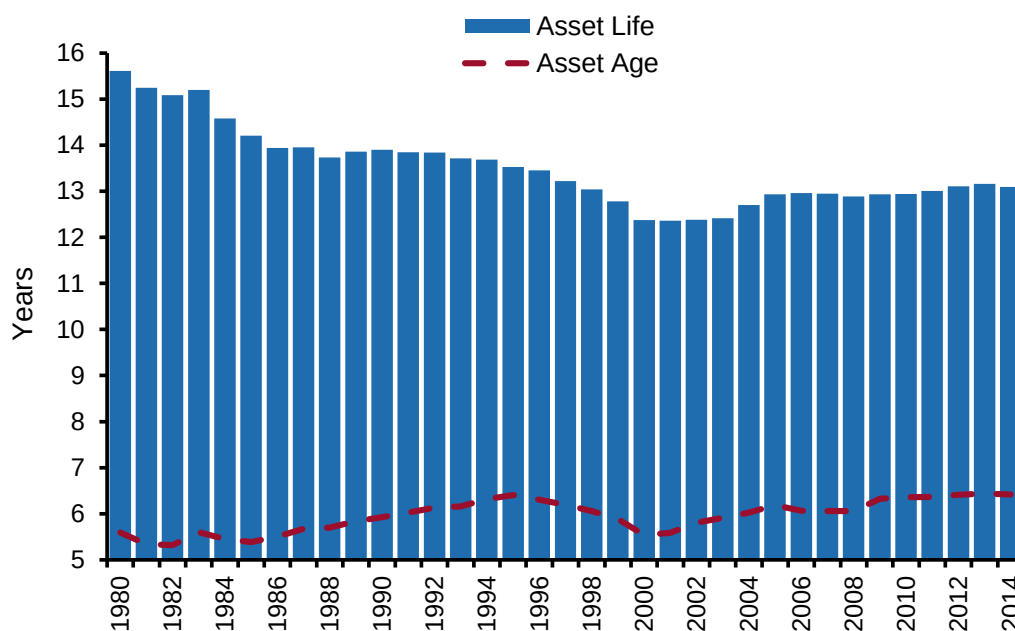
generally signaled by a record of investments that have generated returns in excess of the cost of capital, and penalizes companies that invest in low-quality projects. And for businesses with high economic returns, the market responds positively to unexpected increases in capital expenditures and negatively to unexpected decreases in capital expenditures.³⁴

But there is also a limit to how rapidly a company can grow. Firms that increase their investments the most tend to suffer from poor relative total shareholder returns in the years following the growth. This is consistent with the thesis that empire building generally results in stock market underperformance and the evidence that rapid asset growth predicts poor stock returns.³⁵

Notwithstanding the steady economic recovery from the low of the financial crisis, capital expenditures are expected to decline in 2015. This in part reflects a decline in oil prices, which has prompted a retrenchment of spending in energy. Analysis of asset life and age supports a case for steady growth in capital expenditures over time. Exhibit 23 shows that the average asset life for the top 1,500 companies in the U.S. declined from roughly 16 years in 1980 to a low of 12 years in the early 2000s, with a rebound to 13 years today.

The average asset age rose from about 5 years in the early 1980s to 6.4 years currently. As a result, the difference between asset life and asset age for the U.S. capital stock has shrunk from 10 years in the 1980s to 7 years now. While numerous commentators have emphasized the age of the capital stock, few have noted the simultaneous rise in asset lives.

Exhibit 23: U.S. Asset Life and Age, 1980-2014



Source: Credit Suisse HOLT.

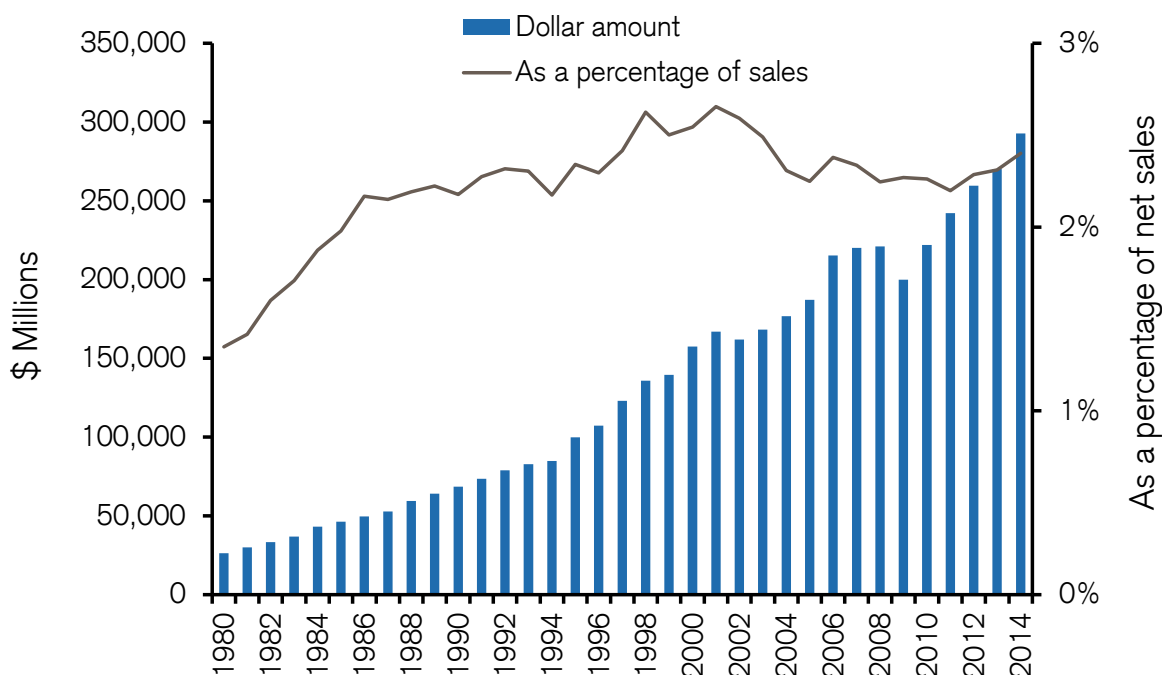
Note: Top 1,500 U.S. industrial firms; asset life is based on gross plant/depreciation expense; asset age = asset life * (1 - net plant / gross plant).

Research and Development. Unlike M&A and capital expenditures, R&D is a capital allocation choice that shows up on the income statement rather than the balance sheet. Accountants expense R&D in the period the company incurs it, notwithstanding the potential long-term benefits, because they deem the outcomes too uncertain and difficult to quantify. R&D is a set of activities that seeks to develop new products or the tools to create new products.

In the U.S., businesses account for about 70-75 percent of total R&D spending, with the government and academia splitting the other 25-30 percent. The industries that spend the most include information technology, healthcare, materials, and aerospace and defense. Technology and healthcare combined represent more than two-thirds of all R&D spending in the U.S., and technology R&D spending is roughly 1.6 times that of healthcare.

Exhibit 24 shows the dollar amount of R&D since 1980 as well as R&D as a percentage of sales. R&D rose from 1.3 percent of sales in 1980 to a peak of 2.7 percent of sales at the time of the dot-com bubble, only to settle back to a level of 2.4 percent of sales today. The substantial rise in R&D as a percentage of sales during the full period reflects the change in the composition of the market. During this time, R&D-intensive sectors such as technology and healthcare have become a larger part of the economy than sectors that are less R&D intensive.

Exhibit 24: U.S. Research and Development, 1980-2014



Source: Credit Suisse HOLT.

Note: Top 1,500 U.S. industrial firms. Dollar amounts are not inflated.

R&D productivity is the relationship between the value a new product creates and the investment a company makes to generate that product. But assessing productivity is a challenge because there is a lag between investment and outcome. A host of other factors, which are hard to capture, also weigh on the outcome. It is useful to distinguish between the cost to launch, or "R&D efficiency," and the value per launch, or "R&D effectiveness." One company may be good at bringing a product to market (R&D efficiency) while a different company may be able to create more value for the product as the result of better design, marketing, or distribution capabilities (R&D effectiveness).³⁶

One approach to assess a company's R&D productivity is to capitalize R&D, amortize it over an appropriate period, and calculate the return on invested capital (ROIC) so as to be comparable to businesses that are not R&D intensive.³⁷ R&D capitalization has the effect of increasing profit (the R&D amortization amount is almost always less than expensed R&D, hence adding to profit) and increasing invested capital (since R&D is

reclassified as a capital item rather than an expense). The challenge is to determine the appropriate amortization period, or roughly the time to develop a product.

Some researchers who study the pharmaceutical industry assess R&D productivity by dividing a company's R&D budget over some period by the number of drugs the company has brought to market. Rather than examining the cost of successful drugs only, this method captures the total costs a company incurs including the cost of failure. Exhibit 25 shows the results of this analysis for the top 10 companies measured by R&D dollars spent per drug. A great deal has been written about the decline in R&D productivity in the pharmaceutical industry, and attitudes about the virtue of R&D are at the crux of alternative strategies for value creation within the sector.³⁸

Exhibit 25: R&D Cost per New Drug for 10 Large Pharmaceutical Companies

	Company	10-year R&D spending	Number of new drugs	R&D per drug
1	Abbott	\$13.2 billion	1	\$13.2 billion
2	Sanofi	\$60.8	6	\$10.1
3	AstraZeneca	\$38.2	4	\$9.6
4	Hoffmann-La Roche	\$70.9	8	\$8.9
5	Pfizer	\$77.8	10	\$7.8
6	Wyeth	\$22.7	3	\$7.6
7	Eli Lilly	\$26.7	4	\$6.7
8	Bayer	\$33.1	5	\$6.6
9	Schering-Plough	\$18.8	3	\$6.3
10	Novartis	\$60.7	10	\$6.1

Source: Matthew Herper, "How Much Does Pharmaceutical Innovation Cost? A Look at 100 Companies," *Forbes*, August 8, 2013.

The academic research on the effectiveness of R&D spending is somewhat equivocal, in part because of the measurement challenges and the decline in R&D productivity in the pharmaceutical industry. One of the best ways to study the market's reaction to any form of investment is to examine unexpected changes. In one such study, finance professors studied more than 8,000 unexpected increases in R&D spending over a 50-year period ended in 2001 and found that the stocks of those companies rose.³⁹ Other researchers conclude that the returns to R&D are positive and higher than other capital investments.⁴⁰

A reasonable question is whether the stock market effectively reflects R&D spending. One large study found that the market does it well. This means that companies that spend a large percentage of sales on R&D realize similar stock market returns as companies that spend a small percentage of sales on R&D. The researchers came to similar conclusions for advertising expenses, which are about one-half as large as R&D expenses in the aggregate.⁴¹

Academics have also found that larger companies that acquire their R&D by buying businesses that are R&D intensive tend to fare poorly in the stock market.⁴² This is consistent with the view that the value of the R&D spending ultimately accrues to the seller, not the buyer. That said, companies with strong execution capabilities can create value by enhancing R&D effectiveness.⁴³

Some recent research suggests that the technology companies that are in the bottom one-third of R&D spending as a percentage of sales deliver higher returns to shareholders than those in the top third.⁴⁴ This finding underscores how tricky it is to assess R&D spending because a number of technology companies have benefitted from R&D that was funded by the government.

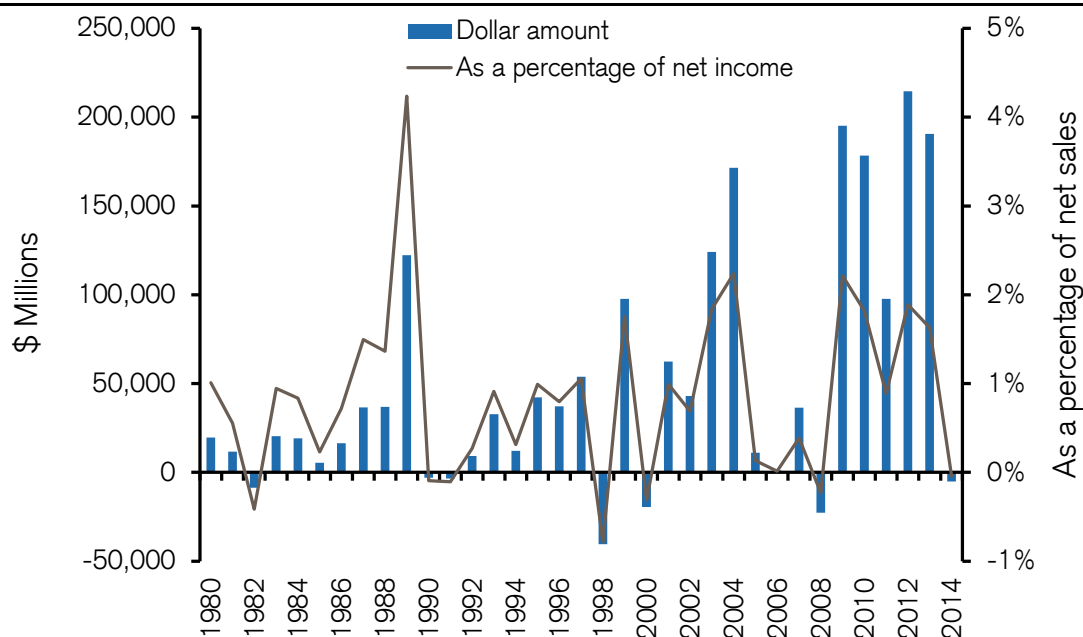
Mariana Mazzucato, a professor of economics at the University of Sussex, addresses this issue in her provocative book, *The Entrepreneurial State*.⁴⁵ Her thesis is that the government funds a great deal of high-risk R&D that companies go on to exploit commercially. She uses the vivid example of the iPhone from Apple Inc., a company that has created a huge amount of shareholder value in the past decade. Four of the main technologies inside the iPhone, including the Global Positioning System (GPS), the Internet, touch screen, and voice recognition software, were developed by the U.S. government. As Mazzucato notes, Apple did a brilliant job of integrating these technologies, designing an attractive and intuitive product, and marketing effectively. But it did not develop some of the key technologies inside the phone, which means the company's shareholders did not have to shoulder those expenses.

Forecasters expect R&D spending to be flat in 2015. The U.S., China, and Japan together represent more than half of global R&D spending, and ten countries account for about 80 percent of the total. At current rates of funding and growth, China will surpass the U.S. as the largest spender on R&D in the year 2022. In the U.S., growth in R&D spending is expected for all industries except aerospace and defense.⁴⁶

Net Working Capital. Net working capital is the capital a company requires to run its day-to-day operations. It is defined as current assets minus non-interest-bearing current liabilities. Net working capital equals about one-quarter of assets on average for companies in the U.S.⁴⁷ The primary components of net working capital include inventory, accounts receivable, and accounts payable. Interest-bearing current liabilities, which include short-term debt and the current maturities of long-term debt, are a form of financing and are therefore not part of net working capital.

Exhibit 26 shows the annual change in net working capital from 1980 through 2014. At year-end 2014, net working capital stood at \$2.0 trillion for the top 1,500 public firms in the U.S. We consider changes in net working capital as opposed to the absolute amount, because changes are what you should consider to be an incremental investment. Net working capital investments are substantially smaller than M&A, capital expenditures, or R&D.

Exhibit 26: U.S. Change in Net Working Capital, 1980-2014

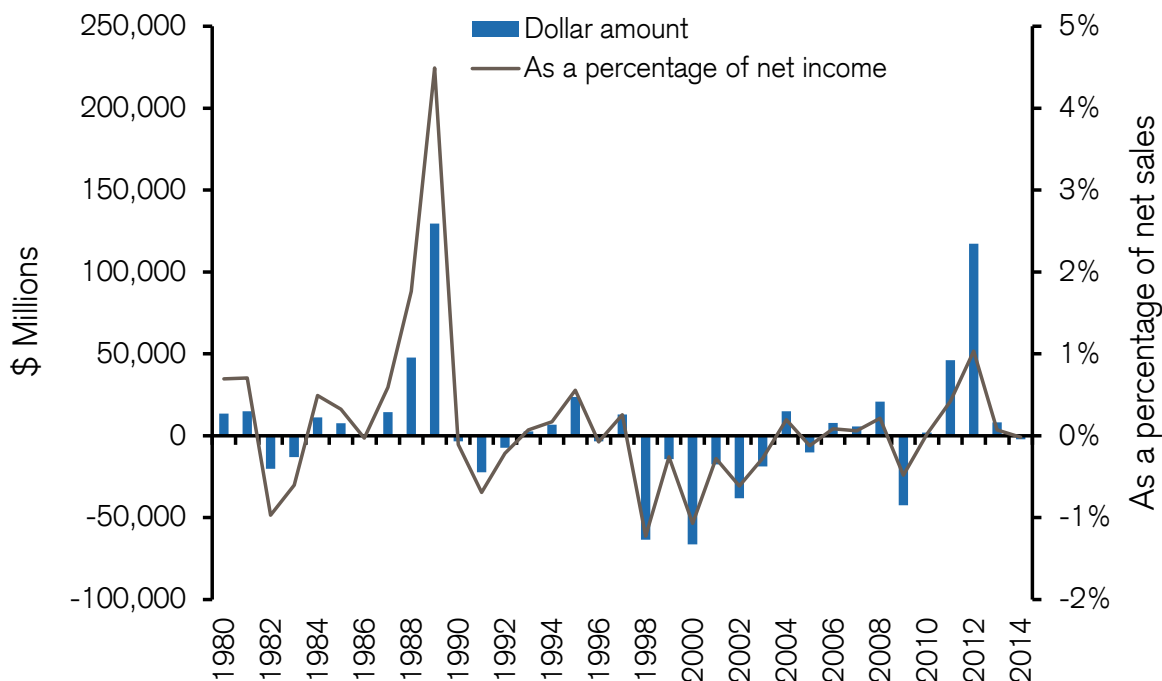


Source: Credit Suisse HOLT.

Note: Top 1,500 U.S. industrial firms. Dollar amounts are not inflated.

We have defined net working capital to include cash. The picture changes dramatically if we exclude cash. Two trends are noteworthy. First, the percentage of firms that are financed solely with equity has gone from 6 percent in 1980 to 20 percent today. Second, the cash held by the all-equity financed firms has gone from 9 percent of assets to 33 percent over the same time.⁴⁸ As a result, increases in cash make up a substantial fraction of the increase in net working capital. At the end of 2014, net working capital excluding cash was about \$300 billion for the top 1,500 U.S. industrial companies, roughly 15 percent of the total net working capital sum. Exhibit 27 shows the change in net working capital excluding cash.

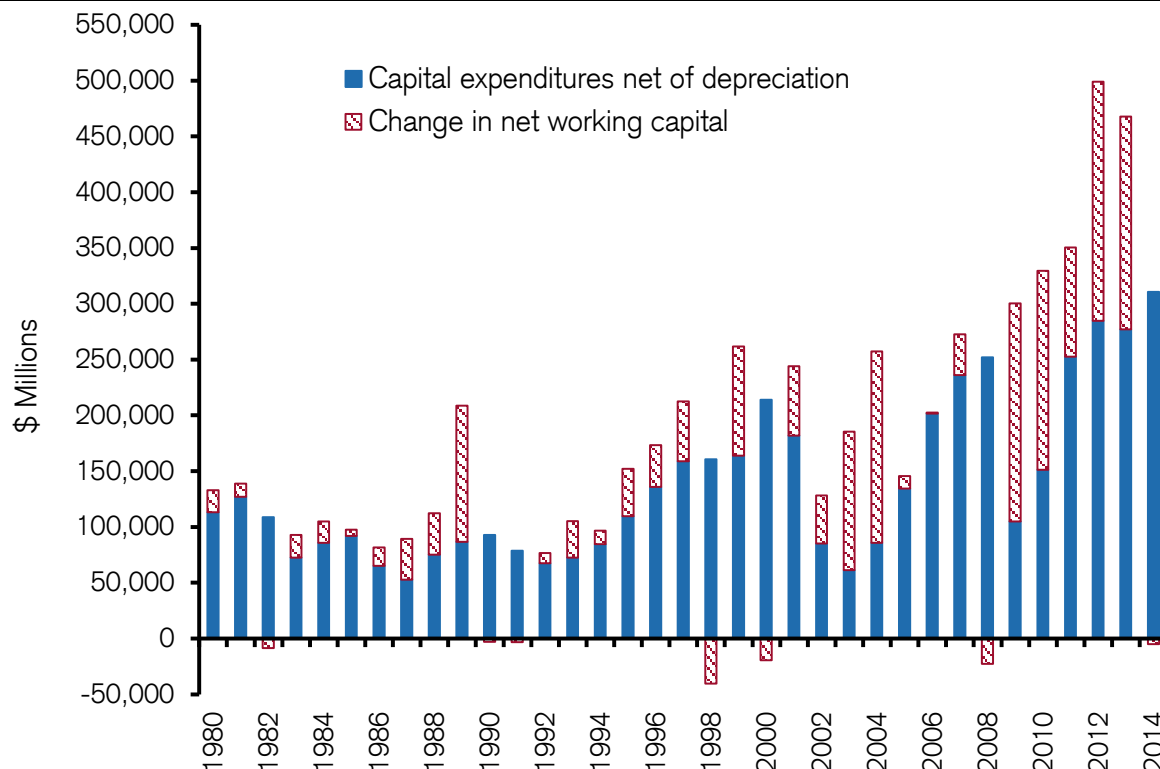
Exhibit 27: U.S. Change in Net Working Capital Excluding Cash, 1980-2014



Source: Credit Suisse HOLT.

Note: Top 1,500 U.S. industrial firms. Dollar amounts are not inflated.

Exhibit 28 shows both investments in net working capital and net capital expenditures together. These items reflect capital investments in organic growth. The exhibit provides a useful view of the relative spending between working versus fixed capital. Net working capital declines in a handful of years, making it a source of cash.

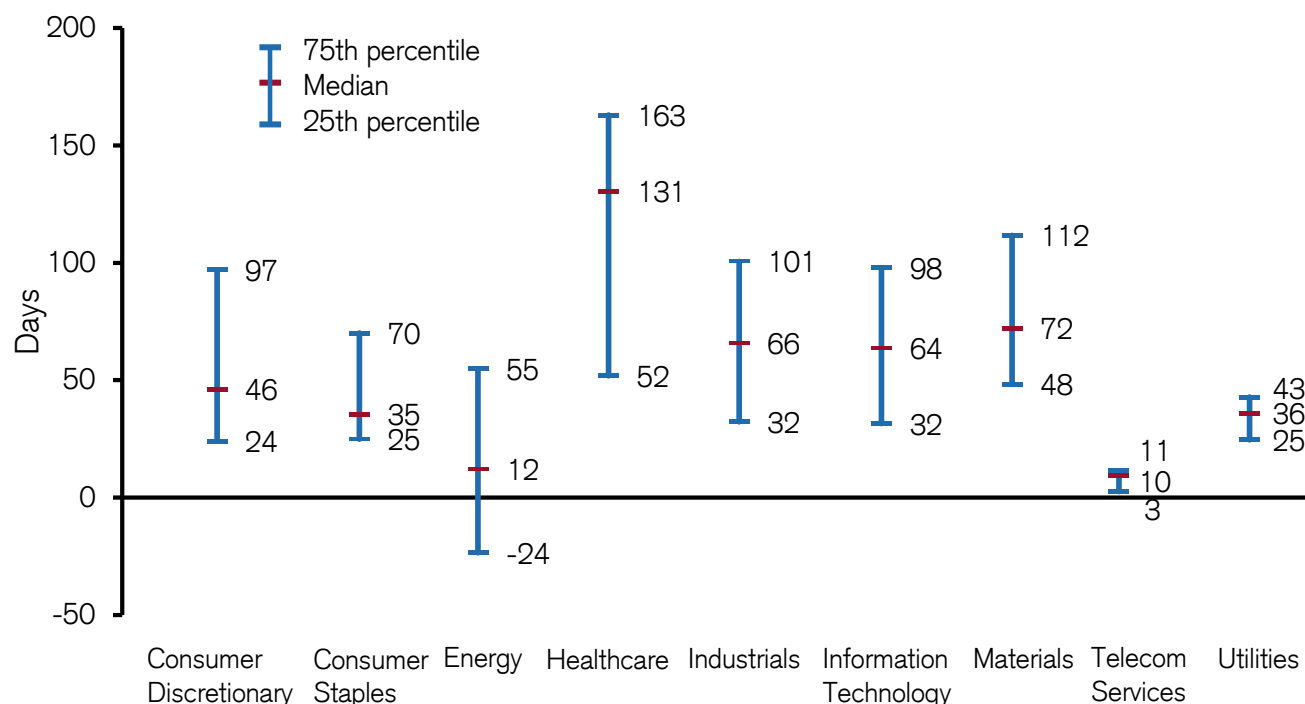
Exhibit 28: U.S. Change in Net Working Capital Plus Net Capital Expenditures, 1980-2014

Source: Credit Suisse HOLT.

Note: Top 1,500 U.S. industrial firms. Dollar amounts are not inflated.

The cash conversion cycle (CCC), a calculation of how long it takes a company to collect on the sale of inventory, is the standard way to analyze working capital efficiency. The CCC equals days in sales outstanding (DSO) plus days in inventory outstanding (DIO) less days in payables outstanding (DPO).⁴⁹ For example, Cisco Systems, Inc.'s CCC in fiscal 2014 was 82 days while Apple's was -31 days.

Some firms, including Apple, have a negative CCC, which means that the company receives cash on the sale of inventory before it pays its suppliers. This effectively makes the company's suppliers a source of financing and can be relevant in competitive interactions. For instance, Walmart Stores Inc.'s CCC was 12 days in 2014 while Amazon.com's CCC was -23 days. With a CCC for each company in hand, you can compare the efficiency of working capital use from one company to the next. Exhibit 29 shows the cash conversion for sectors within the S&P 500, excluding financials.

Exhibit 29: Cash Conversion Cycles for Sectors within the S&P 500, 2014

Source: FactSet and Credit Suisse. Format of exhibit from Ryan Davies and David Merin, "Uncovering Cash and Insights from Working Capital," McKinsey & Company, July 2014.

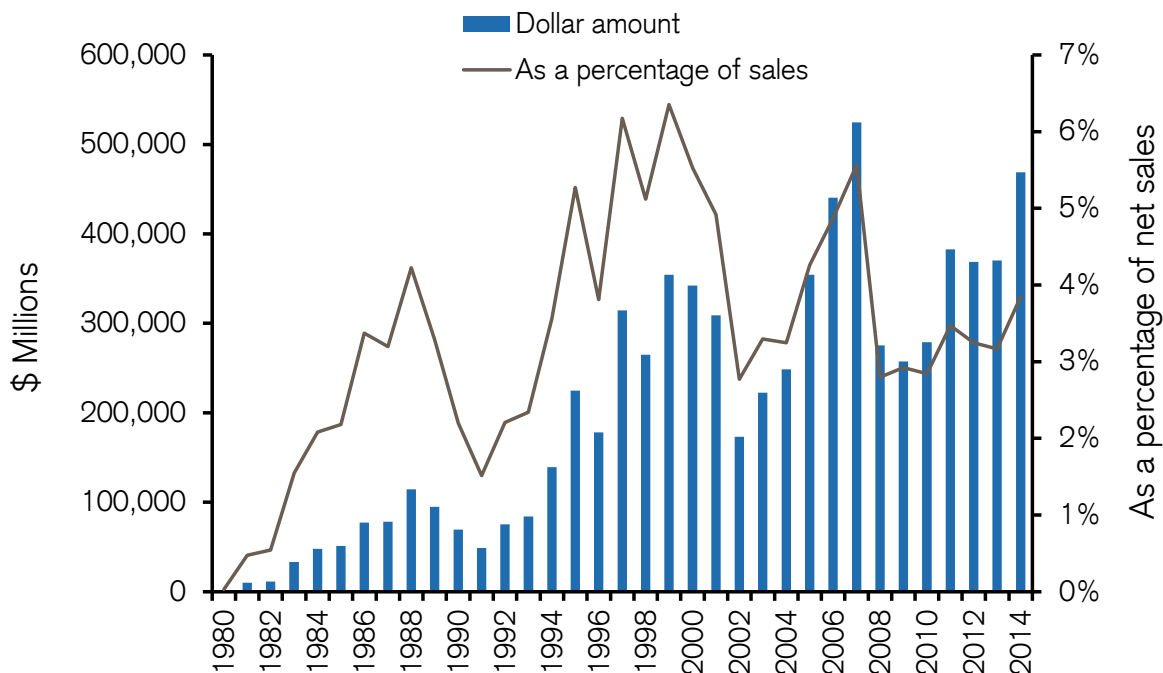
Note: S&P 500 companies excluding financials.

Academic research shows a strong relationship between a lower CCC and a higher return on capital within, and across, industries.⁵⁰ In other words, good working capital management is associated with high returns on invested capital. The impact on total shareholder returns, however, is less clear. Research suggests that a dollar invested in working capital is worth less than a dollar either held in cash or invested in the firm. Further, extending credit to customers through increasing receivables has a bigger effect on shareholder value than increasing inventory.⁵¹

The main issue in the outlook for net working capital is what companies choose to do with their cash hoards. Research shows that investors value cash on the balance sheet of companies with poor governance at \$0.40-\$0.90 on the dollar in anticipation of value-destroying moves.⁵² M&A continues to be a likely use of cash and, as we will see, companies continue to return cash to shareholders via buybacks and dividends at a steady clip.

Divestitures. Companies use divestitures to adjust their business portfolio. Actions include the sale of divisions, spin-offs, and equity carve-outs. A company will divest an operation when it perceives the value to another owner to be higher, or if the divestiture adds focus to the parent and hence improves results.

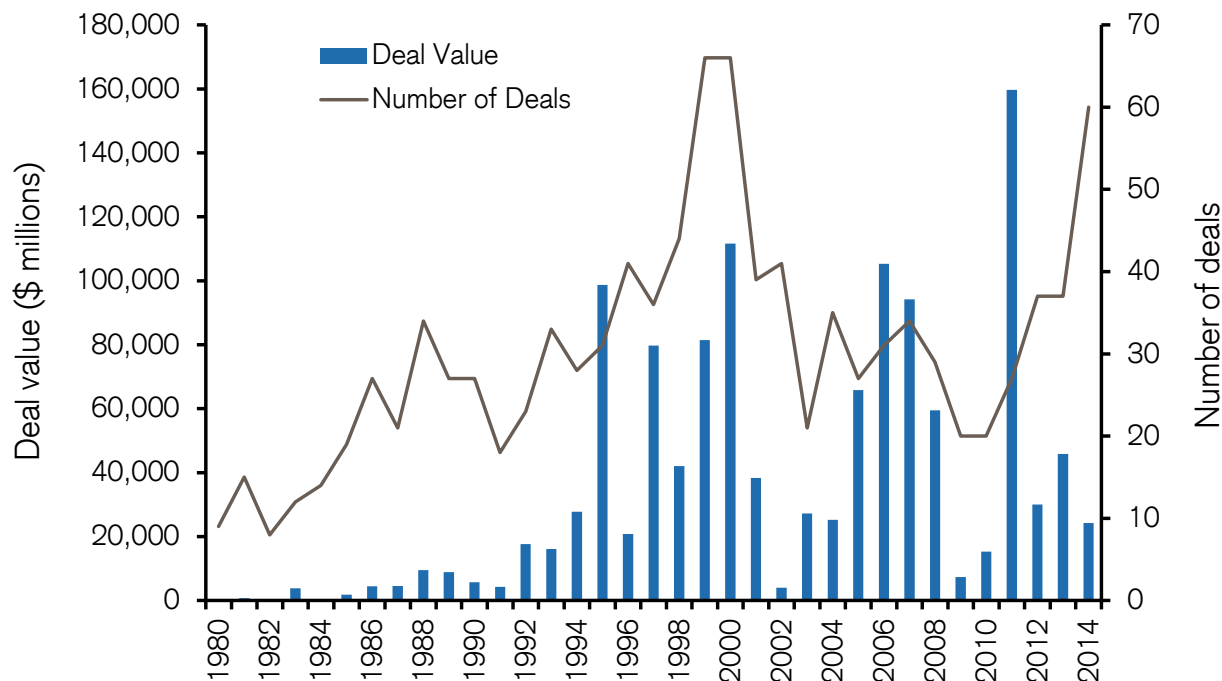
Exhibit 30 shows the magnitude of divestitures from 1980-2014. While divestitures generally draw less attention than M&A, they represent a substantial component of capital allocation. In the last decade, divestitures have averaged 3.7 percent of sales for the top 1,500 companies in the U.S., a level comparable to gross buybacks and higher than dividends and R&D spending.

Exhibit 30: U.S. Divestitures, 1980-2014

Source: Thomson Reuters DataStream, Credit Suisse HOLT, Credit Suisse.

Note: U.S. announced divestitures; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases. Dollar amounts are not inflated.

Spin-offs are a prominent form of divestiture. In a spin-off, a company distributes shares of a wholly owned subsidiary to its shareholders on a pro-rata and tax-free basis. For example, Time Warner Inc. spun off its magazine subsidiary, Time Inc., in June 2014. Following the spin-off, Time Warner shareholders own shares in Time Warner and Time. Exhibit 31 shows the value of announced spin-offs and the number of completed spin-offs from 1980-2014.

Exhibit 31: U.S. Spin-Offs, 1980-2014

Source: Thomson Reuters DataStream, Spin-Off Research, and Hemang Desai and Prem C. Jain, "Firm Performance and Focus: Long-Run Stock Market Performance Following Spinoffs," *Journal of Financial Economics*, Vol. 54, No. 1, October 1999, 81.

Note: Dollar amounts are not inflated.

There are a few considerations in assessing divestitures. First, research has established that most of the value creation for a typical company comes from a relatively small percentage of its assets.⁵³ This means that most companies have businesses or assets that do not earn the cost of capital and that may be more valuable to another owner.

Divestitures can lead to "addition by subtraction" when a company that divests an operation with a low return on invested capital receives more than what the business is worth as an ongoing part of the firm. So there's an addition of value to the company even as there's a subtraction in the size of the firm.

Second, we have already reviewed the evidence showing that M&A creates value in the aggregate but that acquirers struggle to capture much, if any, of that value. This suggests that it is better to be a seller than a buyer on average. This point is particularly relevant when there are multiple bidders for an asset. Contested deals frequently lead to what economists call the "winner's curse."⁵⁴ When this occurs, the "winner" of the bidding pays too much for the asset, hence the "curse." The winner's curse means that there is a wealth transfer, above and beyond the value of the asset, from the buyer to the seller.

Finally, most companies have a natural tendency to want to grow rather than shrink. As companies grow and diversify, capital allocation and strategic control can become more challenging. When a CEO who understands capital allocation takes the helm of a company with underperforming assets, there is a great opportunity to create value through divestitures.⁵⁵

Notwithstanding their significance in capital allocation, divestitures have received substantially less attention than M&A in the academic literature. Research for the most part concludes that divestitures create value. A meta-analysis of nearly 100 studies on divestitures concludes: "In the broadest possible terms, our results

suggest that on average, divestiture actions are associated with positive performance outcomes for the parent firm.”⁵⁶

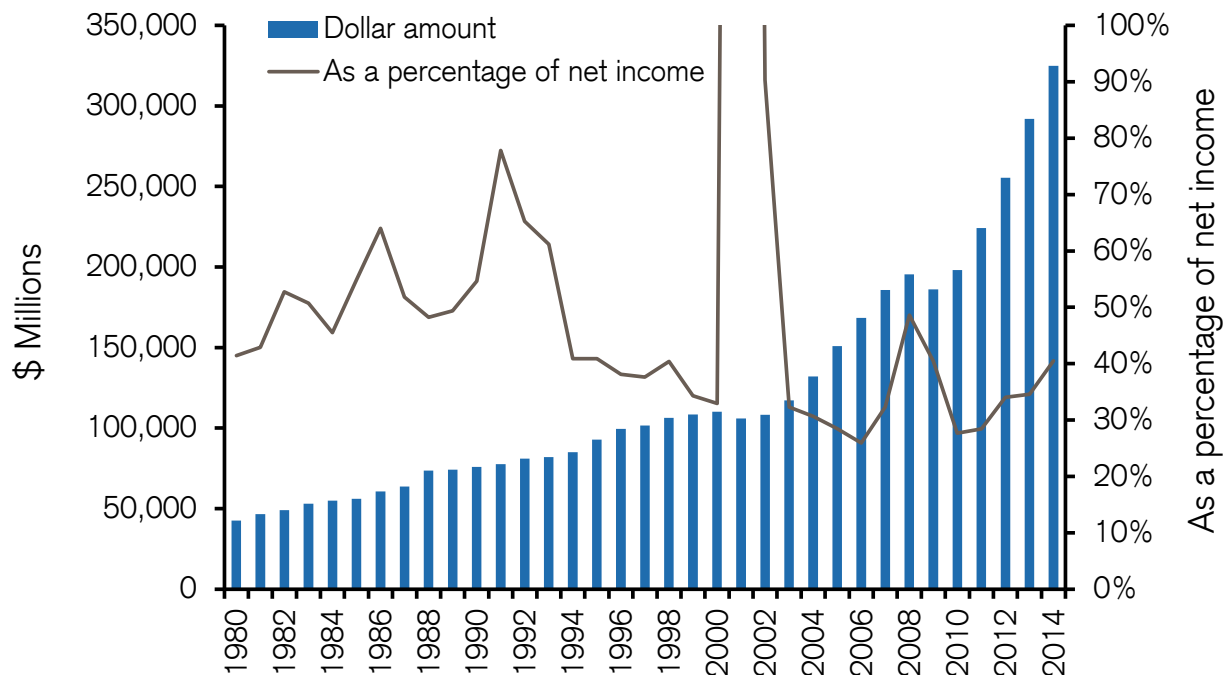
Analysis also shows that spin-offs create value for the spin-offs themselves as well as the corporate parents.⁵⁷ Researchers who did a meta-analysis of more than 25 papers in the spin-off literature summed up their findings this way: “The main conclusion is consistent: spin-offs are associated with strongly significant abnormal returns.”⁵⁸ They suggest the factors that explain these wealth effects include sharpened focus, better information, and in some cases tax treatment.

Divestitures should remain active in 2015, reflecting the influence of activist investors, a more stable economic outlook, and ongoing pressure for companies to create value. The number of spin-offs in 2015 is likely to decline from the 60 completed deals in 2014, which approached the peak level of deals in 2000.⁵⁹ Similar to acquisitions, divestitures follow a wave with deals done at the peak of the cycle delivering lower returns for shareholders than those done at the beginning.⁶⁰

Dividends. A dividend is a cash payment to a shareholder that is generally paid from profits. Dividends and share buybacks are the main ways companies return cash to shareholders. Companies can also return cash to shareholders by selling the company for cash.

The most profound difference between buybacks and dividends may be the attitude of executives. Most executives believe that once a dividend is established, paying it is on par with investment decisions such as capital spending. In contrast, they tend to view buybacks as something to do with residual cash flow after the company has made all investments that are appropriate.⁶¹

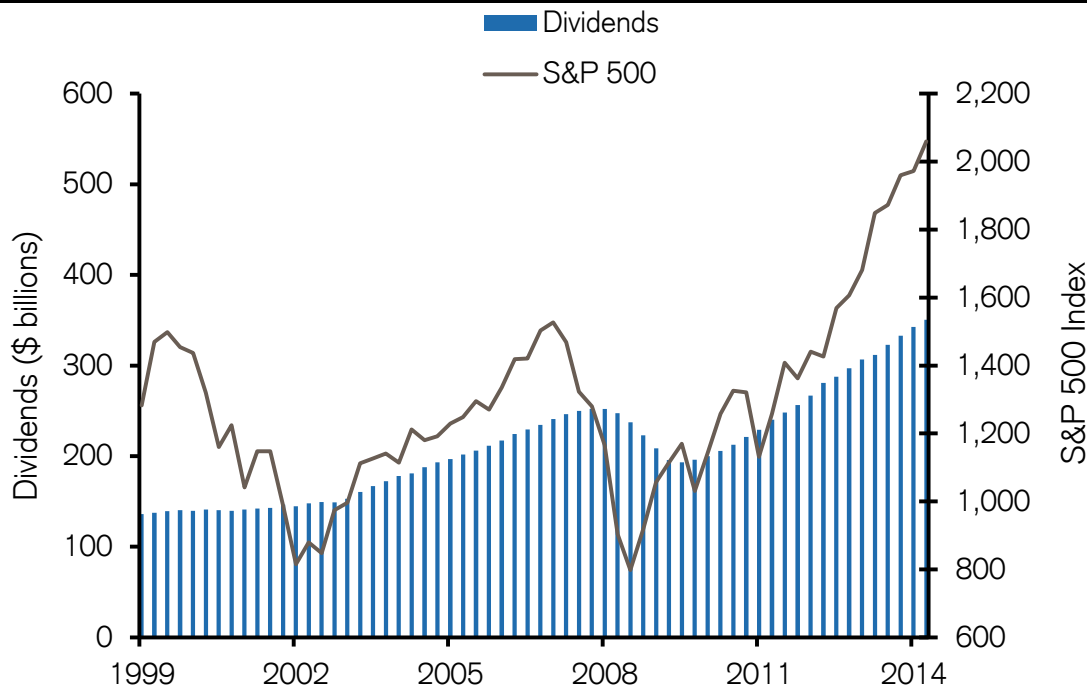
There are a couple of consequences of this difference in attitude. The first is that dividend payments are vastly less volatile than buybacks. Indeed, of all the capital allocation options, dividends have among the lowest standard deviation in growth, as exhibit 7 demonstrates. Exhibit 32 shows the annual amount of dividends on common and preferred stock for the top 1,500 companies in the U.S., excluding the financial services and regulated utility industries, from 1980 to 2014. Dividends are remarkably resilient and were especially stable through the financial crisis from 2007-2009.⁶²

Exhibit 32: U.S. Common and Preferred Dividends, 1980-2014

Source: Credit Suisse HOLT.

Note: Top 1,500 U.S. industrial firms. Dollar amounts are not inflated.

Exhibit 33 illustrates the dividends for the S&P 500, including financials, versus the price of the index. Dividends dipped during the financial crisis as many companies in the financial services industry suspended, or eliminated, their payouts. But overall, dividends fluctuated much less than the price of the S&P 500.

Exhibit 33: S&P 500 Dividends and Index Price, 1999-2014

Source: S&P Dow Jones and Credit Suisse.

How should investors assess dividends? First, dividends are useful to consider in the context of cash flow. To sustain a cash dividend, a company has to generate cash flow beyond the basic needs to maintain the business and support its growth. So an investor should gauge a company's cash flow prospects in order to anticipate a company's ability to pay dividends.⁶³

Second, dividends can play an important role in the capital accumulation rate, also known as total shareholder return (TSR). From time to time you hear that dividends provide the bulk of shareholder returns for equities in the long run. That assertion is wrong if you assume the goal of an investor is to accumulate capital. In fact, price appreciation is the only source of investment return that increases accumulated capital over time.⁶⁴

The equity rate of return is a one-period measure and is simply the sum of stock price appreciation and the dividend. The capital accumulation rate, or TSR, is a multi-period measure that assumes all dividends are reinvested in the stock. Knowing price appreciation and dividend yield, the following equation allows you to calculate TSR:

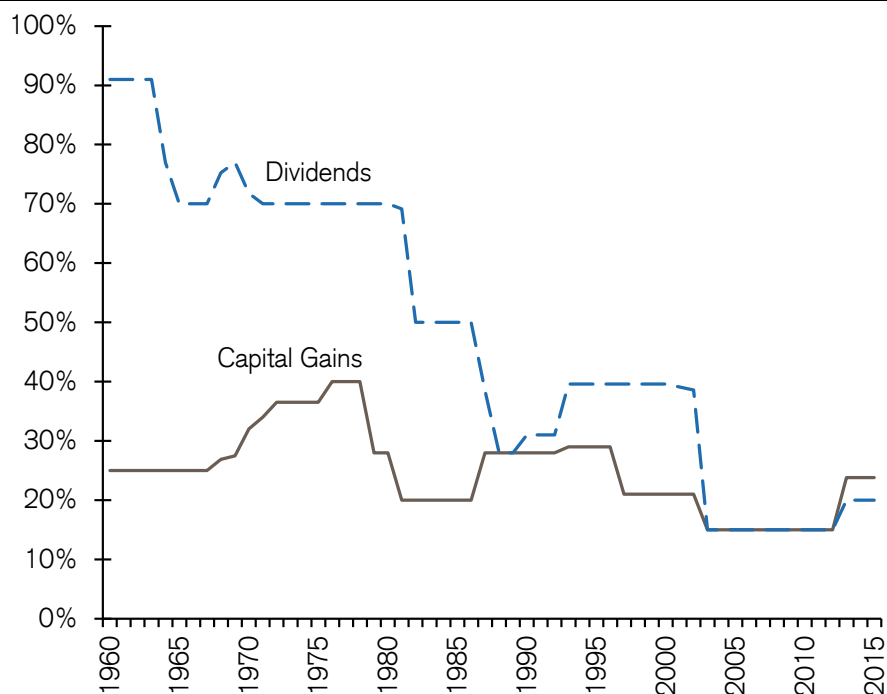
$$\text{Total shareholder return (TSR)} = \text{Price appreciation} + [(1 + \text{price appreciation}) * \text{dividend yield}]$$

The value of the compounding reinvested dividends means that the equity rate of return is always lower than the TSR as long as price appreciation is positive. For example, assume price appreciation of 7 percent and a dividend yield of 2 percent. The equity rate of return is 9 percent $(.07 + .02)$ and the TSR is 9.14 percent $(.07 + [(1 + .07) * .02])$.

The key is that for an investor to actually earn the TSR, all of the dividends they receive must be reinvested back into the stock. That's why price appreciation only determines the TSR.

It's crucial to acknowledge that almost no one earns the full TSR because most individuals do not reinvest the dividends they receive, and dividends are generally taxable. While there are no clear-cut data on the topic, it appears that only one-tenth of all dividend proceeds are reinvested. Naturally, investors can use dividends to consume. But if they do, they can't earn the TSR.

Further, most investors must pay taxes on the dividends they receive. Exhibit 34 shows the top marginal tax rate on dividends and capital gains from 1960 to the present. The TSR declines when you assume that only a fraction is reinvested in the stock. Academic research supports the view that the tax rate on payouts affects shareholder returns.⁶⁵

Exhibit 34: U.S. Top Marginal Tax Rate, 1960-2015

Source: Credit Suisse HOLT and the Tax Foundation.

Finally, investors in the U.S. should recognize that many of the mature, cash-rich companies that are excellent candidates for paying a healthy dividend generate a high percentage of their profits outside the U.S. The companies cannot repatriate this cash to the U.S. without incurring additional taxes. There are a number of U.S. multinationals that do not have enough domestic cash to pay their dividends, even though their balance sheets are flush. A number of these businesses simply borrow in the U.S. to fund their dividends.⁶⁶

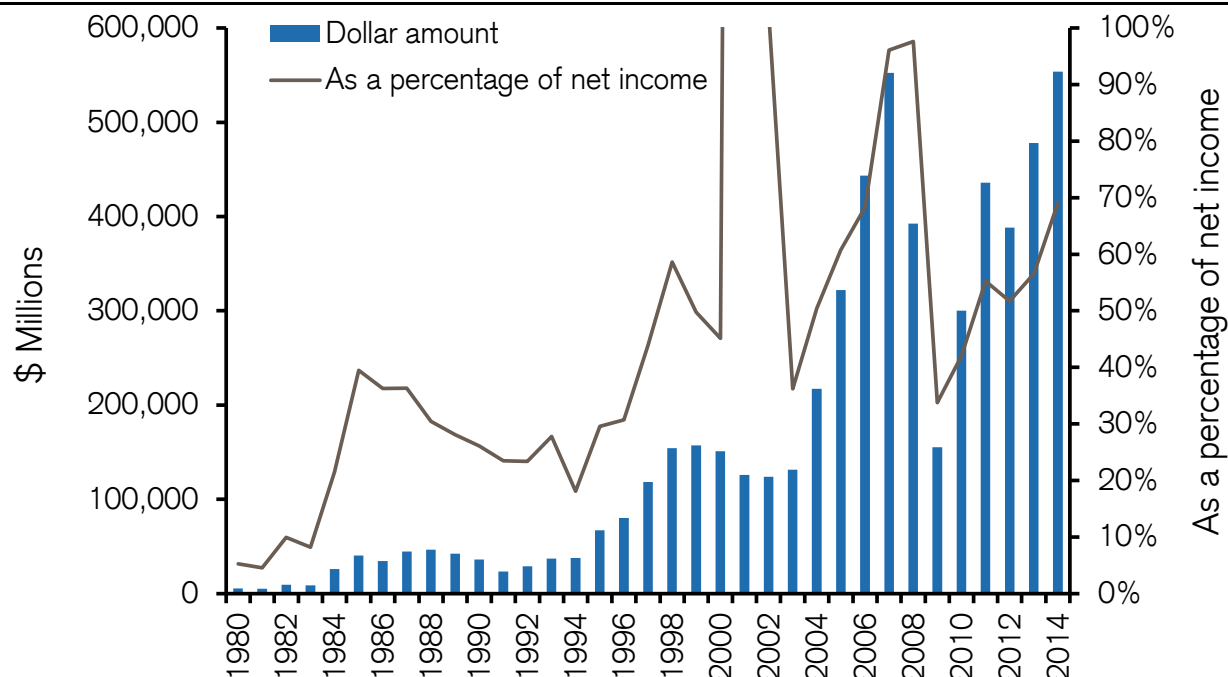
Academic research on dividends supports a few points. To begin, older companies are more likely to pay dividends than younger companies. So any analysis of dividend yields must take into account the maturity of the population of companies under consideration.⁶⁷

Second, dividends provide a strong signal about management's commitment to distribute cash to shareholders and its confidence in the future earnings of the business. This is consistent with the managerial attitude that dividends are sacrosanct once declared. For this reason, companies are very deliberate about the decision to initiate a dividend.⁶⁸

Dividends are expected to grow at a healthy clip in 2015, rising approximately 7 percent following a solid increase in 2014.⁶⁹ But an assessment of payout policy is not complete without considering share buybacks.

Share Buybacks. A share buyback is the second main way that companies return cash to shareholders. Whereas all shareholders are treated equally with a dividend, only shareholders who sell to the company receive cash. This means that shareholders realize very different outcomes based on whether they choose to sell or hold the stock when they deem it to be overvalued, fairly valued, or undervalued.

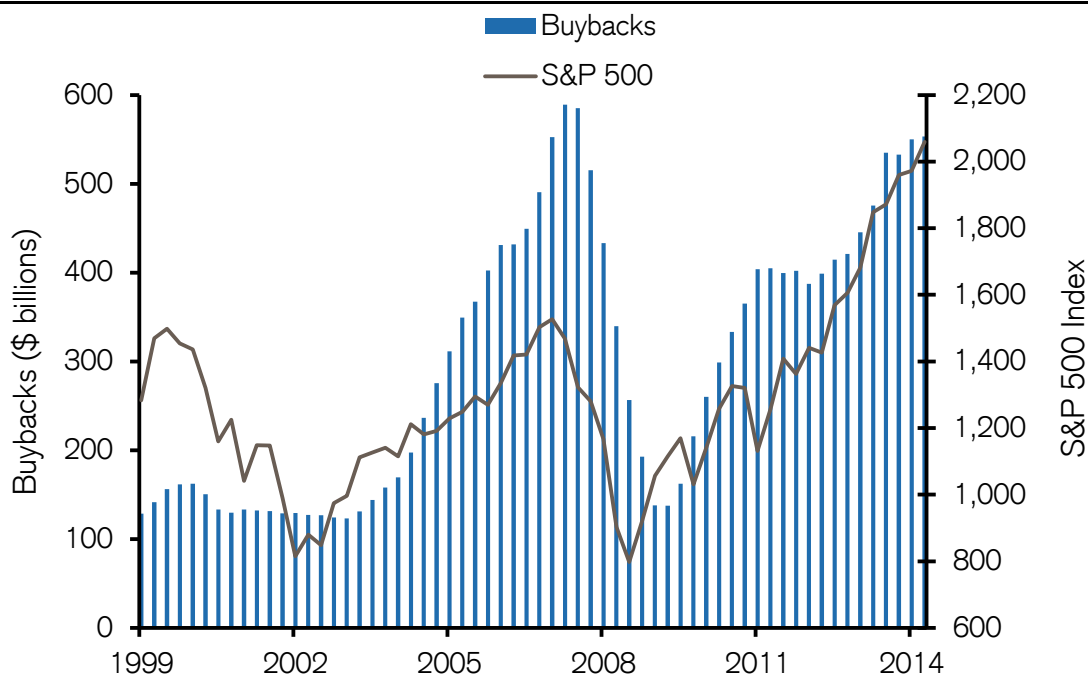
Exhibit 35 shows that gross buybacks for the top 1,500 companies in the U.S. have grown considerably from 1980 to 2014. Buybacks are much more cyclical than dividends, consonant with the attitude that a company should fund a buyback with cash that's left over after all other uses, including dividends, have been exhausted.

Exhibit 35: U.S. Gross Share Buybacks, 1980-2014

Source: Credit Suisse HOLT.

Note: Top 1,500 U.S. industrial firms. Dollar amounts are not inflated.

Exhibit 36 narrows the sample to companies in the S&P 500 Index from 1999 through 2014, and compares their buyback volume to the level of the index. The exhibit makes clear that buybacks hug the results for the market. This fits the notion that buybacks are a use for residual cash and also implies that managements have a proclivity to buy high and not buy low.

Exhibit 36: S&P 500 Gross Buybacks and Index Price, 1999-2014

Source: S&P Dow Jones and Credit Suisse.

Despite the sharp rise in buybacks, many market analysts insist on using dividend yield as a measure of payout policy and as a means to anticipate future market returns.⁷⁰ In fact, you need to be very cautious in comparing data before and after 1982. Buybacks were very scarce prior to that date because the Securities and Exchange Act of 1934 prohibited the manipulation of securities prices. Since the rules weren't clear about what constituted manipulation, most companies avoided buybacks altogether.⁷¹

In 1982, Congress enacted Rule 10b-18, which grants companies a safe harbor provided they follow certain rules. Those rules form a legal shield from the threat of being sued by specifying how a company can execute a buyback in terms of manner, timing, price, and volume.⁷² The Securities and Exchange Commission has subsequently updated the rules to reflect current market conditions. The year 1982 marks a new regime in how companies return cash to shareholders.

When assessing a repurchase program, investors and executives should consider the golden rule of share buybacks, which states: A company should repurchase its shares only when its stock is trading below its expected value and when no better investment opportunities are available.⁷³

The golden rule addresses both absolute and relative value. Companies should only invest where they anticipate a payoff that has a positive net present value. This is a fancy way of saying "you will get more than what you pay for." This absolute benchmark applies to all of a company's capital allocation decisions, including M&A, capital expenditures, and R&D.

The rule also addresses relative value when it emphasizes that companies should prioritize higher return internal investment opportunities over buybacks. Ideally, executives should rank their investment opportunities by expected return and fund them from highest to lowest. A company should expect that all of the investments it funds will earn above the cost of capital. While access to capital can be a constraint, most companies generate sufficient cash flow to fund their internal investments.⁷⁴

The second aspect of assessing a buyback is its impact on various shareholders under different conditions. Only if a stock trades exactly at intrinsic value do buybacks and dividends treat all shareholders the same. If a stock is overvalued or undervalued, the effect of a buyback is different for selling shareholders than it is for those who continue to hold.

From the company's standpoint, corporate value is conserved no matter how the company chooses to pay out cash. What differs is who wins and who loses as the result of buying stock below or above intrinsic value. Since management should focus on building value per share for continuing shareholders, it should always try to buy back shares that are undervalued.

Exhibit 37 illustrates the principle. Say we have a company with a value of \$100,000 and 1,000 shares outstanding that decides to return \$20,000 to its shareholders.

Exhibit 37: The Value Conservation Principle

Assumptions	Scenario A			Scenario B		Scenario C	
	Base	Assume buyback @ \$200	Assume buyback @ \$50	Assumptions		Assume dividend of \$20	
Buyback amount		\$20,000	\$20,000	Dividend amount		\$20,000	
Firm Value	\$100,000	\$80,000	\$80,000	Firm Value		\$80,000	
Shares outstanding	1,000	1,000	1,000	Shares outstanding		1,000	
Current price	\$100	\$200	\$50	Current price		\$10	
Shares post buyback		900	600				
Value/share	\$100	\$88.89	\$133.33	Value/share		\$80.00	
				Dividend/share		\$20.00	
Selling shareholders		100	400				
		\$200	\$50				
Value to sellers		\$20,000	\$20,000				
Ongoing shareholders		900	600	Ongoing shareholders		\$80,000	
		\$88.89	\$133.33	Dividends		\$20,000	
		\$80,000	\$80,000				
Total value		\$100,000	\$100,000	Total value		\$100,000	
Per share +/- sellers		\$100.00	(\$50.00)				
Per share +/- holders		(\$11.11)	\$33.33				

Source: Credit Suisse.

In Scenario A, we assume the stock price is \$200, double the fair value of \$100 (\$100,000/1,000). The company can buy 100 shares, leaving \$80,000 of value and 900 shares outstanding. In this case, the selling shareholders gain \$100 per share (\$200 proceeds - \$100 value = \$100) and the continuing shareholders lose \$11.11 per share (\$88.89 continuing value - \$100 initial value = -\$11.11). Buying back overvalued stock benefits sellers at the expense of buyers.

In Scenario B, we assume the stock trades at one-half of fair value, or \$50 per share. The company can buy 400 shares, with \$80,000 of remaining value and 600 shares outstanding. Now we see that the selling shareholders lose \$50 per share (\$50 proceeds - \$100 value = -\$50) and continuing shareholders gain \$33.33 per share (\$133.33 continuing value - \$100 initial value = \$33.33).

In Scenario C, the company pays a \$20 dividend to all shareholders. Just as in the prior scenarios, the firm value drops to \$80,000, but each shareholder receives identical treatment, leaving aside tax considerations.

This analysis suggests a couple of points that investors commonly overlook. First, if you are the shareholder of a company that is buying back stock, doing nothing is doing something. By choosing to hold the shares instead of selling a pro-rated amount, you are effectively increasing your percentage ownership in the company. One alternative is to sell shares in proportion to your stake, creating a homemade dividend and maintaining a steady percentage ownership in the business.

Second, it is logical that you would prefer that the companies you hold in your portfolio buy back stock rather than pay a dividend. If you own shares of companies that you think are undervalued, buybacks will increase

value per share by definition. The only instance where this may not be true is if you believe that a dividend would provide a more powerful signal to the market, hence creating more value than a buyback.

Tying together these thoughts, there are basically three schools of thought regarding buybacks: fair value, intrinsic value, and accounting-motivated. The intrinsic value school is where you want to be if possible.

The fair value school takes a steady and consistent approach to buybacks. Management believes that over time it will buy back shares when they are both overvalued and undervalued, but for the most part when they are about fairly priced. This approach offers shareholders substantial flexibility as it allows them to hold shares and defer tax liabilities or create homemade dividends by selling a pro-rated number of shares.

The fair value school is consistent with the free cash flow hypothesis, which says that managers who have excess cash will invest it in projects with a negative net present value. By disbursing cash, a company buying back its shares reduces the risk of doing something foolish with the funds.⁷⁵ Research suggests that most companies would have been better off buying back stock consistently versus their actual behavior of buying heavily in some periods and lightly, or not at all, in others.⁷⁶

The intrinsic value school believes a company should only buy back shares when it deems them to be undervalued. A company must have asymmetric information or beliefs, as well as analytical prowess, to profitably pursue this approach. Asymmetric information means that company management has information that the stock price fails to reflect. Differing beliefs occur when management has the same information as the market but comes to different conclusions about what that information means.

Analytical prowess means that the executives at the company know how to translate their differential view into an estimate of the relationship between the stock price and intrinsic value. Investors should not assume that management has this ability. Indeed, surveys consistently show that executives believe their stock to be cheap. For example, in a survey from mid-2013, 60 percent of chief financial officers (CFOs) thought that U.S. equities were overvalued, but only 11 percent thought their own stock was overvalued.⁷⁷

Management can act on its conviction by being bold with its buyback program, buying back a substantial percentage of the shares or even buying them at a premium to the prevailing price through a tender offer.⁷⁸ This school fits the signaling hypothesis, which suggests that companies buy back shares when they deem them to trade below intrinsic value. Further, it is important to focus on actual share buybacks versus buyback announcements. The evidence supporting the signaling hypothesis is mixed, but 85 percent of CFOs believe that their buyback decision conveys information.⁷⁹

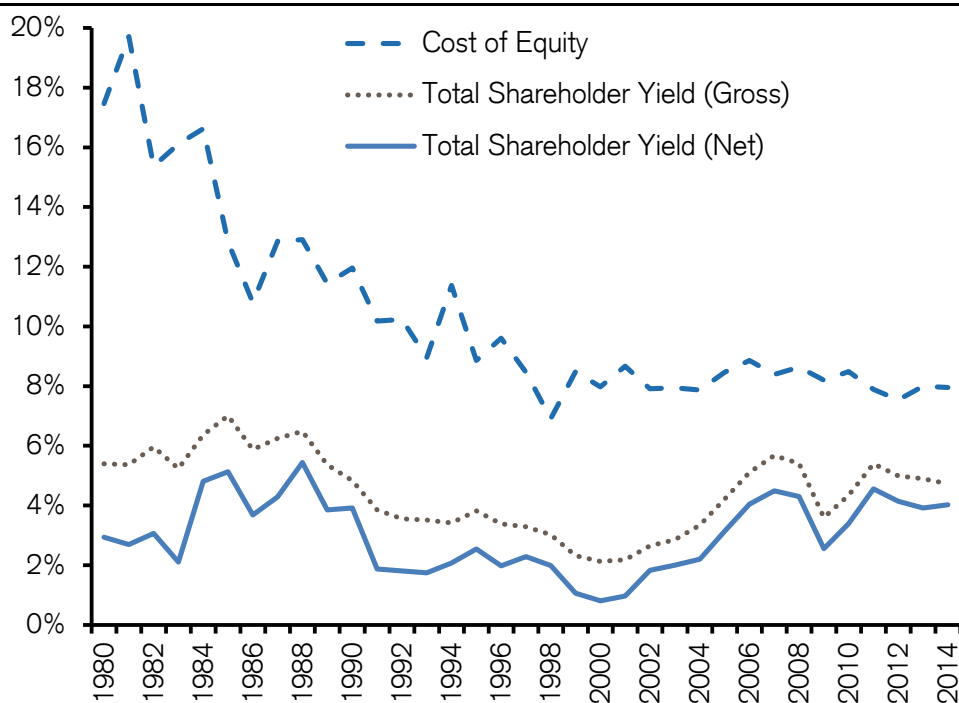
Boosting short-term accounting results, especially earnings per share (EPS), is what motivates the final school.⁸⁰ When surveyed, three-fourths of CFOs cite increasing EPS as an important or very important factor in the decision to buy back shares. Two-thirds of CFOs say that offsetting the dilution from option or other stock-based programs is important. This underscores another essential point: you should consider buybacks net of equity issuance.

The problem with the accounting-motivated school is that its actions are not necessarily aligned with the principle of value creation.⁸¹ For example, there may be a case where buying back overvalued stock boosts EPS and helps management reach a financial objective that prompts a bonus. In this case the motivation is impure because management's proper goal is to allocate capital in an economically sound fashion for shareholders.

Investors assessing companies buying back stock should make an effort to determine which school the management team is in. It can be the case that management buys back stock for the right reason and realizes accounting benefits as a result. That's fine. But investors should be on the lookout for companies that make decisions based on the accounting results without sufficient regard for the economic merits.

A couple of findings from the academic research are worth highlighting. The first is that it appears companies are increasingly using buybacks as a substitute for dividends.⁸² As a result, total shareholder yield (sum of dividends and buybacks divided by equity market capitalization) may be a better indicator of a company's proclivity to pay out than a simple dividend yield. Exhibit 38 shows the total shareholder yield, with and without equity issuance, and the cost of equity for the top 1,500 public companies in the U.S. from 1980-2014. The shareholder yield has been remarkably stable, belying the decline in dividend yield. Equity issuance lowers the total shareholder yield by 140 basis points on average, with a range of 70 to 310 basis points.⁸³

Exhibit 38: U.S. Total Shareholder Yield versus Cost of Equity, 1980-2014



Source: Credit Suisse HOLT and Aswath Damodaran.

Note: Top 1,500 U.S. industrial firms.

Research suggests that buybacks were well received by the stock market in the early days. This is likely the result of a couple of drivers, including the novelty of buybacks and hence the stronger signal they sent, as well as the fact that more buybacks were in the form of Dutch auctions and tender offers versus open market purchases, which are more prevalent today. Analysis of recent buybacks suggests a more muted market effect.⁸⁴

Buybacks continue at a healthy clip. For example, for 2014, buybacks for the companies in the S&P 500 totaled about \$550 billion.⁸⁵ This fits the idea that managements buy when they feel confident. Buybacks and dividends combined should exceed \$1 trillion for companies in the S&P 500 in 2015, an all-time record.

Assessing Management's Capital Allocation Skills

"All roads in managerial evaluation lead to capital allocation."⁸⁶

The final part of this report provides a framework for assessing a management team's capital allocation skills. This framework has four components. First, you want to study how a company has allocated capital in the past. Next, you need to examine the company's return on invested capital and, more importantly, return on incremental invested capital. Third is a careful consideration of incentives and corporate governance. And finally, you can compare management's actions to the five principles of capital allocation.

Regulation may constrain the choices a management team has in the allocation of capital. In industries including insurance and banks, regulators seek to establish capital adequacy to offset possible adverse outcomes. In utilities, regulations limit the returns on invested capital in order to best serve the public good. Understanding regulations and how they might change is essential for these industries.

Past Spending Patterns. The first step in assessing a company's capital allocation skills is to see how management has allocated capital in the past. You should break the analysis into two parts, one dealing with investments in the operations (M&A, capital expenditures, R&D, and working capital) and the other with returning cash to claimholders (dividends, buybacks, and debt repayment).

The value of a business is the present value of future free cash flow (FCF). Free cash flow is defined as net operating profit after tax (NOPAT), a measure of the cash earnings of the business that assumes no financial leverage, minus investment (I) in future growth:

$$FCF = NOPAT - I$$

NOPAT is determined by sales and sales growth, operating profit margins, and the cash tax rate. Investment is determined by changes in working capital, capital expenditures net of depreciation, and acquisitions net of divestitures. You can calculate these sums using what Alfred Rappaport, a professor emeritus at the J. L. Kellogg Graduate School of Management at Northwestern University, calls "value drivers."⁸⁷ Capital allocation is primarily about the value drivers that determine investment.

To make the comparison clean, Rappaport defines value drivers as the number of cents the company invests in each use for every \$1.00 change in sales. For example, if a company's working capital grows by \$10 in a given year and its sales grow by \$100, the incremental working capital rate is 10 percent (\$10/\$100). If in the same year capital expenditures are \$130 and depreciation is \$70, the fixed capital rate is 60 percent (\$60/\$100). You can calculate the value driver for acquisitions less divestitures in the same way.

A useful first step in assessing capital allocation is to see how much was invested in each area for an incremental dollar of sales over time. We like to calculate results for a minimum of three years, if available, and prefer to go back five to ten years when possible. Here are the numbers for Walmart for the five years ending in fiscal 2015:⁸⁸

Incremental working capital investment rate	= 9.4 percent
Incremental fixed capital rate	= 28.5 percent
Incremental M&A rate	= 0.6 percent

Instantly, you will see whether the company is investing in working capital, capital expenditures, or M&A. That allows you to focus your attention. In this case, it is clear that capital expenditures are the most important use of capital.

Here are the numbers for Emerson Electric over the past five years (fiscal 2009-2014):

Incremental working capital investment rate	= 44.3 percent
Incremental fixed capital rate	= 18.4 percent
Incremental M&A rate	= 78.4 percent

Now you can see that M&A has been more important than capital expenditures. In this case, you would roll up your sleeves and figure out how management approaches its M&A decisions. You might also review past deals to see how the market reacted.

This analysis is also useful to assess the change in practices from one CEO to the next. Some CEOs may seek to grow primarily organically, which will raise one set of analytical issues. A successor may be more acquisitive, raising a separate set of issues. Assuming past behaviors provide some basis for anticipating future behavior, this analysis is very useful.

Look for inflection points as well. Are capital expenditures ramping up versus prior levels of spending? Is the company improving its cash conversion cycle? You want to note changes in spending patterns so as to align your analysis with the developments at the company.

The second component of this analysis is to understand how and why management has returned cash to claimholders. This also requires considering a company's capital structure and whether it can or should change. The key is to understand the rationale and motivation for the decisions management makes to evaluate whether they are consistent with the principles of building long-term value per share.

In assessing a company's past capital allocation, it's interesting to determine who exactly is making the decision. Researchers surveyed executives and found that CEOs are least likely to delegate decisions about M&A but much more likely to defer to colleagues on issues such as capital structure and payout ratio. CEOs delegate less if they have a master's degree in business administration, have been around for a long time, or are particularly knowledgeable about a project. CEOs delegate more when the firm is large or complex. Most companies say they use the net present value rule to make investments, but the reputation of the division manager requesting resources is important as is senior management's "gut feel."⁸⁹

It's also useful to understand how the process works. As a practical matter, many companies approach capital allocation through a budgeting process. In a simple version, each division has a capital budget and can either accept that amount or ask for more. Such a request may be subject to a value audit. Research shows that such a budgeting process can lead to overinvestment in low return projects if the budget exceeds the opportunities and underinvestment if the opportunities exceed the budget.⁹⁰

Calculating Return on Invested Capital and Return on Incremental Invested Capital. The second component to assessing capital allocation is determining the output of management's decisions through an analysis of return on invested capital (ROIC) and return on incremental invested capital (ROIIC). ROIC provides a picture of the company's overall performance while ROIIC dwells on the efficiency of incremental spending. Our report, "Calculating Return on Invested Capital: How to Determine ROIC and Address Common Issues," provides details on how to calculate ROIC and ROIIC and includes case studies.⁹¹ Here's a quick summary.

NOPAT is the numerator of ROIC. Because NOPAT assumes no financial leverage, the sum is the same whether a company is highly levered or free of debt. This is essential for comparability within and across industries.

Invested capital is the denominator of ROIC. You can think of invested capital in two ways that are equivalent. First, it's the amount of net assets a company needs to run its business. Alternatively, it's the amount of financing a company's creditors and shareholders need to supply to fund those net assets. These approaches are the same since dual-entry accounting requires that both sides of the balance sheet equal one another.

You should calculate ROIC using the assets side of the balance sheet if given a choice, as that allows you to see how efficiently the company is using capital. In contrast, the right-hand side shows only how much capital the firm has and how it has chosen to finance the business. Ideally, you should calculate ROIC from both the left- and right-hand sides of the balance sheet.

In fiscal 2015, Walmart's NOPAT was \$18.0 billion and its average invested capital was \$146.3 billion, for an ROIC of 12.3 percent. This is well in excess of the company's cost of capital. Since strategies, a bundle of investments, must earn a return in excess of the cost of capital in order to pass the NPV test, ROIC can be a rough proxy for value creation.

Academic research shows that the market rewards investment in organic growth in high return businesses. Typically, companies that earn high ROICs are said to have some sort of competitive advantage. A quick analysis of ROIC indicates whether a company has a competitive advantage and, if so, what lies at the foundation of that advantage.

Bruce Greenwald, a professor at Columbia Business School, argues that there are two sources of competitive advantage: consumer advantage and production advantage. The key to each advantage is the creation of barriers to entry that fend off competition. Barriers to entry are particularly strong when a company enjoys economies of scale, which mean that the cost per unit for the incumbent is lower than that for a challenger.⁹²

A consumer advantage is the result of the habitual use of a product, high costs of switching to a new product, or high costs of searching for a superior product. A production advantage allows a company to deliver its goods or services more cheaply than its competitors and is the result of either privileged access to inputs or to proprietary technology that is difficult or costly to imitate. A competitive strategy analysis focuses on identifying these sources of advantage and assessing their durability.

ROIC can provide a quick and useful way to investigate competitive advantage. You can decompose ROIC into two parts, a modified version of what is known as a DuPont Analysis:

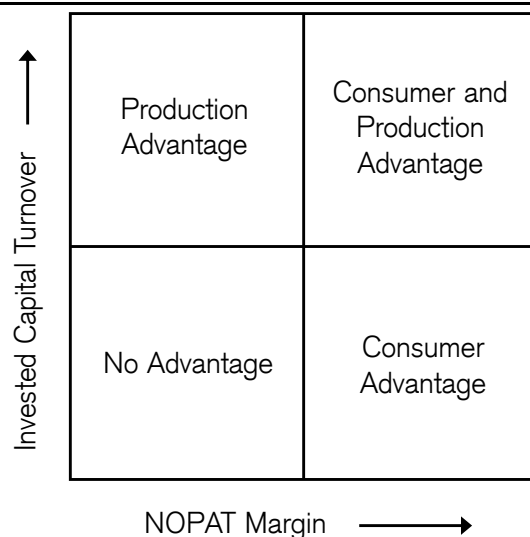
$$\text{Return on invested capital (ROIC)} = \frac{\text{NOPAT}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Invested Capital}}$$

The ratio of NOPAT/Sales, or NOPAT margin, is a measure of profit per unit. Sales/Invested Capital, or invested capital turnover, is a measure of capital efficiency. Sales cancel out when you multiply the terms and you are left with NOPAT/Invested Capital, or ROIC.

It is easy to imagine two companies arriving at the same ROIC by different paths. Walmart got to its 12.3 percent ROIC with a 3.7 percent NOPAT/Sales ratio and a 3.3 times Sales/Invested Capital ratio. This is a classic low-margin, high-invested capital turnover business. A luxury goods seller, on the other hand, may reach the same ROIC with a 20.5 percent NOPAT/Sales ratio and 0.6 times invested capital turnover.

Exhibit 39 summarizes the analysis. If a company gets to a high ROIC through a high NOPAT margin, you should focus your analysis on a consumer advantage. If the company's high return comes from a high turnover ratio, emphasize analysis of a production advantage. For companies that are high in both, consider how the advantages are reinforced by economies of scale.

Exhibit 39: ROIC and Competitive Advantage



Source: Credit Suisse.

Having defined and discussed ROIC we must now emphasize that it's not the absolute ROIC that matters but rather the change in ROIC. Or, even more accurately, what's crucial is the expectation for changes in ROIC. Needless to say, the market is not always perfect at anticipating change in ROIC, so having a sense of where ROIC is going can be of great value.⁹³

One potentially useful measure is return on incremental invested capital, or ROIC. ROIC properly recognizes that sunk costs are irrelevant and that what matters is the relationship between incremental earnings and incremental investments.

The definition of ROIC is as follows:

$$\text{ROIC} = \frac{\text{Year}_2 \text{ NOPAT} - \text{Year}_1 \text{ NOPAT}}{\text{Year}_1 \text{ invested capital} - \text{Year}_0 \text{ invested capital}}$$

In words, ROIC compares the change in NOPAT in a given year to the investments made in the prior year. Let's say a company's Year₀ invested capital is \$2,000 and it invests \$200 during the year (making Year₁ invested capital \$2,200). Further, NOPAT from Year₁ to Year₂ climbs from \$300 to \$350. Given these assumptions, ROIC is 25 percent $[(\$350 - \$300) / (\$2,200 - \$2,000)]$.

It is preferable to calculate ROIC on a rolling three- or five-year basis for businesses with investments or NOPAT that are lumpy. At the other extreme, you can take quarterly changes and annualize them if you want to see if there are any recent trends or improvements. Obviously these results will be the most volatile, but they can give you some insights into how the business is doing. As an example of the calculation, Walmart's ROIC is -23 percent for fiscal 2015, -5 percent for a rolling three-year period ended 2015, and 6 percent for the rolling five-year period ended 2015.

High ROIICs generally indicate that a business is either capital efficient or has substantial operating leverage (which often proves transitory). Calculating a company's historical ROIIC can be very helpful in understanding potential earnings moves.

A final note of warning: ROIIC—for a host of technical reasons—is not really an economic measure of value. Further, ROIIC makes the strong underlying assumption that the ROIC on the base business remains stable. This is clearly not always true. So use the measure to determine the likelihood of change and to understand past patterns, but don't compare it with the cost of capital or consider it a true return measure.⁹⁴

Incentives and Corporate Governance. One of the essential lessons of economics is that incentives matter. But it is also the case that incentives designed to achieve one objective can lead to unintended consequences.⁹⁵ The goal of this section is to consider whether the incentives a company has in place encourage judicious capital allocation. Most of these incentives address compensation.

Agency theory is the classic way to explain why the managers of a company may not act in the interests of the shareholders.⁹⁶ The idea is that conflicts can arise when there is a separation between ownership and control of a firm. There are three areas where these conflicts tend to arise.⁹⁷

The first is that while it is clear that shareholders want management to maximize the value of their holdings, management may derive benefits from controlling resources that don't enrich shareholders. For example, if remuneration is roughly correlated with the size of the firm, management may seek to do value-destroying M&A deals to grow.

The second area of conflict is with tolerance for risk. Since shareholders tend to hold stocks as part of a diversified portfolio and managers are disproportionately exposed to their own company, managers may seek less risk than shareholders would deem appropriate.

The final conflict is with time horizon. To the degree that compensation plans have a shorter time horizon than the period shareholders use to assess the merit of an investment, there can be a mismatch. So managers may dwell on short-term boosts in earnings. Indeed, research shows that a large majority of managers are willing to forego value-creating investments to deliver near-term earnings.⁹⁸

So what kind of executive compensation scheme provides the proper incentives for management to build value? You can start with what you don't want, which is incentive compensation that is completely independent of value creation. In this case, an executive would have limited incentive to build value because he or she would not benefit directly from that increase. At the other extreme would be the case where the CEO owns 100 percent of the company, blunting any concerns about agency theory.

As a broad characterization, compensation for CEOs in the past 30 years has moved from one based heavily on salary and bonus to one much more sensitive to stock price performance.⁹⁹ But the shift to stock-based compensation, seemingly a step in reducing agency costs, has brought with it a host of other challenges. Most pronounced is that many executives are now focused on boosting the stock price by whatever means they can rather than focusing on creating value, which ultimately gets reflected in the market price.

There is a spirited debate about whether equity-based compensation is doing a proper job of encouraging management to focus on long-term performance.¹⁰⁰ In practice, there are two challenges to equity-based compensation that make it less effective than it might be. Properly structured compensation programs can address both challenges, but rarely do. The first is a company's stock price is only a rough measure of corporate performance. Factors outside of management's control, including general economic conditions,

interest rates, inflation expectations, and the equity risk premium, can play a larger role in stock price changes than corporate results do.¹⁰¹

The second challenge is that while the stock market does provide managers with information about investment opportunities and the past decisions of managers, that information can be noisy in the short run.¹⁰² That few managers understand market expectations effectively compounds this challenge.¹⁰³

Before discussing how to address these challenges, let's take a look at the metrics that companies most commonly use in their incentive compensation. Frederic W. Cook & Co., a consulting firm dedicated to executive compensation, does an annual survey of the largest 250 companies in the S&P 500. Exhibit 40 shows the results. The past two years were the first instances in which TSR was the most common incentive metric, followed by measures of profit and capital efficiency.¹⁰⁴

Exhibit 40: Most Commonly Used Long-Term Incentive Metrics

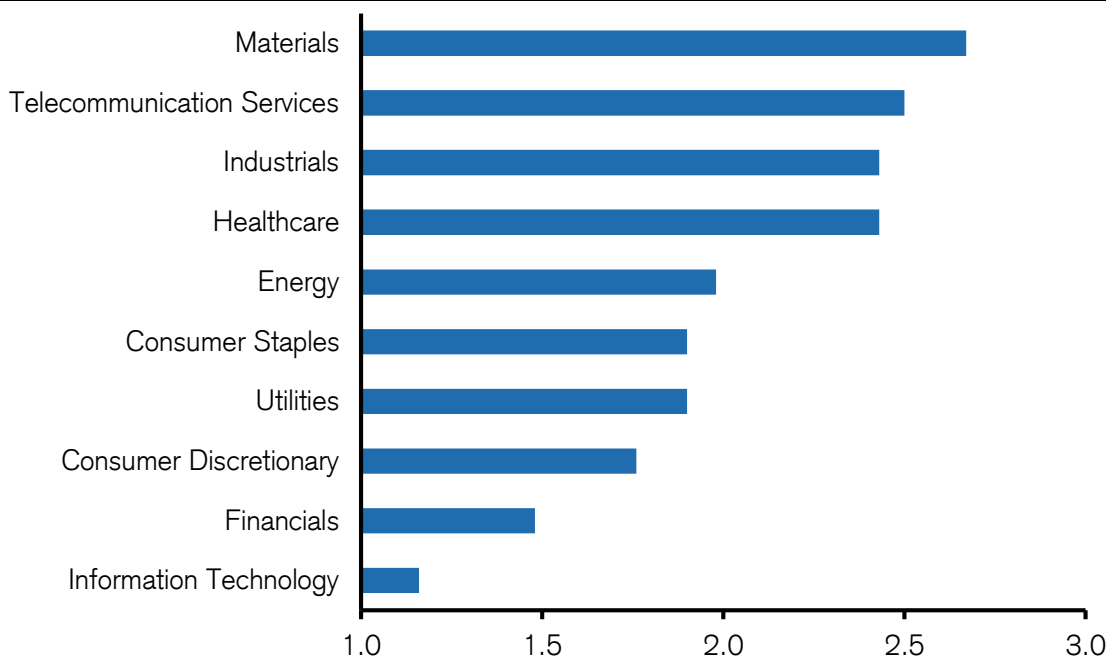
	<u>2014</u>	<u>2013</u>	<u>2012</u>
Total shareholder return	58%	54%	48%
Profit (EPS, etc.)	50	49	50
Capital efficiency	41	40	37
Revenue	21	20	20
Cash flow	13	12	13
Other	15	17	16

Source: Frederic W. Cook & Co., "The 2014 Top 250 Report: Long-Term Incentive Grant Practices for Executives," October 2014.

On the surface it may appear encouraging that TSR is on top of the list. But there are a couple of reasons for caution. Using TSR as an incentive metric doesn't really matter if a company doesn't know how to create value. Having the right goal isn't helpful if you don't know how to achieve that goal. And since TSR is absolute versus relative to some benchmark, external factors may play a bigger role in compensation than company-specific factors. So unless TSR is relative to an appropriate benchmark, it fails to reflect the efforts of the firm.

The Credit Suisse HOLT team built a scorecard to assess the quality of management incentives. Unlike the Frederic W. Cook & Co. survey, the HOLT approach is to award points for positive incentive measures such as operational drivers, return on capital, relative TSR, and long-term plans, and to deduct points for negative measures including no disclosure, absence of financial targets, substantial option expense, and no long-term plan. The sample includes most of the top 1,000 companies in the U.S.¹⁰⁵

Exhibit 41 shows the average management incentive score by sector using the proxy statements filed in 2014. The sectors with the most positive scores include materials and telecommunication services, while financials and information technology fare relatively poorly.

Exhibit 41: Average Management Incentive Scores by Sector, 2014

Source: Credit Suisse HOLT.

So what elements should you look for in an effective incentive program? The key is to look for a company that seeks to build long-term value per share with the belief that the stock market will ultimately follow that value. If the market fails to reflect that value, management can take action by sharpening communication or buying back stock.

There are three elements to an incentive compensation program that supports judicious capital allocation.¹⁰⁶ The first is to compensate senior executives with stock options or restricted stock units that are indexed to either the market overall or an appropriate peer group. Presuming that exogenous factors affect peers in a similar fashion as the target firm, indexing takes a large step toward isolating management skill and reducing the role of luck. Only individuals who can influence the stock price should be paid in equity, which limits the number of eligible executives.

Second, executives who run operating units, as well as front line employees, should be paid for exceeding long-term goals for the operating value drivers. These include sales growth, operating profit margins, and some measure of return on invested capital. Broader value drivers can be further broken down into leading indicators of value, performance measures that roll up to the value drivers.

For example, if a retailer has a goal of opening five new stores in a year, a leading indicator of value might include finding a store location and signing a lease. Here again, the incentives are awarded based on what the individual employees can control. Warren Buffett explains that a good plan “should be (1) tailored to the economics of the specific operating business; (2) simple in character so that the degree to which they are being realized can be easily measured; and (3) directly related to the daily activities of the plan participants.”¹⁰⁷

Finally, recognize that the debate about the short term versus the long term is an empty one. Instead, acknowledge that the goal is to maximize long-term value per share. This applies to activities that management expects to pay off quickly or in the distant future.¹⁰⁸ Amazon.com is a company that appears comfortable taking a long-term view. The company’s CEO, Jeff Bezos, argues that there is less competition

for long-term initiatives. He says, "If everything you do needs to work on a three-year time horizon, then you're competing against a lot of people. But if you're willing to invest on a seven-year time horizon, you're now competing against a fraction of those people, because very few companies are willing to do that. Just by lengthening the time horizon, you can engage in endeavors that you could never otherwise pursue. At Amazon we like things to work in five to seven years."¹⁰⁹

Incentives are an important determinant of behavior. Examine whether a management team is committed to building long-term value by examining their words, incentives, and actions. Agency costs are alive and well, and in many cases companies try to boost their stock price using artificial or superficial methods versus boosting underlying long-term value through the proper conception and execution of a strategic plan.

Five Principles of Capital Allocation. In their book, *The Value Imperative*, James McTaggart, Peter Kontes, and Michael Mankins describe four principles of resource allocation that apply readily to our discussion about capital allocation.¹¹⁰ We added one to expand the list to five and believe that these principles are a sound benchmark that you can use to measure management's mindset regarding their capital allocation practices.¹¹¹

- 1. Zero-based capital allocation.** Companies generally think about capital allocation on an incremental basis. For example, a study of more than 1,600 U.S. companies by McKinsey found that there was a 0.92 correlation between how much capital a business unit received in one year and the next. For one-third of the companies, that correlation was 0.99.¹¹² In other words, inertia appears to play a large role in capital allocation.

The proper approach is zero-based, which simply asks, "What is the right amount of capital (and the right number of people) to have in this business in order to support the strategy that will create the most wealth?"¹¹³ There is no reference to how much the company has already invested in the business, only how much should be invested.

Research by McKinsey suggests that those companies that showed a zero-based allocation mindset, and hence were the most proactive in reallocating resources, delivered higher TSRs than the companies that took more of an incremental approach.¹¹⁴ Further, academic research shows that those companies that are good at internal capital allocation tend to be good at external allocation as well.¹¹⁵

- 2. Fund strategies, not projects.** The idea here is that capital allocation is not about assessing and approving projects, but rather assessing and approving strategies and determining the projects that support the strategies. Practitioners and academics sometimes fail to make this vital distinction.¹¹⁶ There can be value-creating projects within a failed strategy, and value-destroying projects within a solid strategy.

Another reason to be cautious about a project approach is that it is easy to game the system. It is common for companies to have thresholds for project approval. For instance, a plant manager can approve small projects, business unit heads larger ones, the CEO bigger ones still, and the board of directors the largest investments. But at each level, analysts can manipulate the numbers to look good. One of the aspects of the institutional imperative, as Buffett describes it, is, "Any business craving of the leader, however foolish, will be quickly supported by detailed rate-of-return and strategic studies prepared by his troops."¹¹⁷

The key to this principle is recognizing that a business strategy is a bundle of projects and that the value of the bundle is what matters. The CEO and board must evaluate alternative strategies and consider the financial prospects of each.

- 3. No capital rationing.** The attitude at many companies, which the results of surveys support, is that capital is “scarce but free.” The sense is that the business generates a limited amount of capital which makes it “scarce,” but since it comes from within it is “free.”

The primary source of capital for companies in the U.S. is the cash they generate. The patterns of spending on the various uses of capital indicate the attitude of managements. Capital expenditures, R&D, and dividends receive priority, and M&A and share buybacks are considered when economic results are good. Internal capital allocation tends to be very stable from year to year, and inertia plays a large role. Business units may jockey for more capital but, as we have seen, the changes in year-to-year allocation tend to be modest. These observations are consistent with the “scarce but free” mindset.

A better mindset is that capital is plentiful but expensive. There are two sources of capital that companies can tap beyond the cash generated internally. The first is redeploying capital from businesses that do not earn sufficient returns. Management can execute this inside the company or sell the underperforming businesses and redeploy the proceeds. The second is the capital markets. When executives have value-creating strategies that need capital, the markets are there to fund them in all but the most challenging environments.

The notion that internally generated capital is free is also problematic. Thoughtful capital allocators recognize that all capital has an opportunity cost, whether the source is internal or external. As a consequence, managers should explicitly account for the cost of capital in all capital allocation decisions. Too frequently, companies select actions that add to earnings or earnings per share without properly reckoning for value.

The limiting resource for many companies is not access to capital but rather access to talent. Finding executives with the proper skills for success, including an aptitude for allocating capital, is not easy. This is a valid challenge but relates to recruiting and development, not access to capital.

- 4. Zero tolerance for bad growth.** Companies that wish to grow will inevitably make investments that do not pay off. The failure rate of new businesses and new products is high. Seeing an investment flop is no sin; indeed it is essential to the process of creating value. What is a sin is remaining committed to a strategy that has no prospects to create value, hence draining human and financial resources.

Executives who follow this principle invest in innovation but are ruthless in cutting losses when they see that a strategy is unlikely to pay off. Many companies have the opportunity to create substantial value by exiting businesses where they have no advantage. This reduces cross-subsidization within the organization and allows for the best managers to work for the businesses that create the most value.

- 5. Know the value of assets, and be ready to take action to create value.** Intelligent capital allocation is similar to managing a portfolio of stocks in that it is very useful to have a sense of the difference, if any, between the value and price of each asset. This includes the value of the company and its stock price. Naturally, such analysis must include considerations such as taxes.

With a ready sense of value and price, management should be prepared to take action to create value. Sometimes that means acquiring, other times that means divesting, and frequently there are no clear gaps between value and price. As we have seen, managers tend to prefer to buy than to sell, even though the empirical record shows quite clearly that sellers fare better than buyers, on average.

As we mentioned in the introduction, the answer to most capital allocation questions is, “It depends.” Managers who adhere to this final principle understand when it makes sense to act on behalf of long-term shareholders.

Conclusion

Capital allocation is one of management’s prime responsibilities. Yet few senior executives are versed or trained in methods to allocate capital most effectively. Further, incentive programs frequently encourage behaviors that are not in the best interests of long-term shareholders. We believe that the goal of capital allocation is to build long-term value per share.

In this report, we examined the sources and uses of capital. We found that U.S. corporations fund most of their investments internally and that M&A and capital expenditures are the largest uses of capital for operations. We then examined seven capital allocation alternatives, noting what the actual spending has been, how to think about that alternative analytically, what the academic research says, and the near-term outlook.

Finally, we set out a framework to assess the capital allocation practices of a management team. This framework includes examining past behavior, calculating return on invested capital, weighing incentives, and considering the five principles of thoughtful capital allocation.

Acknowledgment

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Checklist for Assessing Capital Allocation Skills

Past Spending Patterns

- ☐ Have you analyzed how companies have spent money in the past, separating operating uses from return of capital to claimholders?
- ☐ How has the company funded its investments?
- ☐ Identify the prime use of capital. Do you know if management thinks about that use of capital properly?
- ☐ Have there been shifts in the pattern of spending?
- ☐ If there is new management, has spending changed?
- ☐ Who makes which capital allocation decision?
- ☐ How does the company conduct its budgeting process?

Calculate ROIC and ROIC

- ☐ Have you calculated ROIC over time and observed a trend?
- ☐ Examine composition of ROIC through a DuPont analysis—does this suggest a consumer or production advantage?
- ☐ Have you compared the company's results to those of its peers?
- ☐ Have you calculated ROIC for one-, three-, and five-year rolling periods?

Incentives and Governance

- ☐ How is the company's incentive compensation structured?
- ☐ How much stock does senior management own?
- ☐ Is total shareholder return calculated on a relative basis?
- ☐ Have you examined the company's incentive score?
- ☐ Are the measures in place to encourage management to think for the long term?

Five Principles of Capital Allocation

- ☐ Does the company use zero-based capital allocation or is it dominated by spending inertia?
- ☐ Is the company focused on funding strategies or projects?
- ☐ Does the company have a "scarce but free" attitude about capital, or "abundant but costly?"
- ☐ Does the company prune businesses with poor prospects for creating value?
- ☐ Does the company know how to calculate the value of its assets and does it act accordingly?

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Q: Hugh Liedtke, the former CEO of Pennzoil, used to joke that he believed in the "bladder theory":

Companies pay dividends so that management can't p--s all the money away.

A: It's hard to improve on that. In the 1960s, in "A Modest Proposal," I suggested that companies should be required to pay out 100% of their net income as cash dividends. If companies needed money to reinvest in their operations, then they would have to get investors to buy new offerings of stock. Investors would do that only if they were happy both with the dividends they'd received and the future prospects of the company. Markets as a whole know more than any individual or group of individuals. So the best way to allocate capital is to let the market do it, rather than the management of each company. The reinvestment of profits has to be submitted to the test of the marketplace if you want it to be done right.

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Triple Crown Teachings

Three Takeaways from the Quest for the Elusive Feat

June 4, 2015

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"When American Pharoah seeks to complete a sweep of the Triple Crown at Belmont Park on Saturday, racing fans will hope to see a great race and perhaps a definitive confirmation that the winner has earned a lofty place in the sport's history. Based on recent history, it won't happen."

Andrew Beyer¹

- The quest for the Triple Crown of horse racing offers three lessons for an investment organization:
 - Pay attention to the results of the past
 - Recognize the value of diversity
 - Value = Probability x Price
- The first lesson is to consider base rates in assessing future outcomes.
- The second lesson is to promote cognitive diversity and thereby avoid the equivalent of inbreeding in your organization.
- The final lesson is to focus on mispricing in investing.

Introduction

To be part of the pantheon of horse racing in the United States requires winning the Triple Crown—the Kentucky Derby, the Preakness Stakes, and the Belmont Stakes. The three races cover different distances and occur over a span of just five weeks. It is an extraordinarily hard task for a horse. Indeed, only eleven have achieved it in the past century.

On Saturday, June 6th, 2015, American Pharoah will be the 32nd horse to attempt to complete the feat.² Up to that point, the three-year-old bay colt had won five of the six races he had entered including victories by a margin of one length at the Kentucky Derby and a more impressive seven lengths at the Preakness.

Whether American Pharoah wins or losses, the path to the Triple Crown offers three lessons for investors and organizations. Some of the teachings may be familiar but are a useful reminder.

Lesson 1: Pay attention to the results of the past. Andrew Beyer, a horse racing expert, said of American Pharoah's chances of winning: "Based on recent history, it won't happen." Why the downbeat message? The answer lies in the base rate of success over time.

In the last 100 years, 31 horses have been in a position to capture the Triple Crown and, as noted, 11 of them succeeded. That places the success rate at about 35 percent. But those numbers belie a marked distinction before and after 1950. Before 1950, eight of the nine horses that tried won, or close to 90 percent. Since 1950, only 3 of 22 have succeeded, and none since 1978. In the past sixty-five years, more than 85 percent of the horses failed to capture glory.

Further, American Pharoah's speed is not particularly distinguished. Beyer developed the Beyer Speed Figure, which measures the results of a horse adjusted for the track conditions. Higher speed figures are better. When you compare American Pharoah's figures for the Kentucky Derby and Preakness to those of the last eight Triple Crown aspirants—reliable speed figures have only been available since 1990—he falls near the bottom of the heap. The sole horse with worse speed figures was last year's failed Triple Crown contender, California Chrome, who finished the Belmont tied for fourth place.

In 2014, California Chrome had to deal with 10 challengers, whereas American Pharoah will run against just 7. That brightens American Pharoah's prospects. But winning the Belmont has eluded all comers in the last 36 years.

The lesson is to consider base rates in assessing future outcomes. While finding an appropriate reference class and the relevant data can be tricky, psychologists have shown that we tend to rely too much on our own point of view and fail to consider sufficiently the experiences of others.

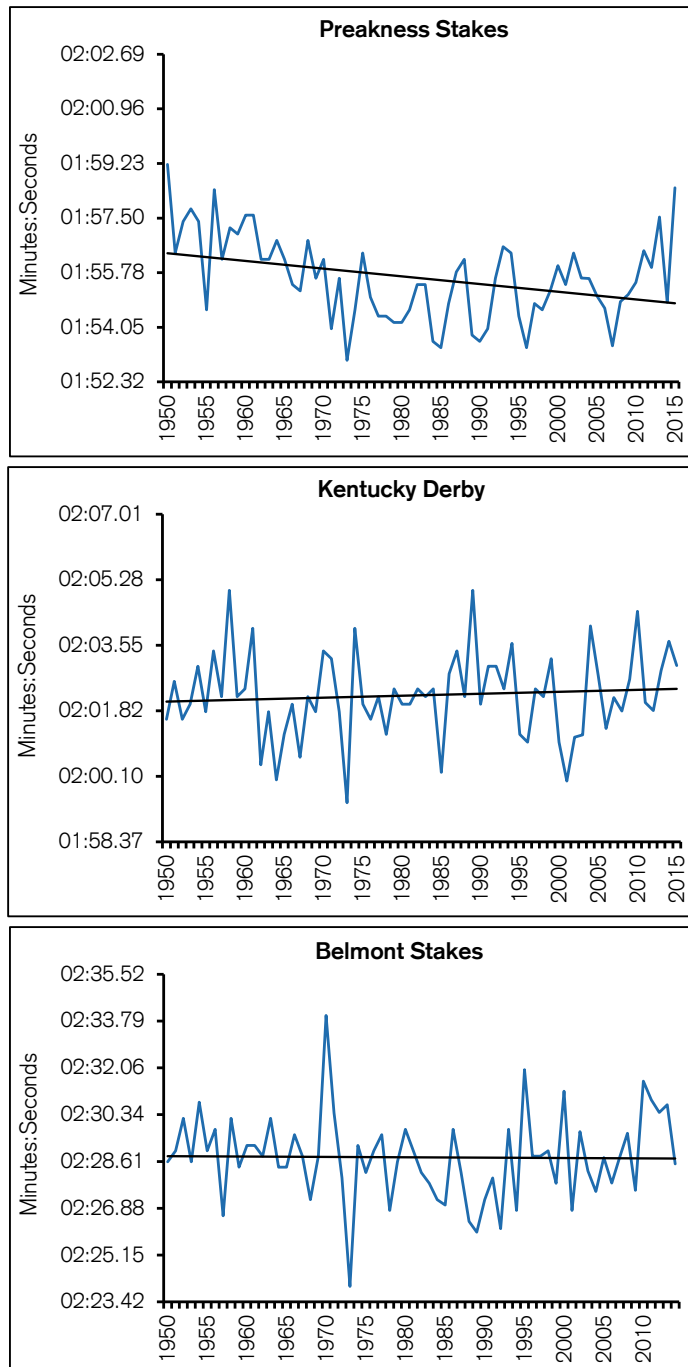
Lesson 2: Recognize the value of diversity. In the discussion of success rates, the year 1950 pops off the page. Why would the horses have succeeded at such a high rate prior to 1950 and at such a low rate after it?

The answer has many facets, but exhibit 1 is a good place to start. It shows the winning times for the three events from 1950 to 2015 (of course, it is without the Belmont result). Rather than listing the races in chronological order, they are ranked by distance. The Preakness is the shortest race ($1 \frac{3}{16}$ miles), the Kentucky Derby in the middle ($1 \frac{1}{4}$), and the Belmont the longest ($1 \frac{1}{2}$).

While the Preakness shows a modest decline in finishing times since 1950, you can see that the trend in times for the Kentucky Derby and the Belmont are essentially flat. For example, the winner of the 1950 Kentucky Derby, Middleground, had a raw time of 2:01:60, faster than American Pharoah's 2:03:02 in 2015.

One academic studying the topic wrote, "Despite intensive programs to breed faster thoroughbreds . . . race speeds . . . have not increased in the last 40-60 years."³ Can you think of any other athletic endeavor where the results have not improved since the middle of the last century?

Exhibit 1: Winning Times for Triple Crown Races, 1950-2015



Source: www.preakness-stakes.info; www.kentuckyderby.ag; www.belmontstakes.com.

Take humans as an example. Researchers estimate that winning times for elite humans running races from sprints to marathons have improved 12 to 13 percent over the same time period.⁴ You can explain this gain through a larger population, better nutrition, refined training methods, psychological incentives, and an improvement in technology. (This leaves aside other potential sources of performance enhancement that are relevant for animals and humans.)

One plausible explanation is that thoroughbred horses reached their physiological peak of performance in the mid-1900s.⁵ Breeding is a key part of this argument. In 1791, James Weatherby established a record of thoroughbred horse breeding, effectively creating a closed population. Analysis shows that about one-third of the genes in the current population of one-half million thoroughbreds come from four stallions born between 1688 and 1725. The top ten contributors are responsible for about half of the genes, and 31 horses account for 80 percent of the genetic makeup of today's stock.⁶ Thoroughbreds have among the highest ratio of inbreeding of any horse breed.⁷

Early horse races tended to be over longer distances than today and owners ran horses that were older. In the last two centuries, the distances have gotten shorter and the horses younger. As a result, thoroughbreds were bred for speed and precocity. This allowed for a steady improvement in race performance from the early 1800s through the mid-1900s.⁸ But horses have simply not gotten faster, save for some improvement at short distances. Since 1950, normal variance explains most of the ups and downs in times.⁹

Indeed, it appears that inbreeding has taken a turn for the worse in recent decades. Whereas the goal for years had been to breed for speed, the emphasis today is more on producing yearlings that fetch as much money as possible at auction. As a result, inbreeding has increased sharply since the mid-1990s.¹⁰

The lesson is to avoid the equivalent of inbreeding in your organization. Research shows that diverse teams tend to outperform more homogenous ones when faced with complex problems. Many organizations, including investment banks, consulting firms, and investment managers, tend to recruit from a select number of universities and place substantial weight on personal fit. This practice can limit diversity.¹¹

The goal is to build a workforce with high cognitive diversity and good cultural fit.¹² You can think of the value of cognitive diversity as similar to that of genetic diversity. Matt Ridley, a journalist, makes the link even more vivid when he suggests that the key to innovation is "ideas having sex."¹³ The point is that you want diverse ideas to engage in reproduction so as to increase the fitness of your organization.

Lesson 3: Value = Probability x Price. Notwithstanding the dismal record of horses trying to win the Triple Crown, bettors appear unfailingly optimistic about each horse's chances. Exhibit 2 shows that the last eight contenders had probabilities of winning the Belmont in the range of 40 to 80 percent as implied by the odds.

Exhibit 2: Implied Probability of Winning the Belmont for the Last Eight Triple Crown Aspirants

	<u>Probability</u>
Silver Charm	49%
Real Quiet	56
Charismatic	39
War Emblem	44
Funny Cide	50
Smarty Jones	74
Big Brown	77
California Chrome	63

Source: Equibase Company.

American Pharoah is in the same range. The recent odds of 3-5 suggest a probability of winning of 63 percent. That figure is very high, representing a lofty expectation of performance. Odds are set through a pari-mutuel system, where the bettors express their expectations by how they allocate their dollars. More money bet on a horse drives up its probability of winning.

Steven Crist, a handicapper and author, emphasizes that the attractiveness of an opportunity is a function of both the probability of the event occurring and the payoff.¹⁴ Before any bettors are rewarded, there is a takeout to pay the race purses, track, and state. This means that the win pool is reduced by 15-20 percent. Assume the takeout is 20 percent. That means a \$4 bet on a horse with a 50 percent chance to win pays, on average, \$3.20.¹⁵

Crist's point is that the intelligent handicapper requires a combination of probability and price to yield a positive expected value. Knowing which horse is likely to win doesn't make you money; you need to know which horse is mispriced. It takes little effort to translate this to the world of business and investing. Knowing which company is best isn't the path to riches; knowing which company is mispriced makes you money.

Triple Crown contenders attract a lot of unsophisticated bettors. On a typical Saturday in the U.S., wagers on horses are about \$50 million. For last year's Belmont Stakes, the bets were three times that amount. You can safely assume that most of the incremental \$100 million was from people caught up in the excitement of the Triple Crown.¹⁶ As a result, Triple Crown contenders are almost always mispriced. Probability times price yields a poor value. Perhaps for some, betting on a potential winner has excitement value that exceeds the cost of the ticket. But that doesn't make it a good bet in monetary terms.

The final lesson is that you need to focus on mispricing in investing. Triple Crown contenders are a little like dot-com darlings from the late 1990s: Their past success draws the attention of individuals who invest without sufficient regard to the relationship between price and value.

American Pharoah may win the Triple Crown, and if he does it will be an extraordinary feat that will bring deserved excitement to the sport. But no matter the outcome, we can say that his current probability appears too high.

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Intuition Is Vastly Overrated

June 11, 2015

Simon Brunner: Are we, as human beings, at all cut out to make good investments?

Michael Mauboussin: Here is the most disheartening statistic in the world of investment: Over the past ten years, the S&P 500 has gone up by 7.7 percent, while the average investor has seen a return of only 5.3 percent. The figures are similar in all of the world's markets. Why is that the case? We often fail to keep a cool head; we buy high and sell low.

Most investors are conscious of this danger, but it is incredibly difficult for them to change their behavior. Why?

We want more of the good and less of the bad. We see that people around us are making a lot of money in the stock market, and we want to be part of that. But markets frequently behave in counterintuitive ways. When they go up, the expected return goes down, and when they fall, the expected return goes up, all things being equal. Another all-too human phenomenon is a desire to be part of the group, which gives us a sense of security. In the context of investments, however, that isn't necessarily a good thing. How did Warren Buffett put it? "You want to be greedy when others are fearful and fearful when others are greedy." It's easy to say, but hard to put into practice.

What does this mean for private investors?

Index funds are a good choice for those who prefer not to spend a lot of time deciding where to put their savings. They represent an entire market or industry, and they are normally broadly diversified. Everyone else can be happy that markets don't always reflect reality, particularly in extreme situations – and such situations provide opportunities for successful investments. Take the first quarter of 2009, for example, when prices were depressed as investors feared the worst.

That's clear in retrospect, but there's an oft-cited stock market rule: "Never try to catch a falling knife."

Of course, it's not enough for prices to be going down, since that might be merely a matter of a price correction. But it was quite apparent in 2009 that certain companies were undervalued.

Numerous observers pointed that out – including me.

If I want to actively manage my assets as a private investor, how should I go about it?

If you want to manage your money yourself, I would suggest the following: First, analyze a stock's price. What are the expectations for the future – the likely revenues, operating profits and investment requirements for the coming years?

And then what?

Second, find out whether the company is likely to do better or worse than expected, strategically and financially. Third, buy or sell. These three steps take a great deal of time and effort. To do this well, you have to be motivated. But the necessary tools are available.

What key figures do you look at when trying to identify stocks with low expectations?

There are several; a low price/book value or price-earnings ratio are good indicators. Historically, such stocks tend to yield a high return, at least over the long term.

When I invest my money, I'm competing with millions of other investors who are thinking in similar terms. So the price of a security reflects the opinion of countless people ...

...Which doesn't mean that they're right!

So I can do better?

Under certain circumstances, yes. But to do better, you have to understand the expectations that are built into the price of a security. Then you can judge whether the market is too optimistic or too pessimistic.

Do you follow your own rules?

I have a broadly diversified portfolio with a number of "cheap" funds, funds with low management fees. I very rarely engage in active trading.

If it's best to invest mainly in index funds and long-term investments, do we really need a bank anymore?

Working with a bank can still be very beneficial for most people: How do you find the right funds? How do you calibrate your

diversification? And ultimately, how do you buy and sell? I think most of us – including me – don't have the time or interest to manage a portfolio on a daily basis. Then you have to ask yourself who can help you with that. A trusted banker can be essential in this very sensitive task.

Am I understanding you correctly: Is investing about combating a variety of human impulses that have served us well in the course of evolution? After all, if those impulses weren't beneficial, we wouldn't have them.

Exactly – but they aren't helpful for making investments. Take optimism, for example. Sooner or later, most entrepreneurs give up their business. But they have a fundamentally positive attitude that allows them to put that fact out of their minds – otherwise they'd never start a company, in all likelihood. In the investment world, however, optimism can be dangerous; you mustn't ignore any relevant information. In other words, investing doesn't come naturally to us, and we need to be conscious of that fact. Then we can act appropriately.

Economists say that we as human beings always seek to maximize our self-interest. Are they right?

As a normative theory, this view of humanity is accurate. When looking at how we should behave, it makes sense to look at a specific action's expected benefit.

And in real life?

Our behavior doesn't really correspond to expectations. One example is our aversion to losses. People are roughly twice as fearful of losing money as they are happy about making a profit. This makes sense from an evolutionary perspective. If your food situation is precarious, any further loss of food may have disastrous consequences. But this may not be the right way to look at investments. People hold on to a security too long because they don't want to take a loss, or they sell a profitable stock too quickly. Another example is the "house money effect." People will go into a casino and keep two separate piles of chips, one with the money they brought with them and the other with their winnings or "house money." They continually keep an eye on the

money they brought – but keeping the two piles separate provides no advantage in the game. A large pile is better than a small one.

Your most recent book is about luck and skill. Just what is luck?

I like the simple definition best: Skill involves things that are within your control, while luck involves things that are out of your control. Luck can play a larger or smaller role, depending on the specific task. We placed these two concepts on a continuum, with luck at the left and skill at the right. Investing tends to be on the left side.

So investments are a matter of luck?

To a great extent, yes. To understand this, it is important to distinguish between absolute and relative skill. The level of absolute skill is very high when it comes to investments. We have access to considerable computing power and a great deal of information, and we can rely on sophisticated theories of investment. Looking at relative skill, in contrast, it is clear that there is no longer a huge difference between the average investor and the very best. Today, anyone can make investments almost as a professional would. This is called the "paradox of skill." Skill is at a very high level, and it is evenly distributed. In this situation, luck plays an important role.

What does that mean for investments?

Discipline, diversification and a long-term approach are very important for reducing the role of luck.

Nonprofessionals, at least, also point to the role of intuition as a factor that lies somewhere between luck and skill. How important is intuition?

That's a difficult question. My personal view is that intuition is vastly overrated. If you are very familiar with a certain area and that area always behaves in a consistent and linear fashion, then intuition might be helpful. Take chess, for example: Asked to analyze a board, a grandmaster will be able to tell you relatively quickly which player has the advantage and point out a good next move. Grandmasters have analyzed millions of games, the board is always the same size and the pieces always move in the same patterns. If the situation is unstable and non-linear, however – as is

usually the case in life – intuition isn't very helpful at all.

But many great ideas have been the result of spontaneous inspiration!

Perhaps someone has actually come up with a 10-billion-dollar idea while taking a shower. But far more people have had an idea while getting dressed in the morning that ultimately went nowhere. Most 10-billion-dollar ideas definitely did not originate in the shower.

Let's talk about sports, your other passion.

You say that luck plays a much more important role in ice hockey than in soccer.

Before I explain, let me mention that I'm a big hockey fan, and I also like to play. But hockey players touch the puck much less than soccer players do the ball. And there is less of a gap in the standings between the hockey teams in North America's NHL than between the top clubs in England's Premier League. The NHL, too, is characterized by a "paradox of skill." When it comes to the soccer World Cup, however, the situation is different – there are far fewer matches, and luck plays a more important role.

You've also examined the careers of great tennis players. Is Roger Federer going to win another Grand Slam title?

I believe that Federer is the best tennis player of all time, and the data backs me up. Seventeen Grand Slam titles is an incredible accomplishment, and I doubt that another man will ever be able to match that record, for various reasons. Roger won Wimbledon – a tournament played on a fast surface – after turning 30. All the same, I think it's unlikely that he's going to win another Grand Slam title.

Why?

He's 34 years old. The problem with getting older is that your entire system slows down. Your hand-eye coordination, your muscles, and so on. At that level this makes a big difference, especially in tennis, where skill plays a major role. His body is no longer up to it.

You're a professional decision maker. How do you make decisions in your day-to-day life? How do you choose a vacation destination, a restaurant, the shirt to put on in the morning?

That's easy: I do as my wife says. All kidding aside, it's incredibly helpful to prioritize decisions based on their possible consequences. At a coffee shop, I don't want to spend hours deciding between a Frappuccino Caramel Cocoa Cluster and a Cotton Candy. I'll order one or the other, and if I don't like it I'll opt for the other one the next time. In the greater scheme of things, even decisions about which car to buy aren't really very important. If you look at it from that perspective, we encounter only a handful of truly important forks in the road over the course of our lives. I'm thinking of marriage or the purchase of a home. I spend a lot of time making those kinds of decisions. For all of the others, my recommendation is this: Don't get caught up in the details.

You have five children. Was that a conscious decision?

Okay, you've caught me there! That was a big decision that we hadn't entirely thought through. We always wanted to have a lot of children, but when it came to the last two or three, my wife was more enthusiastic than I was.

Finally, how much luck have you had in your life?

A great deal. I encountered many people who gave me a lot of support. I had to go through seven interviews to land my first job. Most of the people who interviewed me didn't want to hire me, but then I was able to talk about football with the highest-ranking interviewer. I had noticed that his wastebasket had the logo of his favorite team on it, and made a comment about that. He ended up overruling all of his colleagues.

Is that really luck? Surely you would have done well somewhere else.

In the workplace you need both luck and skill. Probably I would have had a good career in most scenarios, but perhaps it wouldn't have been quite as good.

Where would you place yourself on the luck-skill continuum?

Don't ask – I'm not sure I want to know the answer.

2015 Thought Leader Forum

Proceedings

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Michael Mauboussin

Introduction

We all face a similar challenge: how to pay attention to what matters so as to make sure that we make good decisions. There are lots of bids for our attention, and the introduction of technology in recent years means there are more beeps and buzzes to divert our focus than ever before. Failure to allocate attention properly in the short run can add up to problems in the long run. Hence, the theme for the Thought Leader Forum in 2015 — “Attention: Pay Now or Pay Later.”

This year’s forum featured economists, psychologists, and even a world-class pickpocket. Each explained how focusing the spotlight of attention left a great deal to the shadows. We heard that how you allocate your attention can affect your happiness, how organizational mindsets can perpetuate implicit biases, how a failure to pay attention to small problems can snowball into predictable surprises, and how the notion of multitasking is a myth that should be delegated to the trash heap. And you know that focus can be manipulated when a pickpocket takes an audience member on stage and proceeds to swipe all of his valuables in front of a delighted audience.

You can think of attention on three levels—individual, organizational, and financial markets. In our personal lives, we have to figure out how to filter the signal from the noise. In most cases, the answer is not to try to drink from a fire hose of information, but rather to prioritize attention. Further, one useful approach is to shape your environment in order to shift some of your cognitive load. Finally, we know that creativity is generally associated with a mind-wandering state, but constant focus on screens limits that time. Carving out time for mind-wandering may be the path to doing your best thinking.

Attention is also very important for your organization. Companies, similar to individuals, often have mindsets—a lens through which to see the world. Mindsets can have implicit biases that diminish performance. So, you need to think carefully about whether you can include “nudges” in your organization to steer behavior away from the biases. Motivation is also a crucial topic, and evidence suggests that the conditions of intrinsic motivation—autonomy, mastery, and purpose—can be fragile. Effective leaders shape the organization’s attention in such a way to promote motivation.

Attention is important for markets, too. There is always a topic, or worry, of the day. Understanding how to weight the relevance of that topic is critical. It is also important to pay attention to the person on the other side of your trade. What does he or she know that you don’t? Research suggests that we tend to be overconfident in our beliefs. Allocating attention toward the motivation of others can help check that overconfidence.

We all feel that the pace of change in the world is speeding up. This means that there are more demands on our attention than ever before. And there’s plenty of evidence that our attention wasn’t so good to begin with. So, we need to be aware of the challenges of attention and, more importantly, to adopt methods to allocate attention wisely.

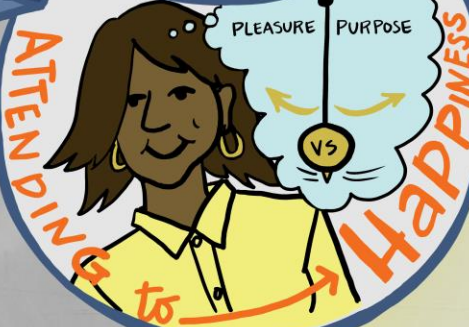
The following transcripts not only document the proceedings, they also provide insights into how you can improve your attention management—as an individual and as a leader. One theme that ran throughout the day was how limited our attention truly is, and how much is going on outside our awareness. Once you recognize this reality, you can take concrete steps to address it in your own life and take advantage of it in business.

CHRISTOPHER CHABRIS

the ILLUSION of ATTENTION



PAUL DOLAN



MAX BAZERMAN



PAYING ATTENTION to WHAT YOU SEE



IRIS BOHNET

APOLLO ROBBINS



ATTENTION:
PAY NOW OR PAY LATER



Michael Mauboussin

Credit Suisse

Michael Mauboussin is a Managing Director of Credit Suisse in the Investment Banking division, based in New York. He is the Head of Global Financial Strategies, providing thought leadership and strategy guidance to external clients and internally to Credit Suisse professionals based on his expertise, research and writing in the areas of valuation and portfolio positioning, capital markets theory, competitive strategy analysis, and decision making.

Prior to rejoining Credit Suisse in 2013, he was Chief Investment Strategist at Legg Mason Capital Management. Michael originally joined Credit Suisse in 1992 as a packaged food industry analyst and was named Chief U.S. Investment Strategist in 1999. He is a former president of the Consumer Analyst Group of New York and was repeatedly named to *Institutional Investor's* All-America Research Team and *The Wall Street Journal* All-Star survey in the food industry group.

Michael is the author of *The Success Equation: Untangling Skill and Luck in Business, Sports, and Investing*, *Think Twice: Harnessing the Power of Counterintuition*, and *More Than You Know: Finding Financial Wisdom in Unconventional Places*. He is also co-author, with Alfred Rappaport, of *Expectations Investing: Reading Stock Prices for Better Returns*.

Michael has been an adjunct professor of finance at Columbia Business School since 1993 and is on the faculty of the Heilbrunn Center for Graham and Dodd Investing. He is also chairman of the board of trustees of the Santa Fe Institute, a leading center for multi-disciplinary research in complex systems theory. Michael earned an AB from Georgetown University.

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Good morning. For those of you whom I haven't met, my name is Michael Mauboussin, and I am head of Global Financial Strategies at Credit Suisse. On behalf of all of my colleagues at Credit Suisse, I want to wish you a warm welcome to the 2015 Thought Leader Forum. For those who joined us last night, I hope you had a wonderful evening. We are very excited about our lineup for today.

I'd like to do couple of things this morning before I hand it off to our speakers. First I want to highlight the levels at which you might consider today's discussion of the role of attention. I then want to discuss the forum itself, including what you can do to contribute to its success.

You might listen to today's discussion of attention at three different levels. Some of the points will span multiple levels, but these are some of the ideas that we'll hear about throughout the day. So here they are.

The first relates to attention for us as individuals. How do I learn to pay attention more effectively? How can I improve my happiness or the happiness of those around me? How do I balance deep focus and mind-wandering? How do I handle the information deluge?

The second is at the level of your organization. This room is full of leaders. What biases are embedded in the organization? How do you motivate employees? How do you pay attention so as to avoid business discontinuities and, in an even more extreme case, ethical breaches?

The final level is that of markets. What information do we pay attention to? And how do we weight it? How do we pay attention to what others are doing without mindlessly falling in line with what they do?

So, let's start with the individual. One of the big challenges most of us face is lots of demands on our time and attention. Our natural inclination is to want to do many things at once—to multitask. Well, the scientific community has studied multitasking, and the verdict is in: it doesn't work. When we think we're multitasking, we are really doing sequential tasking—and each individual task is done poorly. Further, switching tasks is cognitively costly.

So, the prescription is pretty straightforward: don't do it. And don't pretend that you can. You may gain some emotional gratification from multitasking, but the evidence is clear that it degrades your cognitive functioning.

Simply speaking, your mind can operate in two states: focused attention or decoupled attention, also known as mind-wandering. Focused attention is required to complete specific tasks, such as writing a crucial email or reading a legal document. Mind-wandering allows us to consolidate thoughts and provides easier access to associative thinking. Indeed, we often do our best thinking in the mind-wandering state.

I was once at a presentation where the speaker asked people when they got their best ideas. The most popular answers were: in the shower, while working out—and, more specifically, running—and on plane rides. This was before the days of WiFi and handheld devices.

So, the antidote to too much focus is to carve out time to allow for mind-wandering. Walking, especially in a natural setting, is a very effective method to encourage creativity.

Finally, most of us have the sense of being overwhelmed by information. And that sense is not misplaced. One estimate suggests that we are exposed to five times more information daily today than we were 30 years ago. That's the equivalent of reading 175 newspapers!

The antidote for this is to reshape your environment. One idea is called "brain extenders"—offloading your cognitive load on to the environment. Let me give you two trivial examples. Say you check the weather forecast before you go to bed and see there's a good chance for rain tomorrow. Instead of trying to remember that, you can simply place your umbrella by your door, or by your car keys. That way, the environment itself ensures that you remember. Another case is the ideas that pop into your mind as you are trying to focus. Rather than try to remember them,

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simply keep a stack of index cards nearby and jot down what you're thinking. Again, that will free your mind and allow you to focus.

The next level is that of the organization. We have a room full of leaders, and you're all trying to build great cultures that will last. Here's a question—and you'll hear Max Bazerman talk about this later this morning: are there problems in your organization that will become bigger if you don't address them now? If so, are you doing anything about it?

Now, it may seem obvious that you would do something about it. But what if it relates to a person who is highly productive or a business that is very profitable? What then? In his great book, *Creativity, Inc.*, Ed Catmull, the president of Pixar Animation Studios and Walt Disney Animation Studios, describes numerous instances when he had to change the direction at Pixar to preserve the firm's culture. The firm wasn't in trouble at these junctures. They were just vulnerable. He noticed, and took action.

One key idea in attention is *mindset*—the lens, defined by a set of beliefs, through which an individual or organization sees the world. One famous example is Carol Dweck's work on growth versus fixed mindsets in learning. Part of paying attention is carefully considering your organizational mindsets. What you may find is that there are biases in those mindsets—biases that may impede performance.

How might you deal with those biases? One approach is to use nudges—a structure in the environment to encourage a certain, and presumably better, behavior. Let me give you one example of a nudge that's saved my bacon lots of times—the signs written on the streets of London that tell you to look right. For Americans or Europeans used to cars coming from the left, this nudge is a godsend. And I'm sure the British drivers appreciate it as well.

The final issue I'll mention for the organizational level is the idea of intrinsic motivation. We all want happy and motivated employees. And there's a fairly well developed literature on intrinsic and extrinsic motivation. For the kind of work that the people here do, intrinsic motivation is the key. What's important to understand is that intrinsic motivation is fostered by certain conditions, including autonomy, mastery, and a sense of purpose, and that these conditions can be fragile.

Attention is relevant in a couple of ways. First, it is important to be overt about these conditions and to do what's possible to strengthen them. But you have to pay attention to do so. At the same time, organizations commonly make changes that make sense on one level but that undermine intrinsic motivation. Pay attention to unintended consequences.

The final level at which you might consider attention is that of markets. One example is the basic idea of paying attention to the person on the other side of the trade. Why is he or she selling? Or buying? What do you know that the person on the other side of the trade doesn't know? Research in psychology shows that we can be overconfident in our judgments.

Here you see the results of about 2,000 people who answered 50 true-false questions and were asked to assign a level of confidence to their responses. On average, people were 70% confident but correct only 60% of the time. Paying attention to the motivations of others can be very useful in understanding the source of edge.

Markets are funny in that there always seems to be a topic of the day—concerns about Greece, China's growth, deficits, interest rate changes, and so forth. It is also funny that there seems to be a rotation in the concern of the moment.

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Attention can be helpful if you can properly weight the importance of the information in the context of what you are trying to achieve. The key idea is that not all information should be given the same weight in arriving at a proper decision. The ability to weight information is analogous to the ability to properly weight positions within a portfolio—you can get very different outputs depending on how you consider the inputs. Naturally, the key is to place the proper amount of weight on the topic of the day and to maintain perspective.

Finally, it's important to avoid mindlessly falling in with the consensus. There's a great line from Seth Klarman that I love to quote: "Value investing is at its core the marriage of a contrarian streak and a calculator." The "contrarian streak" keeps you vigilant about considering the view that's not popular.

But the calculator part may be more important—it suggests that the popular view has driven a wedge between price and value, which allows for attractive returns. A lot of investors think they treat fundamentals and expectations separately, but few actually do. Paying attention to that distinction is crucial. So, as you listen today, you might consider attention at all three levels.

Before I speak about the goal of the forum, I want to mention the talented folks from Ink Factory. Dusty and Ryan will be graphically recording all of our presenters today. This means they will be synthesizing the words of our speakers into images and text to capture the key concepts. Their slogan is "you talk. we draw. it's awesome." And we think you will agree.

Please feel free to take pictures of the artwork and to tweet the images. And we encourage you to ask them questions—after they are done drawing of course!

Let me end on what our goals are for the day. First, we want to provide you access to speakers whom you may not encounter in your day-to-day interactions but who are nonetheless capable of provoking thought and dialogue.

Second, we want to encourage a free exchange of ideas. Note that our speaking slots are longer than normal, in large part because we want to leave time for back-and-forth. We purposefully call this a "forum" instead of a "conference" precisely for this reason. We want to encourage an environment of inquiry, challenge, and exchange.

Finally, we want this to be a wonderful experience for you, so please don't hesitate to ask anyone on the CS team for anything. We will do our best to accommodate you.

With that, I'm pleased to introduce our first speaker of the day.



Paul Dolan
London School of Economics

Paul Dolan is an internationally renowned expert on happiness, behavior, and public policy. He is currently a Professor of Behavioral Science in the Department of Social Policy and Political Science, and is Director of the Executive MSc in Behavioral Science, both at the London School of Economics.

Dolan earned his degree in Economics from Swansea University in 1989. His masters and doctorate on “Issues in the valuation of health outcomes” came from University of York in 1991 and 1997, respectively. Dolan has over 100 peer-reviewed publications on topics that include behavioral science, subjective well-being, equity in health, and health valuation. He currently holds the position of Chief Academic Advisor on Economic Appraisal for the U.K. Government’s Economic Service. He is also a member of the National Academy of Sciences Panel on Well-Being and of the Measuring National Well-Being Advisory Forum. In addition, he is a Visiting Professor at Imperial College London and an Associate of the Institute for Government.

Dolan is currently researching the happiness hit from the 2012 Olympic Games. He is an author of the “MindSpace” report published by the U.K. Cabinet Office that seeks to apply lessons from the psychological and behavioral sciences to social policy. Last year Dolan appeared at the Hay Festival in Cartagena, Colombia and discussed the role of modern technology and happiness, as well as his work on experiences of purpose, attention, and happiness. Dolan also gave the Queen’s Lecture on “Happiness by Design” at Technische Universität Berlin in November 2013.

In August 2014, Dolan published his book *Happiness by Design*, with foreword by Nobel Prize-winner Daniel Kahneman. In 2002, Dolan won the Philip Leverhulme Prize in economics for his contribution to health economics and for his work on quality adjusted life years in particular.



Paul Dolan

Michael Mauboussin: I'm very pleased to introduce our first speaker this morning, Paul Dolan. Paul is an economist by training and is now a professor of behavioral science at the London School of Economics (LSE).

Paul's book, *Happiness by Design*, came out last year and I read a review of it by Cass Sunstein in the *New York Review of Books*. What struck me was the book's central thesis: that happiness—or subjective well-being—is to some degree a function of *what you choose to pay attention to* and the *environment you create for yourself*. Both of those themes are central to our discussion today.

I mention Paul's background as an economist because he has made important contributions to the world of measuring and valuing healthcare policy. He's used to thinking about costs and benefits. So, he is one of the very few people who makes the explicit link between happiness and behavior. And the behavioral part is where attention fits in.

I'll just note quickly that you'll hear about the balance between pleasure and purpose, and that purpose is a key ingredient in intrinsic motivation—very relevant to the organizations that many of you lead.

Please join me in welcoming Professor Paul Dolan.

Paul Dolan: I'm your warm-up act for the day. Good morning.

Audience: Good morning.

Paul: Good morning!

Audience: Good morning!

Paul: Good. That was like the LSE on a Tuesday morning at nine o'clock. So, I've got some slides today, which I never use, so we'll see how that goes. Are you happy? Would you say you were happy?

All right, I'll see what I can do about that then. Just to be clear, to manage expectations, I always try and talk for half the time that I have. So I shall do that and leave half the time for questions and comments.

So, is my friend happy? Well, the answer is, it depends. That's a very academic answer to most things, actually. But it depends on what we ask him, and what he pays attention to when he answers the question. And when we've been measuring happiness for the best part of the last couple of decades, we've done it usually in ways that ask people to evaluate their lives. And we ask questions like, "Overall, how satisfied are you with your life these days?"

That's a question that's been widely used. It's been asked in the U.K., for 10,000 people for 20 years; in Germany, similar size sample, similar periods of time. It's asked on an international basis. And so when you hear comments made about: Does money make people happy? Does marriage make people happy? It's nearly always in relation to a question that is an evaluation of how well life is going: how satisfied are you with your life these days?

I have some problems with that question, for reasons that I'll elaborate on in a second. But alternatively, we could actually just ask someone how they're feeling: "Michael, how happy are you right now?" And, "Max, how angry are you? How sad are you? How stressed are you? How worried are you?" Actually, we've got many more negative emotions than we've got positive ones, adjectives for them. I could ask you how you feel. And when we do that, we actually get different answers.

Let me tell you a story. We were talking last night about how bands manage to play the same songs for 20 years and make it sound like it's the first time they've ever played the tune. But I'm going to tell you a story that I've told many, many times, and I'm going to try to pretend it's the first time that I'm telling you. And so I'm very excited about telling you this new insight from the book.

Paul Dolan

London School of Economics

I went for dinner with a friend of ours, a friend of my wife, and she works for “MediaLand,” or she worked for MediaLand. She changed her job actually, it’s worth noting. You could probably guess what MediaLand is. We’re not being taped, are we? Are we being taped? We are being taped. MediaLand is fine. It’s a three-letter broadcasting corporation in the U.K. And she complained the whole of the evening about her boss, her colleagues, her commute.

Everything about her day-to-day experiences was miserable. It was very clear. The whole of the evening she just spent moaning. And then without a hint of irony, at the end of dinner she says, “Of course I love working at MediaLand.”

Now, actually, that’s not such an odd thing to say, and it’s actually how a lot of people live their lives. She worked for a great organization, somewhere she’d always wanted to work. Her parents were proud. Her friends were jealous. When she evaluated her life at MediaLand, she was happy.

But her experiences told her something quite different. Day to day, moment to moment, her experiencing self, as Kahneman calls it, was having a pretty miserable time.

So, is she happy? Well, it does depend. But I’d like to say actually she’s not. Because she’s only happy when she pays attention to the great story that she tells about the great job that she has. And actually, most of the time she’s not paying attention to the great story that she tells about the great job that she has.

She’s paying attention to the commute, to the colleagues, to the boss. Day to day, moment to moment, the experiences she pays attention to, much more readily and much more often, are telling her that she’s not happy.

And it’s actually one of the reasons why on the U.K. paperback, one of the quotes from the *New Statesman* is, “The book that will make you quit your job.” Actually, this is not a book about job quits at all. But I have to say, I have had a few emails from people who have quit their jobs, and also from people who have dumped their boyfriends or girlfriends, husbands or wives as a result as well, so I’m not sure it should be called *Happiness by Design*. More like *Chaos by Design* or something.

But again, a lot of people will be living in narratives about the partners or the jobs or the houses or the things that they should be doing, because they’re told either by historical accident, evolutionary processes, social constructions, by their parents, that these are the things that they should be doing in order to be happy. And actually that can often sit in sharp contrast to the things they actually do day to day.

It is worth saying at that point, though, that it’s possible for the evaluation and the experience to also be different in the opposite direction. That is, you could be telling a really bad story about how you’ve got a crap job, you’ve got an awful partner.

But actually, day to day, moment to moment, you’re having a great time. So it’s not always the case that evaluations are good and experiences are bad. It could actually be the other way around.

But anyway, this is actually quite important because ... this is why I was going to use slides, for a change, because I have some data. These are data from the U.S. These are 13,000 American citizens in the American Time Use Survey (ATUS). And they’re asked to evaluate their life on a ladder between zero and ten. That detail doesn’t matter. It’s essentially an evaluation of how good life is.

And when we ask that question, in whatever way it’s asked, however it’s worded, we always find, in every single dataset, a U-shape in age. Always. In fact, there’s a U-shape in age for monkeys. Well, monkeys don’t actually report how happy they are. The zookeepers report how happy they think the monkeys are. And monkeys have a midlife crisis as well. They live to about 40. But about 20 is when they’re having this midlife crisis. Many of you in the room will be at this nadir of happiness. Insofar as you don’t die ... that’s obviously part of the reason why

people get happy as they get older, because you kill off the miserable ones.

But insofar as you don't die, you can look forward to getting happier, probably until the last six months of your life, which are pretty miserable. But if you can know when they're going to be it would be a lot easier. But, massive increases past late 40s, early 50s. And it's worth saying also that men in their 40s are the least happy group of all. So, I've got a tough audience to try to satisfy. And we saw that, as I said, in all evaluation data.

But let's look in the same dataset, with the same 13,000 people, at what experiences tell us. Well, something quite different. And let me, if you can just ignore the purpose line for a second and just focus on the pleasure one, which is the thick line. It's kind of flat, might go up a little bit as people get older. But emotions change through the life course.

Many of you, as you get older, will realize that you experience less excitement, but probably more contentment, maybe less stress, maybe more worry. I mean things change as you go through the life course. But it's much messier. So, it does actually matter how we ask the question.

Now, let me deal then, separately, with something that Michael touched on in his introduction, which is experiences of purpose. For two and a half thousand years, when people have thought about purpose, they've thought about it in an evaluative sense. When I reflect on my life, does it have meaning? Does it have purpose?

Well, because of an attentional process to actually think, you know, I think it's the fortune cookie maxim Kahneman uses, "Nothing in life is as important as you think it is whilst you're thinking about it."

But when you're paying attention to the story that you tell about whether your life has meaning, it really matters. But most of the time you're not paying attention to the story about whether your life has meaning, you're going about your daily business engaged in activities that sometimes feel like they have a point, other times feel worthless.

And so I am interested in the meaning of moments, and not in the meaning of life. I want to know whether the things, the activities that people engage in, feel purposeful, worthwhile, meaningful, fulfilling, as people engage in them, not as they reflect on the narrative and the story that they tell about whether their life has meaning.

So, these data are actually the best dataset and about the only one really, on a large scale, where we've got people to report how meaningful the activities that they engage in are. In the American Time Use Survey, three activities from a diary that people fill out are chosen randomly, and they report essentially how happy they felt during that activity and how purposeful it was, or how meaningful it was, I think is the language that's used in the ATUS.

Now, when you do that, you find something very, very interesting about purpose by age. And that is, young people, up to their mid-20s, experience very low levels of meaning in the activities that they engage in.

And that would seem to me to be particularly interesting for policymakers thinking about high school educations or university educations, and thinking about kind of trying to engage people in learning and education and it may be on-the-job training or whatever. Because if you think about it, in your own lives, there's nothing worse than doing something that feels pointless.

Forget whether you tell a story about whether it's meaningful or not. Actually, in the experience, in the moment, doing something that feels like a waste of time, feels like a waste of time. It hurts. You want to quickly stop doing things that feel like they're a waste of time.

So we must be capturing, I think, we should be capturing much more the experiences that people have as they go about their daily lives, moment to moment, day to day, and not in these big grand stories that people tell.

When we do that, and we look at the American Time Use Survey, we have some interesting patterns that emerge. And I guess some of this is not particularly surprising. Watching television is slightly more pleasurable than time spent with children. Probably watching anything on television is more pleasurable than time spent with children.

But time spent with children is pretty purposeful. And actually that's what ... a lot of our academic interests are informed by personal intuition and insight, and I've considered myself for a very long time to be a pretty good happiness maximizer.

I'm pretty good at happiness. I do a pretty good job at it. And when I was thinking about whether to have children or not, the evidence suggested that I probably shouldn't bother. At best, children are neutral in their effect on happiness. Moments of joy, long periods of worry, stress, misery, and anxiety.

But when you add in experiences of purpose to sit alongside those of pleasure, then ... it's arguable whether you're happier overall having children, but you might be differently happy.

The balance shifts between pleasure and purpose. So, the times that you spend reading to your kids, listening to the kids read to you, tying their shoelaces, teaching the times tables, they feel like they're worthwhile even if they're not the most fun activities that you can engage in.

The argument in the book is that happy lives are ones that contain a good balance between experiences of pleasure on the one hand, and purpose on the other. And it's for you to work out what that balance should look like. It's not going to be the same for everybody, and it's not going to be an equal measure.

But I think I can confidently make the claim that if you're consuming, experiencing lots and lots of pleasure and hardly any purpose, you can be happier if you had a bit more of a purpose and a bit less of pleasure, and equally the other way around.

Again, our academic insight is informed by personal experience and intuition. Coming from a bog-standard, working class background, I was around people who had lots of pleasure in their lives. We had some good parties. They lived for the weekend. Not a great deal of purpose.

Then you work at institutions like Princeton and the LSE, and it's the opposite. People having lots and lots of experiences of purpose, but hardly any fun. And so if I could sort of take the best bits of each of those worlds and put them together, I've kind of got the perfect happiness maximizing machine.

I wanted to speak a little bit about purpose before I move onto attention more directly. It's important. Again, just to restate this again, important in the experience, in the experience as you live and breathe the activities that you engage in, that you pay attention to, and not as you reflect upon your life.

And there are some interesting studies showing the effects of purpose or lack of it, on outcomes that we might be interested in, like graduating from high school or staying married and being happy in your marriage.

I think perhaps more importantly is what we can do about it, and particularly in workplaces. And we had a brief discussion about this over dinner last night. I'll talk a bit about this in the conclusion, but what behavioral science teaches us is that you can have very big effects for small changes. I spent two decades around policymakers, and I think one of the biases around policymakers is if they've got a big problem, they think the solution has to be big too, otherwise you're not doing the problem justice.

The solution needs to be proportional to the problem. But actually, very small changes can have big effects. You can increase purpose in workplaces just by giving timely and salient feedback about the activities that people engage in, particularly when they've done something that might feel like a waste of time.

You started working on a project which has been terminated or cancelled or shifted and you feel like all the time that you spent working on it, all those late evenings or early mornings over the last month, have been a waste of time, and no one tells you otherwise. You get no feedback that this has been useful, that it will contribute towards future projects, that it might not be useful now but we're going to find ways of using it later.

All these things that are, if it's done sincerely, of course, you give people timely and salient feedback—it's absolutely critical to improving their experiences of purpose. In work, as in, actually, our personal lives, what you want is tasks and challenges that are challenging but achievable. And that are best broken down—the evidence on this is very, very clear—broken down into bite-sized chunks, achievable little targets. And what you can do then is you psychologically, if not literally, take off, having achieved the next step.

That makes you feel good. It motivates you to then move onto the next one. You don't set someone a target that, in a year's time, they should achieve something or other. I mean that's completely unmanageable in terms of people's psychology and motivation.

And interestingly, I think, in workplaces often people will get stuck in ruts. You basically find a skill that you're good at and you stick at it and you keep on doing it, but in time that gets a little boring. And so one thing we need to do is to think about how you can shake up attention by using different skills in different ways at different times and kind of give people the opportunity to try new things.

And so, in conclusion to this bit, it's all about—and this is the subtitle to the U.K. version of the book—it's all about finding pleasure and purpose in everyday life, not in the stories that we tell about the things that we think should make us happy.

Let me now move on then to attention. We are what we attend to. There's nothing new in that. It's been around since William James, I think, about 18-something. We are what we attend to. But as an economist, I think about, if that's the case, then how do we best allocate attention? It's clearly a scarce resource.

It's no accident that we use the term "pay attention." Of course, by paying attention to one thing you're necessarily not paying attention to something else—either you're doing that consciously or automatically. So, it's a scarce resource that we need to think about using wisely.

And we need to think about using it wisely in a whole range of contexts, particularly in relation to happiness. Because, when I said at the beginning: "Does money make people happy? Does marriage make people happy?"

The answer to that question is, "It depends." And it depends on how much attention is paid to those things. But economists have almost just gone straight from the input to the output. What's the direct relation between income and happiness?

But Econ 101 teaches you, if you're trying to make a widget, you have a production process that takes the inputs and converts it into the output. You don't just have widgets from land, labor, and capital. There's a production process. And the production process for our happiness is the attention that we pay to the various stimuli.

So the answer to the question, "Does money make people happy?" is, "It depends on how much attention they're paying." And, of course, if you got a pay rise and spent all of your time paying attention to how happy you were with the pay rise, the pay rise would make you very happy for very long. And actually, that's what you think about when you're thinking about whether something will affect you, is you're thinking about thinking about it.

So, when you think about whether the pay rise will make you happy, you're thinking about how happy the pay rise will make you when you're thinking about the pay rise.

But once you get the pay rise, you quickly stop thinking about it. In fact, once you open that paycheck you think,

"Actually, that's not that much, and those other bastards are earning much more than me still. Actually that's now making me miserable." And pizza still tastes like pizza, the *X Factor* is still crap, the kids are still arguing and fighting; all the things that then draw attention to themselves in the experience of your life that have nothing to do with whether you've got a pay rise or not. And so that's it. And so it's about what we pay attention to in our daily experiences.

I have to do a shameless plug for some of our own academic work. We've used attention and its allocation to explain a whole range of different phenomena, particularly, I think, adaptation processes. You know, the human condition is really good at getting over stuff. Most people get over many things, not everything, in time, and sometimes relatively quickly.

We looked at very nice data in the U.K. on happiness reports annually, in the British Household Panel Surveys, now called Understanding Society. And those people are interviewed typically in September, but some of the interviews go through into October, November, and December. And as luck would have it, when the terrorists struck in New York, they did it in September.

And so we had a nice natural experiment where we could look at our interviewees who were interviewed in 2000, 2001, and 2002. And when they're interviewed in September, October, and November, is random; the interviewers kind of turn up when they turn up.

So we could look at the impact of September 11 on well-being in the U.K. without asking people to think about how much the September 11 attacks affected their well-being when they're thinking about it. We can do it because it's all about attention. We can get the impact of September 11 on people's happiness without them having to think about the impact.

And what we find, very intuitively, is that September 11 has an effect on people's happiness on September 12, and through September. It starts disappearing in October. By November or December it's gone.

Now, of course, if you ask people how affected they were by September 11, they would say they were affected because they're paying attention to it. But that's not what I'm picking up. I'm picking up their overall happiness, conditional upon when those attacks took place, and showing that there's actually relatively quick adaptation to that event.

Of course, that's in the U.K., a few thousand miles away, so I wouldn't lay claim that that would be the same in the U.S. But it's an example of many examples in the academic literature of stuff that we get used to relatively quickly, unless we're reminded to think about it again.

Weight gain is, I think, really important for public policy purposes, of course. And what we show in a paper with a theoretical model and then some empirical data, is that basically, what you can do when you get fat is you can do one of two things: You can expend energy and effort to lose weight, but that takes energy and effort. And/or you can expend energy and effort to pay less attention to the weight gain in your overall happiness.

And we show that as people gain weight, their health satisfaction, for example, becomes a less important contributor to their overall happiness. So, we reallocate attention. And it explains the fact that as people gain weight they don't get very much less happy.

A nice example of a focusing effect, by the way, because when we look at someone who is obese, we look at an obese person thinking they must be thinking about being obese, and, therefore, they must be less happy. But they're not thinking about how overweight they are all of the time, in fact, hardly at all. And, of course also, weight gain doesn't just happen overnight, it gradually grows on people, literally, and so there's a kind of nice adaptation process anyway, even without that attentional shift.

I won't speak about the unemployment and health state evaluation papers for the purposes of time because I want to get to the discussion. But one thing that I wanted to pick up on—because I just thought about this with Michael's intro—is, absolutely right, we can't multitask. Women can't as well, by the way. It depends on what you mean by “multi.” I'm actually standing and talking and breathing, so I guess you could say that's kind of multitasking.

But in an attentional point of view, you can't pay attention to two stimuli at any one time. What we do is we single-task quickly, that's what the brain science tells us. And, absolutely, it makes us less efficient and less happy, because all the time that your brain is switching between tasks, it's using attentional resources. It's tiring itself out.

So in one study, a nice study I think, people were asked to do a Sudoku puzzle and a crossword puzzle, and they could do them in any order—they could flip backwards or forwards between them, or they could have the order prescribed to them. Now, in that third condition, people finished those tasks much more quickly than in the previous two, interestingly, even when they could choose the order in which they did them. Because you're still requiring attentional resources to decide, yeah, I'm better at Sudoku than I am at crosswords, do I do the one that I'm good at first?

All that time that you're using attentional resources, you could just be solving the problems. So, sometimes prescription about the order in which people can do tasks might actually be more efficient. But one thing that is definitely inefficient is to be distracted. You should avoid distraction at all costs. We are nearly always happier and more efficient when we're paying attention to what we're doing and who we're doing it with in the moment.

It's essentially mindfulness without having to go on an eight-week mindfulness program and retreat for three weeks and not speak to anybody, which is my idea of a living hell, but it's about being mindful in the moment without having to do the mindfulness training. And the way you do that ... a bit more about that in a second ... is to design your environment in ways that make it easier for you to pay attention to what you're doing.

So, for example, turn your phone off. That's a really basic insight. Really significantly, your unconscious attention is drawn to your mobile phone even if you're not consciously paying attention to it. Hands up if you've ever had your phone in your pocket, felt it vibrate, taken it out, and you've still got no friends. Right? Right. Because unconsciously you're thinking, “My wife should text me at some point. The kids should be in touch after three years.” And they're not. So, you're draining yourself of energy even when you don't know that you're doing so.

So, pay attention to the moment. But that's to be distinguished, and this is really important, in workplaces particularly, from taking a break. Taking a break is an organized distraction, if you like. It's planned. So, as Michael said, absolutely right, no one ... if I said to you, have you ever had your best thought at work when you've been thinking, “Now I'm going to think of a really good idea”? No one has had a good idea when they sit down to have a good idea. They have a good idea when they're in the shower, on the bus, on the plane.

And what we think is happening is, that when you consciously think about something, and then move away from it, your unconscious mind is still processing the challenge or the task or the activity. And what'll happen is, it's as if the answer pops into your head, randomly, by mistake or accident, but you're actually thinking about it without knowing that you're thinking about it.

So, in one study students were asked to choose a poster for their dorm room, and they had to just briefly look at the posters, go away for nine minutes and do something else, and then come back and choose a poster. They were much happier with their choices than students who spent nine minutes consciously and effortfully thinking about which poster to choose.

Now, this is not uncontroversial evidence, but there is a suggestion, at least, that the unconscious mind is

processing the decision whilst you're not thinking about it. So, pay attention to what you're doing, who you're doing it with in the moment, and plan breaks to allow your mind to wander and freely think about the activities when you're not doing so.

Very interesting ... I said the subtitle to the U.K. book is *Finding Pleasure and Purpose in Everyday Life*. The subtitle to the U.S. version—paperback out next month by the way that'll be cheaper than the hard back—is *Change What You Do, Not How You Think*.

Really interestingly, just as we were about to go to press, my U.S. publisher said, "You know what? Americans won't get that vague, waffle-y, *Finding Pleasure and Purpose in Everyday Life*. They need to be told what to do. It needs to be more directive. *Change What You Do, Not How You Think*. That's it, that's what we need. We need to tell these Americans, because they're not as clever."

So, that's what you need to do. Because attention is allocated unconsciously, as well as consciously, you can't think yourself happier. Well, you can try, but it won't work. And if you buy any self-help book, it'll tell you things like, "Be positive." Yeah, no sh**, I worked that out. How do I actually do that?

And you can't do it, so you buy another self-help book. That's why they sell so many. The single biggest factor predicted in buying a self-help book is having bought a self-help book in the last 12 months. So, clearly, they don't work, because they are all about changing minds. And it's really hard to change minds.

In a whole range of different environments, particularly in public policy challenges and in corporate environments, it's really hard to change the way people think. You have a belief that you hold, for whatever reason, and then you search out evidence to support the belief. And when you find evidence to support the belief, you're really clever and you were right to believe it.

When you find evidence that doesn't support the belief, then you're even cleverer. You find a counterfactual that explains away the evidence and why it doesn't apply to you, and why it doesn't apply to what you know to be true, and you're even more right to believe what you did in the first place. Really hard to change minds.

Thankfully, it's much easier to change context, to change environments, to change situations within which people act. Because, as many of you may know if you've read or come anywhere close to the book, *Thinking, Fast or Slow*, most of what we do simply comes about rather than being thought about.

We are driven by System One, as Kahneman calls it, the old, evolved reptilian brain is there. It's there basically to help make your life easier. You're making up to 10,000 decisions every day. You don't think about most of those. Your head would explode if you did. It would be effortful and take a long time.

Your automatic brain, your unconscious system, is just processing and processing and processing and always working, and always active, always present, always engaged, and trying to help make life easier for you. So, if you're going to change your behavior—it doesn't have to be just to be happier, it can be to be more efficient at work—you need to think about how that unconscious reptile is processing.

Because that's the bit that's doing the work, not your conscious mind. You need to get over yourself if you think you think about what you do, because you don't. You might think you do, because that's the only bit that you've got conscious access to. You're really good at telling a nice story about why you're just about to do something, and an even better story about why you just did it, that has no relation to actually why you did it. So, lots of studies around priming. Many of you will know some of this evidence.

We've been doing some work with hospitals in the U.K., in London, where we're having significant increases in hand-washing rates by pumping citrus lemon smells around the wards. Citrus lemon is a clean smell. The brain associates clean smell with then wanting clean hands. But really importantly, when you ask people why they

wash their hands, they don't say, "Because the citrus lemon made me." They say, "Because it's the right thing to do . . . It's important . . . Hand hygiene." All the nice stories that your conscious mind can construct to explain the behavior, because we like stories.

The human condition likes narratives and stories. It likes coherence. It likes structure and organization. And so it's very good at telling a very coherent story about why you do what you do. You're not lying. You're just a poor witness to your behavior. You're just a really poor witness to your behavior.

Priming of smells, of colors, of light . . . one of my favorite studies recently gave students an extra dollar in an experiment—overpaid them. And they looked at whether the students returned the money. How many students do you think would return the dollar, by the way? Ninety percent? Zero? Somewhere between zero and 90, okay. That's probably going to be right, isn't it, somewhere between zero and 90.

Well, the answer is, guess what? It depends. It depends on whether the students are under bright light or under dim light conditions. Under bright light conditions, the person who said 90 percent was quite close. It was 85. Under dim light conditions, 50 percent. Now that's a 35 percentage point difference in honesty primed only by light. And primed in ways that the participants in this study had no idea was influencing their behavior.

They all told a story afterwards about why they kept it or why they handed it back in, unaware that it was hugely affected by the environment, by the situation, by the context within which those behaviors were placed. So if you want honest people in your workplace, you just have to turn the lights up. But, interestingly, maybe if you want creative workers, turn the lights down.

In another study where people were asked to draw an alien . . . I know, all these crazy things . . . and they looked at how far away from the human form the alien looked. And the further away from looking like a human the alien looked, the more creative was the alien. And aliens further away from the human form were drawn under darker light conditions than under brighter light conditions. So if you want to allow your mind to run free, you might want to turn the lights down.

Context matters. That's the really, really significant . . . those are the two words that come out of my mouth at LSE more than any other words: "context matters," "context matters." In fact, students have T-shirts made up with "context matters" because context rather than cognition drives most of what you do.

In the book, I talk about how you can use these insights for yourself in order to be happier. The great thing about some of these effects is you can do them even though you know you're doing them to yourself. When people take placebos and they're told they're taking placebos, they still work. So, we can fool ourselves.

With the priming, my editor at Penguin in the U.K. used to come into work very stressed every day and had so much to do, she changed her password—it's probably case sensitive, so I'm not giving it away—to "hour by hour," so that she just more calmly took her day. And she said it worked. But even though she was changing her password, knowing that that's what it was intended to, just the mere fact of typing that in cued her to behave differently, or to feel calmer.

So, defaults, we know this, I mean you know this much more than I do . . . pension contributions—much more likely to save if they're opt-out than if they're opt-in. Organ donation. We're basically lazy. We go with the flow of whatever the preset options are. So set yourself some preset options that make it more likely you're going to do it.

Commitments are really interesting. Make public promises. You're more likely to act on them. People who posted their weight loss targets on Twitter were more likely to lose weight than those who just listened to a podcast of weight management. Pretty interesting. Norms. We spoke about that a bit at breakfast. If you really want to do something, find people that do it. We're social animals. This is something that you don't get from

people when you do market research, again, customer insight, asking them why they do what they do. They don't say, "Because everyone else does." But you do.

You want to be like other people. You want to be like people like you. We've done some work, some of you might have seen this, with tax collection in the U.K., of late payment of taxes. If you tell people—and in fact, this is the best intervention that we've done through randomized trials—94 percent of people in Exeter, if that's where you live, pay their taxes on time, and you are in a small minority of people who do not.

So, first of all, 94 percent of people are doing something that you're not. It's in Exeter. Exeter is somewhere where you live and you have more association with people in Exeter than you do generally in the U.K. And then, draw special attention to the fact that you're even more different than I just pointed out to you, from the 94 percent of people in Exeter. £700 million paid sooner in three years.

Now I would say that that is a pretty good example of a big effect for a small change. You can still do all the stuff about trying to convince people that paying their taxes on time is the right thing to do. You can do all this big solution. But you can also just tap into norms and make it much more likely that people are going to do what you want them to.

We've been working with energy suppliers. One of my ex-PhD students who's now a postdoc at Chicago with John List and Steve Levitt, we've been doing some work with energy suppliers, and we've been showing sustainable reductions in energy consumption of six percent ... pretty big changes ... in the U.K., by feeding back information about how your energy use compares to neighbors in similar size houses.

Conclusion. Lovely, Michael. Thanks for drawing attention to the behavior-happiness loop. When I first came to these happiness data, I thought there must be something good in misery. And actually there's not really, because when you add experiences of purpose into the mix, even if you're angry, if that anger has a purpose and a point to it, it can actually be quite productive.

People that protest on the streets. They're very angry people, want social change maybe. But they're also very optimistic about being able to do something because they wouldn't be on the streets in the first place. So they have a purpose to what they're engaging in.

All of the things that you would want in a corporate environment, most of the things most of the time, I can't over-claim, most of the things most of the time, come from happier workers. They're more productive. They're more pro-social. They're healthier. They take less time off sick. They have less presenteeism and absenteeism. And they're actually nice people to hang around with, because misery loves company and so does happiness. It's contagious. It is a contagious disease, and you want to get rid of the misery contagion and create more of the happiness contagion.

I've done the small changes, big effects. I'll leave the MINDSPACE thing. I don't want to go into that in detail, but just to say that some of the elements of that work that we did for the Cabinet Office in the U.K. are sort of captured in what I've just mentioned, with the "S" being salience, which is essentially attention. Your attention is drawn to things that are novel and new, and things that you can understand. That's really important.

I just want to finish with the suck-it-and-see approach, or you might otherwise call that test-and-learn. I spent a lot of time in public policy-making and, increasingly now, in the corporate sector. And I thought public policy-making was different and they were less good at doing things than the corporate sector where market values would be quickly driven out, but that actually isn't the case at all.

The public and private sectors suffer from very much the same problem. Whenever launching a new product or a service or an intervention, there'll be an enormous amount of effort and work and money and resources and time going into developing, building that supertanker. They'll do market research and customer insight, ask people

conscious questions about what they're about to do or why they just did something, build that into the launch of the supertanker, set it out to sail, and watch it sink. Or actually, maybe randomly it might work.

It certainly has nothing to do with the market research. Or, it will start sailing in the wrong direction, and then we'll chuck some more resources at it to show that it's working in some other way, or that it really does work because we've spent so much time building the supertanker. Instead, why not launch ten dinghies and watch nine of them sink? And it's okay that they've sunk, for two very important reasons.

One, they didn't cost very much. And two, we can learn lessons from why they sunk. Then we can start building ballast on the one that's sailing in the right direction until in the end we've got a supertanker built for an iterative test-and-learn approach.

Now, that requires a couple of important things. It requires us to learn lessons from our mistakes. And I actually think that that's probably one of the most significant hurdles to effective decision making in any sector—is the institutional and individual memories of things that we've got wrong. Everyone wants to take success for the things that they did well, but you know from your own personal experiences of life, you haven't learned very much from things you've done well. Insofar as you've learned anything about yourselves, about life, it's when you've messed up. So, learn from the mistakes.

And following from that, that requires us to have an environment where we are more readily accepting of—I'm not going to use the word failure because they're not failures if we learn lessons from them—more readily accepting of learning lessons from things that didn't work. And that ability to take the risk and take the chance is probably the most pervasive challenge, I think, in both corporate and public sectors.

That seems a rather negative place on which to ... but it's all about happiness anyway, at the end of the day. Thank you.

Michael: Thank you, Paul. So Paul, we're going to open it up to questions or discussion.

Question: Can you talk a little bit about vacation and your thoughts on how to understand if it's making you happy and what you should be perceptive about?

Paul: Vacation? Going on holiday?

Question: Yeah, going on a vacation, with and without kids. We talked about this ...

Paul: You probably shouldn't bother if you have children. There's a very nice narrative and a very nice story about holidays being enjoyable. But actually in the moments, the experiences of them are largely miserable. Especially when you have children in tow and you're trying to bring everyone together and coalesce or whatever, to have a nice time, and no one really does.

But what we know about memories of the vacation, and of a whole range of other experiences, is that we don't encode duration. We don't remember how long something lasted. But we do remember the peak moment of pleasure or pain that we experienced during that activity.

And so when you go on vacation, you have seven ... you know, six and a half days of hell, and you have one half day where the whole family comes together at the top of the Eiffel Tower or something and the sun's shining and it's beautiful. And then you come back from holiday and your memory encodes that peak moment and you say, "We had a great time." And you want to go back again next year.

Substantively, the scientific answer of whether it's worth it or not, is to be able to account for the six and a half days of misery and all of the memories that you draw down about the half day that was good. And sometimes it'll be worth it and sometimes it won't. And that's not a particularly helpful answer, but it does depend. But I would

probably try to pay less attention to the story that we tell ourselves about vacations being good, and much more attention to actually what we do when we're on holiday. And given that we neglect duration, probably have a lot more frequent, shorter breaks.

Question: Thanks. It's all really interesting. One of the things that strikes me is that a lot of this work seems to rest on the definition of a subjective term, or subjective terms. What's happiness? What's purpose? And individuals might have very different definitions and we can't sort of objectively map them to each other. How much do you think that individuality and subjective definitions affect the conclusions that you could draw from this work?

Paul: I love that question because . . . almost in the tone of that question is there's something pejorative about the subjective nature of these things. And actually, it *is* subjective. The whole life is subjective. All of the things that you experience, that you enjoy, that you get pleasure and purpose and pain and futility from, are subjective experiences. All of how you feel about your financial products and services are subjective experiences. It's about how you feel. It's about embracing subjectivity.

When you go to the doctor and you say you've got a pain in your leg, one of the first things he or she will ask you is how much it hurts. That's a subjective report of pain, which is subject to a whole range of individual differences: how much pain I've had in the past, how much pain I expect to have, how much pain people around me have. But it hurts as much as it hurts.

And I think it's really important in financial services, as well, to bring some of that subjectivity into play because some decisions that people make that might appear to be stupid from a financial rationality perspective, might make a lot of sense from a subjective well-being perspective.

Take a very simple example. You're going to go to work five days a week and you're going to have two coffees each day. You're going to have one on the way in and one at lunchtime from your favorite coffee shop. And you're given the choice: do you want to pay for those coffees up front, or do you want to wait until Friday afternoon?

Well, anyone trained in Econ 101 knows to bring forward benefits and defer costs: I'm going to pay on a Friday evening, or Friday lunchtime. Well, that's pretty horrible, because every coffee you have you know you've got this bill coming at the end of the week. Psychologically, let's get the cost out of the way. Every coffee thereafter is free. So I'm happy every time I go into Starbucks or wherever I go and I'm having that coffee for nothing.

So, look through the lens of financial well-being and we might reach one conclusion. Look through the lens of psychological well-being and we might reach a different one. Also, we are contemporaneous creatures. Whilst we might tell stories about caring about our pensions and our old age and our futures, we actually don't very much.

And so one way that you're going to sell pension contributions is not on how it's going to make you feel when you're 70, but the security that you have about how it makes you feel today. So you're getting contemporaneous feedback about how products and services are making you feel in the moment, and we need to make more salient some of those costs and benefits.

Question: Purpose. The chart you had up there showed that well into the late 20s, people were relatively low on the purpose scale. We all have experiences with talented younger people, in our groups or organizations, who may click in, they may not click in. Any particular thoughts about how you either help people inject purpose into their lives or somehow support them developing some of that purpose earlier so that they can figure out what they're going to do and be helpful or not.

Paul: Yeah. I mean it's a really challenging question and I don't have a very good answer to it, frankly. One of

the things that—and of course these are correlational data—if you look at happiness in particular occupations, you nearly always find that hairdressers and florists are very near the top, and bankers and lawyers are very near the bottom.

And it wouldn't be surprising if that was the case, given the environment within which those people work. If you're a hairdresser or a florist, you're typically engaged in social contact that people with you want to have. You're seeing the fruits of your labor, and you're seeing the fruits of your labor quite quickly and in ways that people generally like.

That isn't to say that banking and being a lawyer are miserable-making jobs, just that the environments are set up in ways that make them misery making. You need to get, I think, more direct feedback on the fruits of your labor, just like doing a haircut, just like making some flowers. You need to feel like this is good and that it's making people feel good from what I'm doing. I think that's how you try to create purpose in the environments that might not otherwise feel like there is any.

Question: I've seen the U-curve that you've shown before, as people get more happy as they exit their 40s and 50s. And I've heard one of the reasons being a shrinking of the realm of possibility, and that as the realm of possibility shrinks, people say, "Okay, this is how my life is going to be, I accept it," and kind of become more happy. And so I'm wondering what you make of that. And then the related question is, when you're in that range, and you're successful, often the realm of possibility expands quite a bit, and how do you deal with the unhappiness that comes from the worry associated with a wide range of possibility?

Paul: So, the simple answer, the easy answer to that question is I don't really care about the question, because I don't care about life satisfaction data in the same way as I care about experiential data for the reasons that I said, because they are snapshots in their constructions, in what attention is paid to when you answer the question.

So that would be where I could stop, but I won't. And one of the reasons why . . . and as you say, really, I think one of the reasons why you get that U-shape is as you get older . . . you're young, you have all these dreams and hopes and expectations.

And one of two things happens when you get into your 40s: either you're in some sense lucky and you achieve all of those things and you quickly realize that they don't make you happy, or you don't achieve them and you're pissed off that you haven't.

And then you get into your 50s and you get over yourself and your future is behind you and there's nothing much you can do about it now. You're not going to play football for England at 55, so you should probably give that up.

And you start doing things . . . and this, I think, is the important bit, whatever the horizon's expanding or shrinking is, you start doing things on a daily basis that actually do make you happy. You start spending more time with people that you like being with, you might start helping others a bit more, you might go outdoors, you might listen to music, all the things that you forget to do when you're chasing the ambition and the success and the achievement. And I think that's maybe part of the reason why we're not as happy in our 40s as we might otherwise be. Thank you.

Question: So how have you changed what you do based on all these learnings?

Paul: I hate when people ask me that question. The question I normally get is, "How has writing this book or whatever changed me?" And my answer is . . . people expect me to be happy all the time, which is quite a challenge. But I don't know. I mean, I think I'm like a good doctor, give advice to other people but don't listen to it yourself. I think I'm very lucky to be temperamentally inclined to being happy.

I think I've been lucky to . . . luck is just . . . we talked a bit about luck last night. Luck is hugely significant in explaining most things. Which, by the way, the human condition doesn't like as an explanation because we like narratives and stories and coherence. Luck doesn't cohere. Randomness kind of is a mess. And people will say things like, "You make your own luck." Well, that's completely undermined the basis of . . . you can't make randomness. So we don't like luck as an explanation.

But I think it's a really significant explanation for how I am and have been. I think I've probably fallen into some of the traps that I talk about in the book—actually, more so I think—rather than overcoming them.

Keynes, back in the '30s, said that with growth we'd be taking more leisure time. We should all now be working three-day weeks. But actually, the complete opposite has happened. As we got richer, we've worked more.

We all know about inequalities in income having widened over the last decade or two or three. But inequalities in leisure time have also widened, in the opposite direction, such that richer people are now taking fewer holidays.

And what's happened is, it's about attention being paid to the opportunity cost of not working. And so as I get paid more money, I'm actually working more than I did when I was paid less because the opportunity costs of not working are now greater.

And I think I've fallen into that trap. And that reminds me not to. So, the one thing that I'm going to do is to turn down many more offers like this. But not this one. Because this is brilliant. And spend more time listening to music, with my family, going outdoors, helping other people, that I'm not doing when I'm coming to New York, or coming here.

Question: That actually gets to the question I wanted to ask, which is . . . it's sort of two-part. And that is that one of the real challenges, it seems to me, when we think about the way organizations work, particularly in the United States, and particularly corporations, is that the environments that most corporations set up are not actually, it seems to me, well designed to maximize happiness or attention or focus or any of those things.

I mean, the time thing you're talking about isn't just a question of the choices people make. Now, you can make those choices because a big part of your income is freelance, and I can make those choices too. But most people, whether or not they're well paid or not, don't have much choice. They're expected—if you're a banker, you're expected to work, whatever it is, 14, 15 . . . you know, however many hours it is. I guess I'm wondering, do you have any thoughts about how to change that?

It seems to me, in particular, this question of environment and time and priming, all of these things, have actually been going in the opposite direction. One of the reasons why Pixar—Michael talked about Ed Catmull—is so amazing, is precisely because it's so unusual. It's such an unusual environment for actually making people creative.

So I'm just wondering, all these things make a lot of sense, but if you look at the way most corporations are run, they're incredibly short-term focused, they're incredibly multitask driven, they're incredibly bad for actually getting people to focus. I'm just wondering if you have any thoughts on how to change that?

Paul: Well, again, that's a really big question. I think you're generally right in terms of the way that things have gone. And I think maybe my answer is to come back to this big effects from small changes point. There's a saying about don't sweat the small stuff. I actually think we should sweat the small stuff.

No matter how time-poor you are, I reckon you could probably find five minutes a day to listen to your favorite tune. I reckon you could probably find another five minutes to phone your best mate. I reckon you might find another five minutes to go outdoors. You could probably find another five minutes to help an old lady across the road. You might find another five minutes to . . . whatever, 20 minutes. I've got four things there.

If you did one of those things every day, you'd be happier. If the corporations and organizations could embed in the design of their architecture ways in which they could make it easier for people to do these things, then we'd all be happier.

And I think maybe that's what we forget. I think we forget how easy . . . maybe how simple it could be. Really simple behavioral science insight, anyone else in this room will tell you this, is the first basic insight is, if you want to do something, make it easy. I just think we don't make it easy for ourselves or the workers that we work with, to be able to do the very small things.

Question: Do you have any concerns along the lines of, you know, William Davies's book, *The Happiness Industry*, that corporations are just going to do those small things to try to sort of make people happy on the surface without actually making any substantive changes that could really make a difference in people's experience?

Paul: Again, that's a big question. And I've spent all of my academic life, essentially, focusing on structure. And this book is about agency. And it's going to be a bit of both. I'm not going to sell many books making it about structure. I'll sell more books making it about agency and about what you could do for yourself. But I completely and readily accept that there's a whole systemic and structural and cultural shift that we might need to engage in, in order to get the agency bit to work better.

Question: So, the way you've organized the data is by age. I wonder if you organized it by men, women, extrovert, introvert? Do you have any view on that, how it might come out differently, on any of those pleasure/purpose . . . ?

Paul: The gender effects are typically very small. Women generally report slightly higher levels of life satisfaction than men do. In experience data, they tend to report—in data that we've got from the U.K.—both being slightly happier, but also slightly more anxious. But the effects of gender are very small.

Personality . . . that's one of the things that there are very few data on in many of the big datasets. Where there are data, we find extroverts are happier than introverts. We find that's the single biggest personality characteristic associated with happiness. Conscientiousness is the next. Neuroticism, of course you'd expect neurotic people to be less happy.

That reminds me, when I first went into Number 10, and was in what the press called the "Nudge Unit," David Cameron's senior policy advisors wanted us to look at relationships as our first behavioral insight. Could we make it better and easier for people to choose partners more effectively, because of all the problems?

It's a serious question about social breakdown and marital breakdown and the impact on children and stuff. I came to the conclusion that it was largely random and chaotic, and that you intervened at your peril.

Sometimes you can intervene and make things worse rather than better. The only conclusion from the personality researchers was, don't marry someone neurotic, which is pretty crap if you're neurotic. And it would probably just make you even more neurotic to know that, but there seems to be no other matching that works.

But yeah, extroverts. A really interesting point that also goes sparking through my mind, is that I'm talking about data based exclusively on self-reports, that is, asking people questions. And it's the subjective bit. And at the moment, the best way of finding out how happy you are is to ask you how happy you are or how worried or stressed or angry you are. But as we have big data, there are other ways and opportunities to do that.

We're sparking off some research on these lines—we're going to look at facial expressions, conversations, sentiment analysis of texts. Because a recent study . . . it's always been shown in the U.S. that conservatives are happier than liberals. If you believe that the world is a just, fair place and all this inequality is acceptable, then

you're probably happier than if you're going around angst-ridden by all the inequality and injustices and about how terrible the world is. And so that's pretty well established.

But interestingly, when these researchers looked at facial expressions and conversations, liberals were happier. So there's a very interesting question about whether some of what we're picking up is due to a self-report effect, and only a self-report effect.

Question: You draw a couple dichotomies. One, for happiness, between purpose and pleasure, because they can be very different and people place different values maybe on each. There's also this concept which you alluded to on the difference between the experiential self and the remembering self or the reflective self. And I guess your view here is on the primacy of the experiential self because a reflective self can tell stories and you're really only experiencing it when you're reflecting.

The question is, is there a place for the reflective self? If you can just automatically get a bio-feed of what my pleasure experience is, so you get like the good data, you know, as you were talking about, or the facial expressions, so you could say, yeah, these people in these activities are happier? Is that really the answer or, again, is there a place for being seen, of course with some reflection, because while narratives can be skewed there's also a replacement, in most places, for that?

Paul: Because the pendulum has swung so far in favor of evaluation to the way that we think about happiness and well-being, I'm trying to make almost a more extreme case than probably is justified for experiences in order to get that pendulum to swing back to somewhere there might be more sense. The more nuanced response, therefore, to your question, would be, of course the stories and evaluations and narratives matter.

But what I'd like to distinguish between, I think, is the stories and narratives and evaluations that we tell ourselves in order to make ourselves happier, and the ones that are told by society as constructions about things that we ought to be doing.

So in the former case, one of the reasons that people of faith are happier is probably because they have a very good story about why things are bad. Often people will find God when an adverse event happens. We don't like the fact that it was random or bad luck. We need a story and an explanation for why this adverse event happened. A higher order being is a really good explanation. And so, that ameliorates some of the pain.

But that's distinct from, I think, the story that I told about my friend that worked at MediaLand. Because that's a story about what a job and an occupation and status and success should look like. And it's those kind of narratives and stories that I think make us less happy. They're hurdles and obstacles to us actually experiencing life better.

Question: I think there's a lot of data out there that says that most people have some baseline of happiness or unhappiness that they tend to return to. You have soldiers who go and they lose a limb and they come back and somehow snap back to whatever their normal level of happiness is.

Paul: That's not true by the way.

Question: Is that not true?

Paul: No. Rich Lucas is a researcher at Michigan State who's looked a lot at this, in the life satisfaction data. And again, that's where most of the data are. He shows greater variability than would be expected. There are things that happen to us that we don't revert to baseline to. Unemployment, for example, stays scarring even when you have a job again.

What's interesting is that we need to be looking less at the differences in the numbers, because a 7.1 to 7.3 is only a 0.2 difference, but in terms of where you move in the distribution of people, you might be going from the

30th percentile to the 70th percentile. And so the absolute numbers don't reflect very much in the actual changes that take place in people.

And if you have mental health problems, they're permanently scarring. You don't ever go back to baseline from those. Some things you do. And it's about attention. It's all about attention. Things that you withdraw attention from, you'll revert back to baseline. Things that are consciously attention-seeking you won't.

Question: Let me frame it slightly differently. You talked about people in London after September 11, kind of for a period being bummed out by that but bouncing back pretty quickly.

Paul: By and large we bounce back from things quite quickly.

Question: If you simplified the world and said there are some people who are lucky to have a happy temperament and some people who are not so lucky and don't have such a happy temperament, is one group or the other more likely to benefit more from making these contextual changes or taking these steps?

Paul: That's a very good question and . . . I mean for policy purposes, of course we'd care much more about the group that start off less happy, for reasons of inequality. For reasons of efficiency, I don't know. That's a very interesting question. I say this, almost glibly, that if you found five minutes each day to do those three or four things you'd all be made happier—I don't know whether that would be to the same degree, whether people that are less happy would benefit more from it. I think that's still a very open issue.

Michael: We have time for one more.

Paul: This is the last one so it's always a good one.

Question: It's the best yet. Trial and error could be a very expensive way to figure out where you should be on the balance between purpose and pleasure. So if I have kids in their 20s and they're making career choices or family choices and they decide, "I want purpose. I'll have six kids." That's kind of irreversible as a trial. How do you help people, how do you help yourself figure out where your balance, your unique balance should be? And maybe that changes over your lifespan as well.

Paul: It probably does change over your life course. Certainly, I wouldn't have been a very good father much younger. And I guess my kind of desire for purposeful experiences has probably increased and that for pleasure has diminished. Dan Gilbert, in *Stumbling on Happiness*, makes a big case of drawing on the experiences of other people. If you want to know what a cruise is going to be like ask someone that's just got off the boat.

That's a challenge because you want to make sure that they're people that aren't living in the stories that we might tell. So you don't want to go to your parents and say, "Should I take this job at MediaLand?" Because they think that you should have that job at MediaLand because they have the story that says that that's what would make you happy.

So you need to, I think, find people that you can get suggestions and insights from that are more likely to be living in experiences than you might otherwise be. That's probably as helpful as I can be. The other thing to remember is, because of adaptation processes and shifts, to think about what being in the condition would be like, not what becoming will be like.

So, for example, you think, would you be happier moving to San Francisco? What you're asking is, "Would I be happier in the first week or two when I'm in San Francisco?" And you would be. But what you really want to know is, "Would I be happier in San Francisco after ten years?" And so you want to pay attention, if you can, to what happens once you've adjusted and shifted attention into the more steady state, rather than into the change.

And I'll just wrap up with something that we talked a bit about last night at dinner. And that is that often too

Paul Dolan

London School of Economics

much of the time we're living in a joint evaluation between two alternatives, like this job versus that job, this partner versus that partner, San Francisco versus New York.

And what we do is we draw out what makes those two alternatives different from one another. But actually, once we've made the choice, we only live in one experience, and very rarely will we then be paying attention to the contrast that we made.

So actually, most things in life—and this is a nice place to finish—don't actually matter that much, because once we experience what we've chosen, we quickly get on with it and we don't really worry too much about what otherwise might have been.

Michael: With that, thank you very much Paul.



Iris Bohnet

Harvard Kennedy School

Iris Bohnet is a Professor of Public Policy at the Harvard Kennedy School (HKS) and Director of its Women and Public Policy Program. She is also Co-Chair of the Behavioral Insights Group at the Center for Public Leadership at HKS, an Associate Director of the Harvard Decision Science Laboratory, and the Faculty Chair of the executive program “Global Leadership and Public Policy for the 21st Century” for the World Economic Forum's Young Global Leaders. From 2011 to 2014 she served as the Kennedy School's Academic Dean. Currently, she serves on the boards of directors of Credit Suisse and University of Lucerne, as well as the Advisory Board of the Vienna University of Economics and Business, and numerous academic journals. She is a member of the Global Agenda Council on Behavior of the World Economic Forum.

Bohnet teaches decision making, negotiation, and gender in public policy and leadership in both degree and executive programs, and has been engaged in the teaching, training, and consulting of private and public sector leaders in the US, Europe, India, and the Middle East.

A behavioral economist who combines insights from economics and psychology, her research focuses on questions of trust and decision making, often with a gender or cross-cultural perspective. Her most recent research examines “gender equality nudges,” interventions that decrease the gender gaps in organizations, politics, and society. Bohnet's academic work has been published in the best journals of her profession, including the *American Economic Review*, the *American Political Science Review*, and *The Quarterly Journal of Economics*. Leading media outlets around the world have profiled her work.

A Swiss citizen, Bohnet received her PhD in Economics from the University of Zurich in 1997 and spent a year as a Research Fellow at the Haas School of Business at the University of California, Berkeley from 1997 to 1998. She joined the Harvard Kennedy School as an Assistant Professor in 1998 and was made Full Professor in 2006.

Iris Bohnet
Harvard Kennedy School

Michael Mauboussin: Welcome back. It's my pleasure to introduce our next speaker, Iris Bohnet. Iris is a professor of public policy at the Harvard Kennedy School and Director of its Women and Public Policy Program. From 2011 to 2014 she served as the Kennedy School's academic dean.

I have long been a fan of Iris, having had the opportunity to see her in action at Richard Zeckhauser's behavioral finance conference at the Kennedy School. She is a behavioral economist who thinks deeply, and teaches effectively, in realms including decision making, negotiation, gender issues, and leadership.

Today she will cover some of the implicit biases that we have as individuals and as organizations. But her particular emphasis will be on methods to *implement changes* in mindsets in order to improve outcomes. This is a key point: it's one thing to know about biases, but it's another thing altogether to effectively cope with them.

I also love my conversations with Iris. She has vast knowledge and a wide range of interests but is also pragmatic and grounded. Let me also plug her forthcoming book on how to design gender equality—I'm sure we'll hear a bit about that today.

I will also mention that Iris is on the board of Credit Suisse, but we have asked her to join us today in her academic capacity and not in her governance capacity.

Please join me in welcoming Professor Iris Bohnet.

Iris Bohnet: Thank you, Michael. Good morning. It's a great pleasure to be with you here this morning and talk a bit about attention and that seeing really is believing, that what we see affects what we believe is possible, affects our attitudes, affects our behaviors. And Michael and I also thought that it was particularly appropriate to talk about gender equality in this room, which isn't completely gender equal, but nevertheless you all care about gender equality, at least for three reasons.

One is that you probably believe in the business case, and you probably believe that it's better to draw on 100 percent of the talent pool than just 50 percent of the talent pool. You also probably have heard about some of the research suggesting that diversity in teams is a good thing, and you'll hear a bit more about that from Chris this afternoon. So that's the business case.

Secondly, many of you, I hope, also believe in gender equality because it is a human right. Because it's just the right thing to do.

And thirdly, many of you are fathers of daughters. In fact, could I see the hands of fathers of daughters? Yes, that is a majority. So it turns out that fathers of daughters are among the biggest proponents of gender equality. There's been a lot of very interesting research looking at judges, male judges, as well as male politicians and male CEOs, and all of those who have daughters care much more about gender equality. So I'm going to speak to all of you, but particularly to the fathers of daughters.

This is what I want to talk about. I want to spend a little bit of time talking about gender bias. I'm going to very much build on where Paul left us off . . . and on the unconscious mind, talking about how hard it is to change mindsets, and that often it is easier to change environments. I'll talk about some of the things that organizations can do to equalize the playing field. For example, hire and promote based on performance and merit rather than demographic characteristics.

Here's an image of a woman whom you may or may not want to hire. The question is, what do you see when you see someone like her? This happens to be Ellen Johnson Sirleaf, who later on became the President of Liberia, a graduate of Harvard, and a recipient of the Nobel Peace Prize. When we saw her earlier it probably was hard to predict what would turn out to be the course of her life. Now she does look a bit like a leader, even in her younger years, but that's kind of the point, that it's hard to predict just based on someone's appearance.

Iris Bohnet

Harvard Kennedy School

Here's another person. Her name is Heidi Roizen. Now, Heidi Roizen is a real person. Some of you might know her. She's a venture capitalist in Silicon Valley, a successful entrepreneur, in fact, so successful that a colleague of mine, Kathleen McGinn, at the Harvard Business School, wrote a case study about Heidi. The case study is now being taught at many business schools, including at Harvard, including at the Kennedy School, about how Heidi created these different businesses in Silicon Valley.

And here's a bit of the case study. That's how it starts: "Heidi Roizen, a venture capitalist at SOFTBANK Venture Capital and a former entrepreneur, maintains an extensive personal and professional network. She leverages this network to benefit both herself and others. The case considers the steps she's taken to build and cultivate a network that is both broad and deep."

Now, we have been teaching this case with both Heidi as being the protagonist, as well as by replacing Heidi's name with Howard. Now, Heidi is the real person, but to understand whether there's a gender bias in the perception of our students, we had half of the students look at the case with Heidi as a protagonist and the other half with Howard as a protagonist. Everything else is completely identical. You can already see where I'm going with this.

Of course, it turns out that people don't quite like Heidi. Heidi is too power hungry, self-promoting, and disingenuous compared to Howard. What's worse, and particularly bad and depressing for me as an educator, is that people, and that includes women, female students, learn less from Heidi.

So when you ask students afterwards, how good was this case? How much did you learn? They learn more from Howard than from Heidi. So, seeing is believing. Heidi doesn't fit our mindsets, doesn't fit the stereotypical images that we have about a typical venture capitalist in Silicon Valley.

Now, a lot of studies have been done to understand how biased people are. Some of them you're probably familiar with. This is another famous one that some colleagues of ours have done. They responded to job advertisements and sent applications with different names on them, but the application as such was completely identical, independent of whether the name was Lakisha or Emily.

So these were equally qualified people either called Jamal or Greg or Emily or Lakisha, and the question was, "Who would be invited to an interview?" And of course, what the researchers found was that if your name was Lakisha or Jamal, the likelihood that you will be called back is about 50 percent lower than when your name is Emily or Greg. Greg gets most calls, Emily second most, and then there's not a big difference between Jamal and Lakisha.

In fact, when you go and talk to people and ask them—these are all experienced people in the banking sector, in law firms, consultancies—what they look for when they interview someone, these are the kinds of things they would say.

So here's Denise, a white attorney who says, "I really do think it's about finding something in common with your interviewee."

Carlos, a Hispanic attorney says, "You use yourself to measure fit, because that's all you have to go on."

Now, my favorite statement is this one here that will make those of us in banking particularly proud. Ariel says about the interviewee, "She and I both ran the New York marathon. We talked about that and hit it off. We started talking about how we both love stalking celebrities in New York. We had this instant connection. I loved her."

So these might be somewhat extreme examples. Hopefully, none of you interviews this way. But it is certainly very tempting to use ourselves as implicit standards of what we're looking for in a job applicant.

Let me show you this picture, and some of you might have seen this before. But if you haven't, then try to compare square A with square B. I presume that most of you see square A as being darker than square B. It turns out that this is an illusion, and when I cover the surroundings, I presume most of you now see them as having the same color. Some of you look at me . . . not trusting . . . much of my work has been on trust, so I believe in proof. So I'm going back. This is what the pattern looks like. And here's how this is working.

We all think in terms of patterns, in terms of categories. And your mind immediately makes sense of the pattern that you see here. This is a checkerboard, and you also see there's a bit of a shadow here. And your mind accounts for the shadow but makes sense of the pattern that you see.

So, the question that you should ask yourself is, "What are the patterns that you see in your jobs, in your environments, in your families, in the world?" Do you see these two squares as being surrounded by a checkerboard, or do you see them in isolation? And if you see them in isolation, your interpretation of them is likely quite different.

Let me do another little game with you. And this, of course, is going to convince you that being here is really worth your time. Mainly, what I'm going to ask you to do is, to read the colors that you see, as a group, to me, as quickly as you possibly can. So I'm going to time you and you will read green, red, blue, orange, pink, as fast as you possibly can. Okay. Three, two, one, go . . .

That was very fast, although not completely coordinated. But very fast, as one would expect from a group of leaders. So that's about ten seconds. That's among the fastest times I've ever seen.

So let me make it slightly more challenging for you. Now, you still read the colors that you see to me. So, the first one would be orange, the second one would be green, the third one would be pink. And again, I'm going to time how long it takes you to do that. Three, two one, go . . .

I think we are giving up, although you are trying to save the day. I thank you very much. I notice you were very quick in the first round and you're still with me on this second round. So this is pretty crazy.

You all are obviously very smart and accomplished people. And still, you are having a harder time doing this than my son did when he was four years old. My son had no problem recognizing the colors, of course, but he couldn't read when he was four, so he was very quick. So, this is strange.

There's a little bit of complexity here that I'm adding to the decision process. I am matching two things that don't belong to each other. It says "green," it should be green, or at least some neutral color such as black. But if "green" comes at you in a pink color, it is hard for you to say "pink" rather than read "green."

This really is the basis of a test that was developed at Harvard, in collaboration with some other places, on implicit biases. That is how the researchers measure how biased we all are, by trying to see how long it takes us to make associations, for example, between women and office, and men and children. You can apply the bias to everything, and it has been applied to lots of different dimensions.

Of course, it plays a role in race, it plays a role in nationality. You can do religions, you can do how people look. You can do size, you can do weight, you can do height, you can do eye color, hair color, everything. So all of these things really matter in how quickly we are to make associations between different items.

And if ever you log onto this web page, thousands, millions of people have taken the test so far, you will find out that, I would predict, 98 percent of you are sexist, and racist, and nationalist, and many of the things that you don't want to be.

How you interpret whether he is the leader, she is the leader, who is attractive, who is competent, who is warm, depends on what you typically see. And what we typically see depends, of course, on the roles that you'll play.

When you are first confronted with a male nurse, most of us, including I, would feel slightly uncomfortable, unclear whether this person is really qualified to do the job. In fact, the story I'm telling in my book is a true story that when I took our older son to the Harvard day care center for the first time, I had to hand him over to a male caregiver, and I thought this was the most horrible thing that ever happened to me.

I got over it relatively quickly, but in the moment I couldn't help but expect a caregiver to be female. And he just didn't look the part and didn't fit my expectations. Nor are we used to women board members, women professors, women CEOs for that matter.

So, seeing is believing. And this is true despite evidence suggesting that gender diversity on corporate boards or gender diversity in senior management—that's a newer study that Credit Suisse did—is correlated with company performance. So, even though I started by reminding you of the business case, the business case is not going to do it for us. It is a helpful motivator for us to care, but it's not going to translate into action. In order for action to happen, we have to do much more, and that's really where I want to go.

Here are some of the things that we have been trying so far. Let me tell you a bit about the evidence about whether or not they're working. So, for the last 20 years the most likely program that organizations would have introduced is a diversity training program. Frank Dobbin, a colleague of mine at Harvard, a sociologist, has looked at a large sample of companies, about 3,000 companies, and he's done a very simple correlational exercise.

Namely, he's looked at different measures of diversity as a dependent variable. One of them, just a very simple one, is how diverse your workforce is. And then he looked at what these companies are doing. Do they have a diversity training program? Do they have a chief diversity officer? Do they do mentoring? Do they do other things?

The question was, "Are there any correlations between what we do and the outcomes that we'd like to achieve?" And it turns out that on diversity training programs, the verdict is quite devastating. The correlation is basically zero. So even though it has been one of the favorite tools to be used to increase diversity in companies, the evidence suggests that there's probably not much happening. This is just correlational, but if a correlation is basically zero, we can imagine that causation doesn't do much better either.

So diversity programs don't work, and that's pretty much very directly related to what Paul left us off with: it is very hard to change mindsets. By definition, these biases are unconscious, and even though you might agree today, or during the program, that you don't want to discriminate and you will change how you perceive people, how you evaluate people, how you promote people, it's very, very hard to follow through.

It's a bit like dieting. You can now, you know, think that you should do more exercise, eat more healthfully, but then to follow through is actually very hard. So diversity training programs haven't helped much.

Other things that we've tried are fixing the people who face challenges. These include leadership training programs that many companies have introduced for women, and also include—this is a newer tendency—behavioral training programs for male students.

Many of you might have seen the new OECD report that came out earlier this year showing that the gender gap in reading and writing is now about a year for 15-year-old boys and girls. So boys lag girls by about a year in reading and writing when they're 15 years old, and they never quite catch up.

This is in stark contrast to girls catching up in math. So, the gender gap in math, where boys typically have outperformed girls, has been closing relatively quickly in recent years, and has reversed in some countries—in Scandinavian countries, for example, it has reversed. So, schooling and boys is a huge issue. And increasingly, schools offer these behavioral training programs for boys, to fix the boys, to make the boys able to succeed in

the contexts that they're in. And the same is true for women. So, we're trying to help women succeed in the systems that they're in.

The evidence in those programs is a bit mixed, but I can't draw on huge amounts of data here because, sadly enough, also understandably enough, people are rarely randomly assigned to participate in these training programs.

So, many of your organizations, of course, I'm sure, run these training programs for traditionally discriminated-against groups, and you pre-select the people who then participate in the leadership training program. If you do a great job selecting the right kinds of people, and we don't screw it up in the leadership training programs, they will come out beautifully. So, that's why it's not a really good experiment.

We have a few experiments, for example, in financial literacy training, some leadership training in developing countries where people have been randomly assigned. And it looks like the evidence goes a bit in all different places. Sometimes it helps, sometimes it doesn't help. It helps for some people but not for others. Typically, the evidence is that for those groups for whom the leadership skill that we're trying to teach is, in fact, the binding constraint, it can help. But it only takes us so far.

Other initiatives that we have been employing in the past years are networks. Turns out networks are generally a good thing. Peers do matter. It is true that there are fewer peers for women to learn from—in our sector, for example.

And it also is true, as Boris Groysberg of the Harvard Business School has shown, that women tend to have vaster networks outside of the organization, because there are fewer peers of the same sex to learn from within the organization, which of course makes their skills also more transportable.

The most successful program to date probably has been mentoring and sponsorship where some supervisors have taken a keen interest in, in fact, mentoring particular individuals and sponsoring these particular individuals.

But what are the issues with programs that I have just been showing you? There are many, but let me just point my finger at two. One is the problem of the hammer. And that is that if the only tool you have is a hammer, everything looks like a nail. So we have been using these programs a bit on . . . not really understanding what the underlying problem really is.

Here's a study that we did in academia just to understand, to uncover what's really going on. And that might also be interesting and relevant for some of the professions that you're in.

So, many of us continuously claim that there's a pipeline issue, that we don't, for example, have enough qualified women to fill the jobs. And that is certainly true for some professions. It is true for engineering. Fewer than 10 percent of the students are female. It's been very hard to change those numbers. Been pretty persistent over the last 20 years. There's a real pipeline issue in engineering.

Turns out, in science the numbers have started to change. There are increasingly more women going into science. We're now at about 35 percent women in science. But the issue there seems to be something that a relatively famous MIT study has coined "performance support bias." What that means is that in the '90s, MIT realized that they weren't treating their female professors or their female scientists the same way they treat their male scientists.

And they have, as would be appropriate for MIT, collected lots of data on whether this was true. They found a bit of a compensation gap, but that actually wasn't the big driver. They found huge differences between men and women in terms of support. And that meant: size of the laboratory, resources, research assistant. So the budgets that they were endowed with were much smaller for female scientists than male scientists, and they've

rectified that since. So, that's support bias.

Thirdly, my own discipline, economics, we found something quite surprising. And that is the blue bar here on the right. And what it shows you is that men are about 21 percentage points more likely to be promoted to tenure, to full professorships, than women. Now, this is not controlling for anything because it's just raw data. It's not controlling for output or expertise or performance, but it still made us wonder whether something was going on.

You also see some other differences. You see some pro-female biases, for example, in engineering or life sciences. But these are small numbers, these are small deviations from a gender neutral performance process. This allowed us to introduce what I think is one of the only experiments on mentoring, leadership, and network programs at the American Economic Association meetings.

So we now do training programs for female assistant professors every year, and the beauty, from a research point of view, of course, is that we literally do pick the applicants randomly out of a hat. So these aren't pre-selected people, but people apply, about 120 apply, we pick 50 every year, and then we give them additional training. And we also follow them through their careers. And they get to know their peers, they're in a network, there are lots of different things that I just talked about in the previous slide.

We introduced it in 2006, and we can show that over the years it does matter whether someone has received additional training or not. The beauty in academia is that output is measurable relatively objectively. You can look at people's publication record, their citations, at universities they get tenure, et cetera. So it can help. It *can* help to try to enable the traditionally discriminated-against groups to navigate the playing field more successfully. But still, it only takes us so far.

The second concern I have in addition to the hammer finding a lot of nails is social backlash. And that's actually quite serious and I think a topic that we might not have talked about enough. So certainly Sheryl Sandberg's book, *Lean In*, has had an important impact, has made a very important point.

And it also talks about the research on negotiation, suggesting that for women, in fact, negotiating like a man, or for Heidi, leading like Howard, is socially risky. Heidi experiences what we call social backlash. She cannot afford to behave the same way that a man can. Neither can women negotiate as assertively as men can, because they violate stereotypes about what the typical woman should look like.

So, just offering leadership training to women and saying, "Look, here's how we've been doing this so far, and here's how career trajectories are in our firm, and here are the kinds of things you need to do," likely won't work because of the norms that we have, these implicit associations that we have in our minds.

So what do we do? Is there some magic algorithm, some magic method that we might be able to employ to change, as Paul discussed, the context. Basically, make it easier for our biased minds to get things right. So, rather than fixing how we think, making it easier for our minds to do the right thing. And that's where, as Michael talked about, my book is going to go. My book talks all about what organizations can do to equalize the playing field, for example, by promoting or hiring based on performance.

Let me give you kind of three ideas. The first one is a relatively simple one: why was the Obama campaign so successful in getting the vote out? Lots of motivated people, lots of passion. But one of the key reasons was that they used data. They used data, they ran experiments, they really tried to understand what it takes to get someone to the voting booth.

These include randomized, controlled trials where, for example, researchers have studied whether people, in fact, do what Paul described people doing in tax compliance. So does it matter how many other people are voting? If I call you and remind you that an election is coming up, does it matter whether I remind you how many other people are voting? It turns out, which of course is painful for an economist, people are super irrational. They are

more likely to vote when everyone else is voting. When, in fact, in economics you would assume you're more likely to vote when you are a decisive voter. But no, we are herding. We go with the herd and we're more likely to vote when most other people are. So you *can* remind people of what the thing to do is.

Another study that the Obama campaign ran went as follows. They did the call and, by the way, they didn't just do the call, they always had a control group which got the control condition, and then they had a treatment group which got the treatment, like in the natural sciences.

The control group, you would just get the regular call: "Do you plan to vote?" "It's important to vote." "Please vote." The treatment group got a slight addition: "It's important to vote, "Do you plan to vote?" And, in addition, they asked people whether they have made a plan.

Now, it seems pretty silly to ask people to make a plan about something as relatively simple and straightforward as voting, but it turns out that when you get people to think it through, including: "When are you going to vote? Who is going to take the kids to school? Are you going to go alone? Do you have transportation?" People are more likely to vote. It increases the likelihood that single households vote by ten percentage points. And if you cohabit with someone else, it increases the likelihood that you will vote by four percentage points. So it's pretty crazy.

This follow through between intention and action is really important. Think of some of the discussions that I'm sure you and all the firms are having these days around culture. Most of us want to be honest people, ethical people, good people. But the follow through is a difficult part. It can't just be that we have these statements and we read the statements and we train people on understanding what the moral code is in our companies. We also have to think about how we could help people to get from A to B. And plan-making is one of those interventions which turns out to be pretty successful.

Now, the Obama campaign benefited from data and, thankfully enough, data is starting to play a more and more important role in the private sector as well. And, like Paul, I have to say I've been similarly surprised working with the private sector, how little data, in many ways, we use in some parts of our businesses.

So we're very good using data in our economics departments. We're very good using data in our marketing departments. But, for example, in human resource management we haven't been very data driven, and that's kind of part of the mission of the book also, to kind of transform how we think about people, and make thinking about the people equally based on real evidence, the same way we think about financial decisions, the same way we think about marketing strategies.

So, I have a number of different initiatives here in my slide. One is the MIT initiative that I've just described. It really did help MIT to understand the root causes of the issues—not just use a hammer, not just do some diversity training program, but really understand where the gender gap comes from. There's also an interesting study by Janice Madden that some of you might have heard about, on stockbrokers, finding the very same support bias that was found at MIT, where female stockbrokers were assigned worse performing portfolios than their male counterparts.

There's also technology now that helps companies understand what's going on. The two examples I have here, one is Logib, from my country, Switzerland, where the government, in fact, created a website where companies can just download a tool which helps them plug in their own data—it's basically a bit of a more advanced Excel spreadsheet—and analyze where issues might be.

And there's also private companies, such as EDGE, for example, that some of you might have been using, which help companies self-evaluate how well they're doing in terms of treating their employees equally. So if you haven't used any of those, I suggest to you that you might want to look into those—understanding where the

issues are, starting with the problem, is probably a more effective and a more efficient strategy than just using a hammer relatively broadly.

Now, let me talk about another issue that we all face in our organizations that's now more forward looking. Forecasting—and, of course, many of you are in the business of forecasting—is tough business. In fact, Phil Tetlock has studied this question of forecasting for a long time—a new book of his is coming out this fall—looking at how well we do when we make these kinds of predictions.

And he's studied, literally, thousands of expert decisions trying to understand whether experts are relatively good in forecasting the economic future, political events, lots of different financial markets, lots of different types of dependent variables. And his verdict is pretty damning.

Namely, his verdict at the end of the book is that we experts aren't much better—he talks about dart-throwing chimps—a little better than chance, but not much better than chance.

So, prediction is difficult business. And of course, when we evaluate job candidates, in effect, what you're trying to do is to predict future performance. Is this the kind of person who will flourish at our organization and do well in our organization? And there are lots of effects in psychology and behavioral science suggesting that we are very bad at predicting how well someone is going to do based on our instincts.

In fact, many of us, including I, would say that interviews are one of the most overrated instruments that we use in evaluating people. We tend to trust our gut instinct, and we will tend to behave like Denise or Carlos and look for people who look the part, either using ourselves as a standard of reference, or using the majority of people in a particular profession as a reference.

Let me just talk about one of these: the beauty premium. The beauty premium is actually quite an interesting topic. A colleague of ours, an economist, Daniel Hamermesh, has been studying beauty for about 20 years now and finds some really interesting effects. So, beauty does matter, and there is a beauty premium.

Now, in America, it turns out, the beauty premium is more pronounced for men than for women. So, men who look better than the average man, on average, make five percent more, and men who look worse than an average-looking man make about 13 percent less, on average. This is controlling for everything that you can control for.

It's also true for women that there's a beauty premium, but it's less pronounced than for men. And that's generally the pattern in the U.K., in Western countries. It's not necessarily generalizable. So, for example, in China, it's quite different. In China, it turns out that the beauty premium is much bigger for women.

A recent study that has just come out, I think a month or two ago in the *American Economic Review*, looked at job advertisements in China. And, as some of you might know, in China you can still advertise in sex-segregated columns: so these are jobs for men, and these are jobs for women.

And the simple exercise that they did was to try to understand which descriptions are most likely to be associated with male jobs and which descriptions are most likely to be associated with female jobs.

And it turns out that the adjective that was most likely to be used for male jobs was “age” or “experience.” And in female jobs, the adjective that was likely to be used was “attractive.” So, there is a premium, but the question that you might ask yourself is, “Is it predictive of anything?” Maybe that's actually a good indicator.

Maybe beautiful people are better performers. You're laughing. It turns out not to be true. And it's actually quite interesting. It's even a bit more complex than you think. Not only are they not better performers, but they run into the following problem: they are expected to be better performers. They are taken to a higher bar, and then they don't live up to my high expectation of the beautiful people, and then I punish them even worse than I would

have if they hadn't been beautiful. So, beauty is not a good predictor of performance. So, what is?

Generally, looking at people there are very few examples. I mean there are some smart people who are able to read faces, but that's a very difficult business. Generally, looking at people is not a good predictor of performance. So here's one study that I think resonated with many of us in the field, which really brought home the point.

The major orchestras in this country, and increasingly around the world, have introduced something quite surprising. They now have their musicians audition behind a curtain. In fact, this was introduced in 1970 when some of the major orchestras realized that they only had five percent female musicians, when in fact many, many women studied music, and it seemed a bit surprising to not have more female players.

Having women and men audition behind a curtain increased the likelihood that female musicians would be hired by 30 percentage points. That's blind evaluation. And that's really what would be ideal for all of us.

It would be great if we could just base our judgments on someone's performance and not what they look like. But, of course, in most of your jobs and in my job as academic dean—my job was to help select professors—you don't have the luxury of blindness.

There are some interesting tools which will come on the market this fall or next spring, which will help us keep applications blind for a very long time, maybe until the very last stage, and some of you might want to use some of these tools. So, blindness would be a good thing, but hard to implement until the end.

Max and I, with a doctoral student of ours, Alexandra van Geen were trying to find an alternative to curtains. What we are trying to do, basically, is to find an intervention that is practicable, that organizations like yours could be using, that would debunk this little stereotype, this little reference here, that says "female nurse" or "male banker," and help us actually focus on performance rather than demographic characteristics.

So, we ran a number of studies on comparative evaluations, where what we did was actually relatively simple. We tried to mimic, in a very simple way, first in a laboratory, a simple evaluation situation that is involved in most hiring decisions or promotion decisions, for that matter.

Some promotion decisions that you are involved in, somebody comes up for promotion because, for example, the person has an outside offer. Certainly, also true in academia, someone gets an offer from the LSE, we have to respond. So then it's about this one person. So then I have to evaluate this one person. Is he or she fit for the job? Or do we let him or her go?

It turns out that when we focus on one person we naturally compare him or her with the referent in our head. In fact, comparison is a very natural thing for us to do. Behavioral scientists would argue that it's very hard to make absolute judgments. In fact, almost anything that you experience is relative: whether you like the coffee, whether you think the temperature is hot or cold, whether you think the room is empty or full. It has something to do with the experiences that you typically have, with the reference points that you have in your minds.

The same is true when we evaluate people. There *are* reference points, implicit reference points, which we're not necessarily conscious of, that help us calibrate whether the person fits or not.

But we *can* counteract the stereotype in our heads by forcing you to evaluate at least two people at the same time. Two is enough. You can also do more. You don't want to create cognitive overload, you don't want to do too many. But two is already enough.

When we have evaluators look at two candidates at the same time and evaluate them comparatively, they're much more likely to focus on performance. Now, why is that? Turns out that comparison generally is a very successful tool.

Paul alluded to a study that Opower did in many different countries, where they compared people's energy consumption to that of their neighbors. And a typical energy bill looks something like this. So, your energy consumption is compared to the efficient neighbors, all neighbors, and then you. And it turns out that you use more energy than your neighbors. In some versions there are rankings, so you're compared to your hundred neighbors and you're number two or number 65, just lots of different versions.

So it turns out my family was a subject in this experiment, involuntarily, as it should be, of course. And I wouldn't show you my energy bill if it wasn't great. But here is, literally, our energy bill. So this is us, the blue ones, and we do compare favorably with our neighbors. They also tell us a bit more about our specific energy consumption.

So, this is literally our energy consumption. We're doing great in the cold months. And this is June, when we turn on the heat in the pool, when we do worse than our neighbors. And then by July and August we don't have to heat the pool anymore and so we're doing okay again. We're doing well in winter because we got this first comparison—next thing my husband did was to get our roof insulated and install solar panels.

I am showing it as an example because it actually works. This is now a randomized control trial with millions of households around the world. And as Paul said, it's a super simple, super cheap intervention that costs these energy companies basically nothing, provides a bit more information that does two things.

One is it helps households calibrate. How do you know whether you use a lot or a little? You see the bill, you see how much you have to pay, but is \$1,000 a lot or is it a little? Compared to whom? It's very hard to calibrate. Calibration is a very helpful mechanism in helping our minds get things right.

And secondly, it also creates some sort of crazy competition. My husband and I, we're now ranked number two in our environment, among our neighbors. So, we're walking around looking at these families who spend winters in Florida and summers on the Cape and don't use any energy at all.

But anyway, comparisons really do matter. And I *have* introduced them at Harvard. You can actually change how you do things. So the fun part of helping lead an institution and not just studying how organizations work, was that I got to use some of my own research and implement it tomorrow.

So, we did change how we look at faculty, how we promote faculty. And one of the simple things we did is we tried to bundle our decisions. So not only do they help us compare, but as soon as we make more than one decision—for example, now we're trying to make three promotions at the same time, faculty promotions, and then we have nine finalists, for example, and we make three appointments—diversity emerges much more naturally.

And you're, of course, all in the business of portfolios, so it's very intuitive that when you look at a portfolio of choices, you're much more likely to go for variety than for the same thing all the time.

In fact, some of this work was inspired by an early study in psychology that was a very, very simple experiment, but it's going to make my point here. It went something like this. They went into a high school, and they offered half of the high school kids snacks for the next 30 days, and all of you on this side of the room would have to decide today what your snacks would be for the next 30 days.

And these were like 200 snacks, a lot of different choices, you make 30 choices today and that's what you're going to have for the next month. This part, this other half of the high school, or this part of the room, was asked every morning to choose a snack for today.

And it turns out that the group choosing for today would go for much less variety than the group choosing for the month, because even if a Mars bar is your favorite sweet, you cannot imagine that you would want to have the same piece of chocolate 30 times in a row. But on this side of the room you're like, every morning: apple,

chocolate bar, apple, chocolate bar . . . you go for the chocolate bar today and you'll go for the apple tomorrow. So, of course there are other things going on in that particular study with time and planning, et cetera, but it still makes the point that bundling choices can lead to very different results than doing choices sequentially.

So, in the study that I did with Max, we had people evaluate, either separately—one candidate at a time—or jointly—comparing at least two candidates at a time—and this is what we found. This is what you kind of want to see, namely, a huge performance gap in joint evaluation.

What that means is that you chose the better performer, or, evaluators chose the better performer, and basically there was no gender gap, because gender was not predictive of future performance. When in separate evaluation you see a bigger gender gap and a performance gap.

Okay, so, second take-home is: evaluate comparatively. Whenever you can, evaluate comparatively, because you do it anyway. You always evaluate comparatively, but you're not aware of it. You always compare with this implicit referent in your mind. So make comparisons explicit and they will help you and your teams evaluate more accurately.

Now let me turn back to Ellen Johnson Sirleaf, where I started out. So, about six years ago at the Kennedy School, and I've been there for 17 years, so to my credit I noticed it in year 11—that's a really steep learning curve—I noticed that we have only male portraits on our walls. Only. So, that's quite amazing. I mean many boardrooms, of course, only have male portraits on the wall because former chairmen are on the walls.

And, so, we started to commission portraits of female leaders from around the world. Here is Ellen Johnson Sirleaf. This is a photo where we had this portrait of Ellen Johnson Sirleaf, she's in the foreground there, inaugurated. So why are these portraits relevant?

Turns out there's something in psychology that is called stereotype threat. And what stereotype threat suggests is that there are triggers in the environment that will prime certain parts of your identity. Maybe the triggers are male, maybe the triggers are American, maybe the triggers are white, maybe the triggers are banking. Whatever there might be, there are these environmental factors which will affect how you behave.

And one of the, I thought, more impressive studies that I've seen on stereotype threat, which literally has been studied in many, many different areas, was one where girls were either primed for their Asian identity, or for their female identity. So the same girl would either see a picture that would remind her of Asia, these are Asian-American girls, fourth graders, ten years old. Or, they were reminded of being female.

It turns out that when they are reminded of being Asian, they do much better in math than when they are reminded of being a woman. Same is true for boys. When you prime gender identity in terms of reading and writing, boys do worse than when they're not reminded of their gender identity.

In fact, this is a super easy fix in the tests that we construct. A very simple fix is don't ever, ever collect demographic characteristics in any questionnaire survey that you'll ever conduct in your life before you ask people to fill out the survey. Because if you ask people beforehand, that will prime what they think of as they are completing the survey.

Surveys are, by the way, an interesting—this is a bit of a side comment while I have time—are a very interesting problem for us. So I'm happy to say that one of our bigger successes in terms of designing gender equality has been the redesign of the SAT. Some of you might know that in 2016 there will be a new SAT test coming out. It's still going to be multiple choice, heavily multiple choice. Will have other questions as well. Lots of different changes, about ten different changes. But one of the changes is influenced by our work on gender equality.

Here's one interesting fact. In these multiple choice questions, it turns out that it has been rational to guess. And

many of you, I'm sure, have been studying for the SAT, either yourself or with your kids, it's rational to guess when you can exclude at least one alternative. So there are five alternatives, you can exclude one, you know Napoleon wasn't a Roman emperor, then you can just guess among the remaining four. So that's the rational strategy. There was a small penalty associated with guessing wrongly, but if you can exclude one, it's rational to guess.

Turns out women don't guess. Women are much less likely to guess—the same dynamic that keeps women from speaking up in public. You've all been in meetings. It's typically not the women who ask the first questions, if they ask a question at all. Women need a higher confidence level to be able to speak up, and they're more risk averse. So, female test takers haven't been willing to guess. We've studied this. It turns out it costs women 70 points on the SAT, controlling for ability and performance. 70 points.

The new SAT, there are two things we could have done, and we studied both. One, which in many ways would have been my favorite one had it not led to other biases, would have been to force choices. We could have said you can't skip anymore. So, now on the SAT you can skip. If you don't want to answer the question you can skip. So you could have said, just force people to answer every question so nobody can skip.

Turns out that doesn't quite work either, and it created biases among class, not so much gender biases but created a lot of stress, particularly for students with a socioeconomic background that is not necessarily represented in this group. So, we couldn't do that either. We couldn't force because the anxiety that was created didn't help.

So what the new SAT is going to do is do away with all penalties. It blatantly, openly invites guessing. It now says the smart strategy is: study this, have the right answer, but if you don't have the right answer, guess. So, of course, criticism has come back—"That's really crazy, you want to evaluate performance and now you're inviting guessing . . ." And the counterargument is we couldn't force people to answer because that would have biased results against people who come from different backgrounds. So what we did was to just make it open so everyone could be guessing.

So, test taking is important, and we really have to think about these stereotypes and these kinds of triggers that our environments create. Last night at dinner I actually shared one more study that we could never do anymore these days but that really impressed me. So, in the '60s a number of psychologists, from Harvard in fact, went to California and ran the following study.

They went into a school and administered intelligence tests to first grade, second grade, third grade, fourth grade students—four grades of students between six and ten years old. And they were interested in whether this predicts future performance. And in fact, they collected the data and they determined the 20 percent best performers. And they informed these performers of their performance and that they are in the elite group. They also informed the teachers and then tracked how well they performed over the course of their studies.

Turns out the test is very predictive. But here is the important message: these students were chosen randomly. The test actually didn't matter at all. You couldn't do that anymore today. No human subjects committee would allow this. If I were a parent in this study I wouldn't be very happy. But it is important evidence and that is that these students are chosen randomly, but they were told that they are among the best performers as were their teachers. That became a self-fulfilling prophecy.

So we really do have to worry about the messages that we all send in our organizations, purposely and often unconsciously, most often unconsciously, about whether we trigger images of economists or psychologists, or Americans or Europeans or Asians, and what they might do to people's performance.

Here's another interesting study on how important seeing is believing really is. So, it's portraits on the walls, it is

checking boxes with the demographic characteristics, but of course the most effective intervention likely is actually seeing people in particular roles, people in counter-stereotypical roles. Some of you, and I'm happy to talk about that in the conversation, might wonder about the effect of quotas.

The best quota experiment today is actually not Norway, but it has been run in India. India, in 1993, amended its constitution with the provision that a third of its village heads, a third of the mayors, had to be female. And a group of researchers has been able to follow the experiment. It was a real experiment because a third was literally drawn out of a hat. So a third of the villages had to have a female mayor, but two thirds didn't.

So, you could see what difference it made. And it turns out that the first woman wasn't very effective. Even though she already provided more public goods for her community, she didn't think she was effective, nor did her village think she was effective. She didn't want to be reelected, she wasn't reelected. It was a second woman who made a difference. So, after exposure to at least two counter-stereotypical role models, mindsets started to change.

In fact, researchers have been administering the implicit association test—that I've just shown you before—with these villagers over many years now, and can show that after having been exposed to a female mayor for at least eight years, doesn't have to be in a row, but eight years in the last 20 years, mindsets are starting to change and people are starting to believe that women could be political leaders.

In fact, the last paper that has just come out in *Science* shows that one of the key career aspirations of parents in the villages which have seen female leaders is for their daughters to become politicians. So this is, of course, not based on irrational assessment. These jobs are really rare. But it *is* about changing mindsets, about helping people imagine what might be possible.

Let me end on a kind of important topic. Typically, my talks just remind us that behavioral interventions are small but can have big impacts, including on big problems. But this problem is really big. This is bigger than not having enough women on boards or not having enough female professors or female CEOs.

The *Economist* coined it "gendercide," a few years ago. The UN now estimates that about 158 million women and girls are missing in Asia because of sex-selective abortion or neglect during the first five years. One hundred and fifty-eight million women is about the number of women living in the United States, so that is like zero women living in this country.

That's a huge problem. And people have tried many huge solutions, as Paul said, many huge . . . and of course, we've also been very nervous because of ethnocentricity concerns and coming in as Westerners and telling people in India and China that it really wasn't appropriate to kill your daughters. So, what can we do?

So, my favorite study is a study by Rob Jensen, a former colleague of mine who's now at Wharton, who exploited the fact that call centers preferably moved into India in the '90s. And they also overwhelmingly hired women, so these were new job opportunities created for women. But in order to understand whether that does anything at all, of course you have to run an experiment.

So what he did was, he selected 200 villages to receive the treatment and two other control villages. The treatment in this experiment meant that he hired a firm which provided training and information for women to go and work in those call centers. The other villages didn't receive that kind of training, and he was interested, of course, in whether more women then would go and work in the call centers. But that really wasn't his primary motivation.

More importantly, he cared about whether this affects how parents treat their zero-to-five-year-olds—this creating options, role models, even though the changes per village were like two percent more women having work. These are small changes. But did it affect the survival chances of these girls? And that's what he studied,

that was his main interest.

So he measured survival rates, he measured health, BMI—body mass index, survival, education. And he can show that, in fact, it does matter, that in the treatment villages where economic opportunities were created for women, parents started to treat their daughters better. And the beauty of that is, it really was an efficiency argument. It didn't affect the sons, so parents didn't just treat their sons worse, but they were able to increase the size of the pie and treat their daughters better.

So the discussion that we have today is neither hypothetical, just about our minds, nor just about your organizations or my organization, but it really is about the world. Role models can matter. Seeing is believing, and if you can create role models either by having actual counter-stereotypical people in the jobs, or even portraits, or if you can't do that, gender-neutral tests, that will take us a long way. With that, let me end.

These are just three ideas on how you can promote change.

Data, it's a very trivial point, but I am making it repeatedly because many organizations just don't collect enough data, in particular on people decisions. And I'm very excited about a new field, and those of you in human resource management call it people analytics, where we're applying the same kinds of analytical tools that we apply to economic forecasting and financial decisions to people decisions. So, people analytics, if you ever want to check it out, is a very promising field, based on data, based on real evidence, big data, trying to help us make better decisions in our people management.

Secondly, compare. Everything you can, compare. Compare to calibrate, because you will compare anyway, typically, unconsciously.

And thirdly, think about the triggers in your environment, the threats, the opportunities in your environments, the images that you portray, and the kinds of opportunities they might create. And with that, happy nudging.

Question: Back to the beginning. Business school case, very similar to the one you mentioned, blind, male protagonist, female protagonist, and it was about a tough boss, was sort of the basis of the case. And the most disturbing thing to me about it was that the reaction was far more negative to the female boss. But peeling the onion back one step further, the reaction among the female students was far worse about the female boss than the male students' reaction to the female boss. I don't know if any further peeling of the onion was done on that as to why that bias existed. That was surprising to me and kind of really more disturbing than the overall conclusion, frankly.

Iris: It's a very good question, a question that many people often ask which is, "What is the gender bias in the eyes of the observers?" And, "Are women more or less biased when they evaluate women, in this instance?" So it's a bit of a longer answer to your question because it is an important question.

So, I think the most important message is that it's much more important *what* you see than *who* sees. Most of the variance is eaten up by what you see. If you don't see male kindergarten teachers, you don't associate kindergarten teachers with men. If you don't see female CEOs, you don't associate women with CEOs. That's the most important driver.

Then, we sometimes find that observers also differ. Sometimes we find some of the differences that you just talked about. And it is quite interesting that, if I may make a comparison, which is not completely fair, but which has been striking to me as I've been working on my book, there is a very interesting study on refereeing showing that there is a bias among white referees judging African American players, and the reverse is also true, but it's mainly among white referees, more pronounced among white referees judging African-American players, which actually has changed dynamics quite substantially since the study has come out.

We typically refer to this as in-group bias: you like your own people who look like you—homophily—kind of a general tendency. I'm telling you that because that's typically the wisdom that we've had, that there's a bit of a tendency to like people who look like ourselves. So, in-group biases have been less pronounced for women, generally less pronounced, so your sense of that study is actually right.

And there's been a really good experiment in Spain where evaluation committees in academia are randomly created. So, from all academics in Spain you're randomly allocated to an evaluation committee of five. And sometimes there are four men and one woman, sometimes it's four women, one man, et cetera. So they were able to look at if it matters whether we have more women than men on the evaluation team.

And it turns out that women often are harsher when evaluating women than men are when evaluating women. And the best explanation to date is that there's some sort of gender-specific competition in our minds that women tend to think that there are slots for women—say, 30 percent slots reserved for women and 70 percent for men, and that the more women I have in my field, the harsher the competition is going to be.

This is supported by the fact that when these same committees evaluate people for tenure, at which point the competition is kind of over because of job for life, the gender bias goes away. So, it's particularly pronounced when junior people evaluate other junior people who are still competing for these rare slots. Then it appears as if women have a sense of gender-separate kind of tracks for men and women and are more harshly evaluating women.

Question: A related question to kind of specific cohorts and how they evaluate themselves . . . the demographic profile, particularly in the West but also in China, means that we're going to have to do an awful lot more, particularly for high value jobs with older people. But some of the cohorts most biased against themselves are older people—ageism among the older people. I think some of the studies show that old people are biased against old people, possibly because a lot of people don't consider themselves to be old. And so I'd be interested in your thoughts on this, ageism and that particular aspect of bias.

Iris: I think, just to link your question to the earlier question, we generally also find that groups which in our minds either have traditionally been discriminated against or we associate with fewer leadership roles, such as older people or women or people with disabilities or African Americans, just to spell out the biases that we have, that if you are a member of this group, it doesn't necessarily pay for you to associate with your own group. Often you want to distance yourself from the group because you know that these stereotypes go with the group.

These are the stories. That's not actual research. But these are the stories, that women start to dress like men and start to behave like men and have a different pitch of voice and wear suits and slacks and things of that sort.

So the same might be true—now I'm not a specialist on ageism—might also apply to ageism, that you want to distance yourself from your age group, appear younger, be younger, don't hang out with your peers, in order to be associated with the group that stereotypically is associated with having the highest profile in our world.

Now, ageism, as you rightly say, if you do the implicit-association test (IAT), ageism is a huge problem, particularly in the Western world. It's quite interesting that the implicit association tests that have been administered in Asia haven't quite been able to track that.

So, again, I don't want to generalize too much, but the studies that have been done are quite interesting on the IAT and age, just a bonus for being young—young are the new generation, the entrepreneurs, really fun. And there's a bonus for being relatively senior, much older than in Western countries because that goes with experience and respect and authority and it's the unhappy middle again, which they found.

But generally, I think you're right. Ageism is another bias, very prevalent in the U.S. and Europe. And, older people don't necessarily want to associate with other older people because that might tell you something about

who they are. I think we had a question here.

Question: Thank you. This is specifically a question about the SAT test, but it's something that kind of bothers me about all of this or . . . I shouldn't say all of it, a number of things you mentioned. Let's say you answer 100 percent of the questions and you get 85 percent right, and I answer 80 percent but I get all of them right, it seems like it's silly for the SAT committee to decide which one of us is a better thinker.

Why not, did anybody consider ranking with a heavy penalty for wrong answers and no penalty for wrong answers, reporting the score of whichever group you scored higher relative to, and also a check box for which kind of thinker you seem to be? More generally, it seems to me, that some of this is about getting a more diverse group of people to fit in existing slots rather than exploiting the diversity of people that kind of open up slots, or people think slots should be.

Iris: I'm not sure I completely understood your question. Are you saying maybe the whole multiple choice framework is a bad framework, or the SAT more generally is a bad framework?

Audience Member: Single number score.

Iris: I mean, generally, I completely agree with you. Thankfully, the new SAT is going to have many more sections. So the multiple choice part, for example, is going to be a much smaller fraction of the overall test. But I think maybe your implicit question, which is not the question you may have asked, I don't know, is if the SAT is a good predictor of future performance? Right? Are we actually using a test that tells us anything about anything?

The evidence is completely mixed. I'm not defending here the SAT as a measure of future performance. The evidence, completely mixed, depends very much on demographic groups, on where the test was administered. It's really crazy.

If you take the test—I think, Michael, you talk about this in a book of yours, in fact—if you take the test some place and you're surrounded by 99 other people, like in this room, you will perform worse than when you are in a group of only nine others, which of course shouldn't matter at all because you're competing with the rest of America. It doesn't matter how you take the test, but even such small things in the environment matter.

So, I'm not enough an expert on the SAT to say I shouldn't completely throw it out, but certainly some colleges have. Some colleges have said this is a super bad predictor of future performance. It has biases that we're trying to do a better job of correcting, but we're not really getting there. So, I think the final verdict is going to be out whether the new SAT is going to do a better job. But it does try, I think, to address some of the questions that you have.

Question: Let me ask a slightly politically incorrect question, which is, what is the imperative for diversity? Is it social? Is it moral? Is it economic? And once we answer that question, would there be some level of gradation of the diversity drivers? That is, once we define what the imperative is, would we be better served by focusing on a particular aspect of diversity, whether it is gender, whether it is class, whether it is something where the outcome is significantly better for whatever the imperative is?

Iris: Thank you. Chris [Chabris], are you here? Are you going to talk about your gender diversity study this afternoon, or no? Should I talk about it? A little bit, so I don't want to . . . I'm not going to steal the thunder . . . Chris is going to answer the business case question but the short answer is, it's all three of those. I think, honestly, I don't think we can separate the human rights case from the business case. The human rights case has been there for a long time. And so I think the moral case is everyone's individual decision: do you believe in equality or don't you believe in equality? And, so, that's really up to you and humanity to decide. But the business case, there's more and more evidence suggesting that there's a business case also, and some of it is the talent pool, which is a very straightforward one, in particular, as we have increasingly more women graduate

from college than men.

The second one is gender diversity in teams, which has been shown, in Chris's work and in the work of others as well, that cognitive diversity in particular is very predictive of a team's success. Now I should also add—and that's actually not just a footnote but an important comment for those of you who try to create diverse teams—there's another piece of the evidence which is important.

There's some research suggesting that when you ask people in a diverse team, particularly in a gender diverse team, how well their team performed, after they've just done the task, people will report that their team probably didn't do so well and that they didn't like the task much, because it is hard work.

So diversity is not simple. I'm not suggesting here to go home, diversify your environments, and kumbaya, everything's going to be great. Diversity is hard work. It's very hard to make diversity work, but generally we do find these positive impacts.

Now, to your question. I actually don't think that the tools that we use depend so much on the motivation of why we're doing it. For me, a nudge, or behavior insights, is just another tool in our big tool box that we can use to motivate certain kinds of behaviors. You could use incentives instead, we could use regulation instead, we could do lots of other things, moral appeals, other interventions.

Nudges are another tool in our tool box that I suggest we should use because they are smart and efficient and cheap. But whether you want to get from A to B, or from A to C is not really in the realm of behavioral scientists. That's a moral decision or a business case decision that we as individuals or we as organizations have to make. Chris, did you want to jump in?

Chris: There's nothing else I can add right now. I'll say a few relevant things this afternoon towards the end of my talk so we'll come back to the topic then.

Michael: I think, by the way, I'll mention James Surowiecki is here, and he wrote the book on this, a book on this, *The Wisdom of Crowds*, so if you want to talk about wisdom of crowds there's the guy that wrote the actual book on that. One more quick one, since we're running a little long. Steve, go ahead.

Question: Not sure this is quick, but, how important is diversity of thought in the whole scheme of diversity? And I come at this from the angle of academia, where there's a huge and very prescriptive thought both among faculty and students for socioeconomic diversity, gender diversity, ethnicity diversity, et cetera, but there's not any thought, as far as I can tell, put into diversity of thought relative to the faculty, in particular.

Iris: In fact, I think the evidence suggests that the driving factor is cognitive diversity. So, I'm not sure I'm disagreeing with what you're saying. My sense is that the literature has heavily focused on comparing the impact of cognitive diversity compared to sociodemographic diversity. And I think the strongest evidence we have, the biggest bulk of research, is that cognitive diversity, unequivocally, is a good thing.

Now, it depends also a bit on the task that we're looking at. If we all have to run out of this room because there's a fire alarm, we should probably all run after the leader and not cognitively have a discussion of what's the best strategy, et cetera.

So, sometimes if you have to execute—running is probably a good thing. But creativity, brainstorming, lots of other tasks—cognitive diversity can really help. And then the question is, when is cognitive diversity correlated with sociodemographic diversity? And are there other aspects of sociodemographic diversity, in particular now and of interest in our discussion here, of gender diversity? And that's, I think, literally, where Chris is going to take us this afternoon. But there are, in fact, other aspects that gender diverse teams bring to the task that cognitive diversity doesn't do. Is that a fair, I think, a fair ending?

Iris Bohnet

Harvard Kennedy School

Michael: We're going to call it there. And, Chris will talk about this later this afternoon, but I'll also mention, we wrote a piece about this last year, called "Building an Effective Team," where we actually talk a fair bit about cognitive versus social category diversity versus values diversity and that kind of stuff, and there's a lot of references on that. But I think you're right. You're talking about academia, it's a different topic, but for our businesses I think it is cognitive.

So with that, please join me in thanking Iris for this presentation.



Max Bazerman

Harvard Business School

Max Bazerman is the Jesse Isidor Straus Professor of Business Administration at the Harvard Business School and the Co-Director of the Center for Public Leadership at the Harvard Kennedy School.

Bazerman's research focuses on decision making, negotiation, and ethics. He is the author, co-author, or co-editor of 20 books including *The Power of Noticing* (Simon and Schuster, 2014) and *Blind Spots*, with Ann Tenbrunsel, (Princeton University Press, 2011) and over 200 research articles and chapters.

In 2006, Bazerman received an honorary doctorate from the University of London (London Business School), the Kulp-Wright Book Award from the American Risk and Insurance Association for *Predictable Surprises* (with Michael Watkins), and the Life Achievement Award from The Aspen Institute's Business and Society Program. In 2008, Bazerman received the International Institute for Conflict Prevention and Resolution (CPR) Outstanding Book Award for *Negotiation Genius*, and received the Distinguished Educator Award from the Academy of Management. Bazerman's consulting, teaching, and lecturing includes work in 30 countries. Details are available at www.people.hbs.edu/mbazerman.

THE Power OF NOTICING

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Max Bazerman

Max Bazerman

Harvard Business School

Michael Mauboussin: Welcome back. I met our next speaker, Max Bazerman, more than 20 years ago and am delighted that we are able to have him join our forum today. Max is a professor of business administration at the Harvard Business School and truly one of the great business educators in the world today.

Max's research focuses on three areas, all of which tie intimately with the theme of attention. The first is decision making. When I am asked for the most practical book on heuristics and biases, I still point people to Max's book, now co-authored with Don Moore, called *Judgment in Managerial Decision Making*. The book is now in its eighth edition and is going strong.

The second area of research is in negotiation—and I think there would be little dispute if I suggested that Max is the best teacher of negotiation in the world. By the way, I got a taste of it when we negotiated his appearance today!

Finally, he has done some very important work on ethics. One of my favorite papers is about goals: not only considering their upside, but also acknowledging their downside.

He is the author, co-author, or co-editor of 20 books, including *The Power of Noticing*, which directly addresses our theme today.

Max is an engaging instructor, as you will see shortly, and someone from whom I have learned a great deal.

Please join me in welcoming Professor Max Bazerman.

Max Bazerman: Thank you, Michael. And here I thought he did so well in the negotiation about being here [Laughter]. I always find the beginning of a talk the most awkward part. So what I do is I always have a hundred-dollar bill on me. Actually I have a few of them because I use these, because I run auctions, and what I auction are hundred-dollar bills, and that's what I'm about to do.

So in a moment or two, if you like, you can participate in an auction. Some of you already do participate in auctions, and you know that the rules are important. So, let me tell you about the rules before the auction starts.

First one is that silence is in effect starting now. After the auction is over, if you want to yell and scream, interrupt, that'll be just fine but not during the next ten minutes.

Second, this is for real money. If you win money from me, I pay you. If you lose money to me, I fully expect to collect. So, please do not enter the auction under the assumption that we'll call off the money part.

Rule number three. If there's a first bid, it must be five dollars. Bids go up five dollars at a time. So don't try to start the bidding at \$12 because I won't accept that. That would violate rule number three.

And rule number four says you can't bid twice in a row. You can't be the five-dollar bidder and then also be the ten-dollar bidder. Some of you are wondering why would you want to. That's a topic for an advanced lecture. For now it's simply a rule of the auction. If you bid five and someone else bids ten, you could potentially be the 15-dollar bidder, but you can't be five and ten.

Rule number five, standard rule of most auctions. Highest bidder gets the hundred for his or her bid, but the second highest bidder, under rule number six, has to pay his or her bid, and he or she will get absolutely nothing in return.

So if the bidding went five, ten, 15, 20, and nobody bid 25, the 20-dollar bidder would get the hundred for 20 dollars, earning a nice 80-dollar profit, but under that story the second highest bidder would owe me 15 dollars and get nothing in return and suffer a 15-dollar loss.

So I remind you, silence is already in effect. Real money. Bids start at five dollars and go up five dollars at a time.

Can't bid twice in a row. Highest bidder gets the hundred for what he or she bids. Second highest bidder owes me his or her bid and gets nothing in return.

So I remind you that silence is already in effect. Real money. Bids start at five dollars and go up five dollars at a time. Can't bid twice in a row. Highest bidder gets a hundred for what he or she bids. Second highest bidder owes me his or her bid and gets nothing in return.

Do I hear five for a hundred? Got five. Do I hear ten? Got ten. Do I hear 15? Looking for 15. I've got 15. Do I hear 20? Got 15. Do I hear 20? I got 20. Do I hear 25? I got 20. Do I hear 25? Twenty-five. Do I hear 30? Looking for 30. I got 30. Do I hear 35? Looking for 35. Thirty-five. Do I hear 40? Do I hear 40? I got 35. Thirty-five going once. Do I hear 40 anywhere? Forty. Do I hear 45? Do I hear 45? Forty-five. Do I hear 50? Do I hear 50? Fifty in the corner. Do I hear 55? I have 50. Do I hear 55? Fifty going once on my right-hand side. Do I hear 55 anywhere? Fifty-five. Do I hear 60? Do I hear 60? I got 55. Do I hear 60? Fifty-five once. Sixty. Do I hear 65? Do I hear 65? Sixty-five. Do I hear 70? [laughter] Do I hear 70? Do I hear 70? Sixty-five once. Seventy anywhere. Seventy. Welcome to the auction. Do I hear 75? [laughter] Do I hear 75? Do I hear 75? I got 70. Do I hear 75? Seventy-five. Do I hear 80? Do I hear 80? I got 75. Seventy-five once. Do I hear 80? Seventy-five twice. Eighty. Do I hear 85? [laughter] Do I hear 85? I got 80. Do I hear 85? Eighty going once. Eighty going twice. Do I hear 85? Eighty-five. Do I hear 90? [laughter] I got 90. Welcome to the auction. Do I hear 95? I got 90. Do I hear 95? Ninety going once. Ninety going twice. Do I hear 95? [laughter] Last chance for a profitable bid. You're on the hook for 85 bucks. Do I hear 95 anywhere? Going. Ninety-five. [laughter] Hundred. I've got 100. Do I hear 105? [laughter] Hundred going once. Do I hear 105? A hundred and five. [laughter] Do I hear 110? Do I hear 110? Do I hear 110? One ten. Do I hear 115? One ten going once. One ten going twice. Do I hear 115? Sold for 110. And I just want you to know that I got \$105 from an investor who outperformed the market 15 years in a row.

Question: Has it ever gone for less than a 100?

Max: We'll come back. The answer's no. Never. I thought it was going to happen today, but no. I'm going to come back to all these questions, and then if I don't answer your question, we'll come back to it, but first I want to tell you about this problem.

You're company A. I'm company C. I am listed on a major stock exchange. My market capitalization is a billion dollars. I've announced that I am for sale. I'd be happy to be acquired by another firm at some price in excess of a billion dollars.

And the analysts have already quickly analyzed that there is synergy for both A and B because A and B are currently co-leaders in my industry and being the leader would be a strategic advantage. The estimated value of that synergy is \$200 million. That is, while C is worth a billion as a standalone, C is worth 1.2 billion if owned by you, company A, or if owned by company B.

The problem is that if A or B were to acquire C, the company being left out of the deal would suffer a strategic disadvantage by no longer being the co-leader and by becoming the number two player in the industry.

You are company A, and the question is, what would you do? Now in the interest of time I'm going to short-circuit this because I want to get back to the questions that were asked about the earlier slide, but I will tell you that when I solicit bids, the most common thing I hear is, "I'll offer you \$1.1 billion." And all I want you to think about now is, "What will be due?" And the quick answer is, they'll bid 1.2. You'll bid 1.3. And now we're going up to 1.7, where you'll both suffer a half a billion dollar loss, and you'd both be better off not bidding.

Now, I ran a 20-dollar auction in dollar increments for many years. I moved to hundreds because you're a special audience. [laughter] I ran 20-dollar bill auctions back in the '80s. But it was in November 1995 when I wrote this

slide. And the story was US Air, who was worth a billion dollars with rounding, did announce that they were for sale, and the business press did speculate that United and American were the obvious bidders.

And I don't know the \$200 million number nor the \$500 million number, but all I need is for synergy to exist for a small number of players, and for the loss to a party being left out of the deal to be larger than that synergy to create a dynamic where we can predict that if bidding does occur, the winning bidder is going to pay more than it's worth to them. And their own stock price will go down on the acquisition. So, we can identify the competitive environment in which this is likely to occur.

Now, Robert Crandall, the CEO of American, decided to send a memo to his 118,000 employees that basically said American is not going to be the first to bid on US Air, but if United made the mistake of doing so, we would be forced to protect our position in the industry. There's some chance that one out of those 118,000 memos made its way to United. [laughter]

We'll skip the antitrust politics here, but it's certainly argumentative whether or not that should be allowed. But there was good reason to know that it would be allowed, and for multiple years there was no bid on US Air. I won't go through the history in 2000, as well as the more recent history on bidding for US Air, but back in 1995 Crandall came up with a means to communicate: "Not only am I not going to bid, but you shouldn't either."

Now, I ran about 400 auctions for a 20-dollar bill, I've run over 100 auctions for a 100-dollar bill, and the quick answer is my auctions have never ended below 100. I don't know whether Michael was rescuing me by bidding in the auction [laughter], but things were slow, but I wasn't nervous. Once I have five and ten, I pretty much know I'm going to 95 and 100. And that's actually something that I want to talk about in some detail because normally in a group this size, and my guess is a lot of you . . . so how many of you have seen this auction before in some version?

And I think that that may have slowed down the auction a little bit, but I often have more enthusiasm to bid in the 5 to 60 dollar range, and often people don't do what I think of as appropriate analysis, and it has to do with noticing something that never happened. What I'm referring to is if the bidding went 5, 10, 15, and you're about to bid 20, what I would argue is that before you bid 20, you should be thinking about the question of if nobody new bids, what's the 15-dollar bidder going to do?

Is she going to quit or bid 25? And if you go through that mental thought, you'll quickly conclude that she'll bid 25. The 20-dollar bidder will bid 30. The 25-dollar bidder will bid 35, and I think I'm going to get up to 95 and 100 hundred every time I do this for the rest of my life.

Now, perhaps a secret of investment success is to know when to quit. Because in many cases, my 95-dollar bidder and my 100-dollar bidder will continually invest ten dollars more to avoid coming in second. And if I get that going, we can go higher to 115, 120, 125, 130, and if we can clear 200, what I can tell you is my bidders get mad at each other. [laughter] And so far in my 100-dollar bill era, I've had four auctions that have gone to a thousand where I've offered those eight people out for 800 apiece, and so far they've all taken it. That's a very good deal.

But what I want you to notice, that in this story, as well as in the 100-dollar bill auction, you need to notice, you need to and you can notice, information that hasn't happened. Can I anticipate the decisions of other parties?

Michael in his introduction this morning talked about thinking about the fact that if you're buying, someone must be selling. Do I know something that they don't know? So often we fail to think about what other parties know. We fail to notice that there's information available by putting ourselves in the shoes of others. And I think that that's something that we want to do more often.

I'm up here talking about noticing. I wrote a book called *The Power of Noticing*, and a lot of people find that

funny, particularly a woman by the name of Marla. Now I've been married to Marla for 36 years, [laughter] and she would be happy to clarify that I am terrible at noticing. A lot of people write books about what they are really good at. For me this is a self-help effort. [laughter] I've been working on this for a quite a while, and I still have some work to do.

But I do want to convey to you what I think noticing problems look like. And I'm going to start by telling you about what I honestly view as my most important noticing failure.

I'm predicting some of you are going to treat me with benevolence and suggest that it was nothing terrible. It bothers me to this day. So, a little bit of background. I'll try not to bore you with too much legal history. But in 1999, the Department of Justice filed a lawsuit against the entire tobacco industry. And it was filed under something called RICO statutes.

RICO are a set of laws having to do with racketeering. They were created to go after the mafia. And we probably have lawyers in the room. By the way, I'm not a lawyer. So anything that I say that sounds legal, don't take it seriously. So, RICO was created to go after the mafia, and under RICO laws you need to prove both fraud and a conspiracy across organizations to commit fraud. The reason that the Department of Justice might file something under RICO rather than just a fraud case is that the powers for punitive remedies under RICO are potentially far more serious than under a standard fraud case.

And in this case, in 1999, here were the alleged frauds. And what you'll generally notice is they take the form of doing something bad while publicly denying that you're doing so. That creates a fraud. And there's also an allegation that this was done through a conspiracy across the entire tobacco industry. Again, I'm not a lawyer. As of 1999 I knew little about that.

2004, the trial actually starts. February 2005, the DOJ litigation team thinks that they're winning the case. And an appeals court ruled that the trial could continue, but the DOJ could not pursue its main remedy. And the main remedy that it was seeking, which at least the litigation team was serious about, was \$280 billion to pay for all the costs incurred by the U.S. government as a result of these frauds. Basically, healthcare costs.

But a court ruled that RICO is a future-oriented set of laws, not a backward, punitive set of laws. So, that was an inappropriate remedy to pursue. So, the DOJ found itself thinking it was winning the case but being told you can't have the penalty that you wanted.

So, on March 10, I was contacted by the Department of Justice. I'm an anti-tobacco guy but no expertise at this point. I was hired having to do with some work that I had done on audit firms and other organizations. I was hired to basically assess the likely psychological decisions of tobacco executives in the future and to offer an alternative remedy to the court given that they couldn't go after the \$280 billion.

And my testimony concluded—by testimony, I mean my expert report as well as the written direct examination of the DOJ to me—my testimony concluded with the argument that absent significant court intervention, misconduct would continue into the future.

And I recommended, based on the assumption that the DOJ had proven liability—I said that line like a zillion times because I was repeatedly reminded it was not my job to prove the case, only to recommend remedies—that the court should appoint monitors to the tobacco companies to consider appropriate structural changes not limited to but including removal of senior management. This is not a good recommendation if you wanted to be popular among the tobacco senior management. [laughter]

So, this is in writing. Here's a quick history of what was going on. I was hired on March 10. Busiest year of my life before I added this work. Filed an expert report on March 21. I was deposed on April 10th. For those of you who don't know deposed: ten people line up across from you and they take turns asking you questions, and you

Max Bazerman

Harvard Business School

have to answer them all. Mid-April, submitted written direct testimony. I'm going to skip number five for a second and tell you that I was scheduled on May 4 to show up in a court where the tobacco lawyers would be cross-examining me—some of the best legal minds in the world.

And I showed up on April 30th to prepare with the DOJ lawyer who was in charge of my testimony. He was a young, earnest, brilliant guy. And when he met me on March 10 he called me Professor Bazerman. And I said, "I'd rather you call me Max," and he said, "I'll try, Professor Bazerman." So, it took him a couple weeks, but after a couple weeks, by late March he called me Max and continued with Max for the next month.

But I show up on April 30 at the Department of Justice to prepare for my May 4 testimony, and he sits down across from me and he says, "Professor Bazerman," and my ears noticed this. He says, "Professor Bazerman, the Department of Justice requests that you amend your testimony to note that it would not be relevant if any of the following four legal conditions existed."

He then read me a bunch of legalese that I wasn't even close to understanding, and then said, "Do you so amend your testimony?" and I said, "Now you know me well enough to know I didn't even understand what you just said, and that if I did understand what you just said, I'd say no. So why would I possibly say yes?" And he said, "Because if you don't say yes, there's a good chance my superiors will be removing you from this case before you testify on Wednesday."

So at this point I had spent 166 of the eventual 214 hours on this case, and having to do with a marital dispute having to do with how much time I spend working, I had already publicly committed that I was donating 100 percent of my earnings as an expert witness to charity. So I had spent 166 hours of time on this case. I cared about this case. And I said, "Okay, I don't amend my testimony," and he smiled and said, "Good. Let's prepare in case you're still in court on Wednesday."

Now some of you are confused at this point in the story, and I want to clarify that I was at least that confused [laughter] as I heard this request from a Department of Justice attorney who I like and respected. I also mentioned life was busy, and I was not taken out of the trial. So, on May 4, I did appear in court. I showed up in court and, by the way, I do a moderate amount of external work. Not in this capacity. This was the third expert witness case of my life. I don't really like this kind of work, but I was doing it.

I show up on May 4. The judge comes in. People stand up, et cetera, and the first thing I hear from the tobacco attorneys is, "Before the witness takes the stand, we would like to submit a Daubert challenge." Now, again, for the non-lawyers, don't get your legal advice from me, but as I understand it Daubert are a set of laws to keep junk science out of the courtroom.

So, you could file a Daubert challenge because someone said, "I read the stars last night, and I can tell you he's guilty." A Daubert challenge could be based on the fact that the person's field of expertise is not a legitimate science, or because they're not an expert.

On hearing that, the DOJ team immediately jumps up and says, "Are you questioning his field or his expertise?" and the answer to that is both. [laughter] So the judge says, "Okay, life is a little bit busy here. I'm not going to rule on the Daubert challenge. We're going to get busy. Since he's here we're going to hear his testimony, but by Friday you each need to submit five-page briefs to me on whether or not the Daubert challenge should be upheld. Welcome to court, Professor Bazerman."

So that's my welcome to court. I'm cross-examined all day, and as soon as court ends I see the DOJ attorneys, and they basically said, "Okay, let's get busy. We need to file a brief on Friday."

The next two days I'm working nonstop to basically say my field of expertise is a legitimate science and I'm not a complete idiot. The judge rules I'm not a complete idiot and it's a legitimate field. All right. And then I get busy

preparing to help the DOJ cross-examine the expert witness who's going to show up to say I am an idiot.

So this is kind of life, and I need to get back to my Harvard job. The trial ends in early June, and I move forward with life. Now I want you all to think about that April 30 episode and stew on that in the back of your mind for just a little bit. I'm going to come back to it. And instead I want to give you an investment problem because I can really use some investment advice, and this seems like the right crowd to use. You said I could get free investment advice while I'm here. Right, Michael?

Now, what you'll see in blue is the S&P 500 over the last nine years. And what I want to know is, which of these four investments should I put my money in. I'm going to put my money in one of these four funds. So, if you have other plans, I doubt you're an index person, but if you're an index person, don't tell me about indexes. I want your help on picking between these four funds.

One is the Tobacco Trade Investments fund, for those of you who are bold and brave despite the story I was telling you. Another is this rusty orange Alpha fund. Then we got that spiky Power Trade fund, and finally we have Fortitude. And despite the fact that you might not want to, I'm going to strongly request that everyone in this room pick one of those funds, and we'll find out which one you pick by hand-raising. Everybody ready?

How many of you are going to be bold and go Tobacco Trade? I've never seen so much interest in Tobacco Trade. Alpha? Power Trade? Fortitude? Okay, Fortitude won. Everybody saw that? Next question. What's wrong with one of these funds? Yes, sir.

Audience Member: Fortitude's a fraud.

Max: Fortitude is a fraud. I showed you the last nine years of Madoff's returns. And this is the most elite group I've ever showed this to, but I've shown this problem and lots of different variations to many audiences, and what I want to highlight is the question: "What should I invest in?"

And I understand you're not given enough information, enough time, et cetera, et cetera. But the question, what should I invest in, leads to a focus of return and low volatility. And my guess is that if I gave you each a 15-minute assignment to think independently about what's wrong with one of these funds, the vast majority of you would tell me Fortitude's a problem.

You cannot dramatically outperform the market with absolutely no volatility over a nine-year period of time. We all know that that's not possible, yet that's exactly what Madoff provided. And there were hundreds of people who had access to this data who just didn't notice.

My colleagues, Ann Tenbrunsel and David Messick, have a term called ethical fading, where ethical fading refers to the fact that in so many business decisions there are ethical aspects to it. But because we're focused on other dimensions, we're not thinking about the ethical dimension involved. And perfectly good, nice, honest investment advisors could have been recommending Madoff despite the fact that they had the knowledge and the clarity to know that that wasn't possible.

A simulation that I use in the classroom all the time, I'm going to give you the four-minute version of a three-hour learning experience. This is a chart from a case called "Carter Racing," written by Sim Sitkin and Jack Brittain. I think it's one of the great pieces of business school pedagogy that exists.

The basic problem is: you're racing a race car, it's a half hour before race time, and it's very cold. It's going to be 40 degrees at race time. And of the 24 races this season, you've had engine problems in seven of them. And here are the temperatures for the seven races with problems. You'll notice that at 53 degrees we blew three gaskets, not just one, and students are asked, "Are you going to race or not?"

Now, the way this case is presented, is if you race and you come in the top five, great things are going to

happen. If you blow an engine on national TV, you're out of business. So, a high stakes race today. And as students are reading the multipage version of this, I repeat three times: "If you need any additional information, please let me know."

Very few people ask for additional information. After they make their individual decisions, if I want to kill some more time, I send them off in groups to make the decision, and there's often discussion about whether or not temperature is related to engine failure.

It's rare, but about one out of a hundred people asks a pretty obvious question, because if you wanted to know whether temperature was related to engine failure or not, would you want to look at the failures, the successes, or both? That was an easy question. The answer is both.

And if you asked for the temperatures for the other races, here they are, and I have a sheet of paper waiting to give them. And if you go from the fact that these are on kind of different maps and you combine the 24 races and look at which ones have failures and which ones don't, now a very different picture emerges where it looks like cold is a problem, and it's 40 degrees today.

For those of you who like this kind of presentation, this makes it pretty clear as well. Now, the disturbing part of "Carter Racing" is that Sim Sitkin and Jack Brittain wrote this simulation to be as close as possible while hiding the fact that this is about the Challenger disaster, where Morton Thiokol and NASA argued the night before about whether O-ring failure was related to temperature, and they only looked at the seven failures, or seven launches where they had some problem. And, despite having very smart people in the room, nobody bothered to ask for the other 17 data points.

Now, this is getting a little technical, but for me it raises a fascinating question of: have you ever been in an important group meeting where someone presented a PowerPoint presentation that guided the information that the group used, and you never even asked for the data that you would actually want in order to make the most appropriate decision? I'm guilty of that. I think that there are people who can manipulate what information we pay attention to and what information we don't pay attention to.

This afternoon our last speaker may be the world's expert at that very topic of how to get you to pay attention to some information and not pay attention to other information. So I'll wait for him to talk about this in more detail, but what I want to suggest to you is every time you're in a meeting for the rest of your life and someone's organizing the data in front of you, have in the back of your mind: if this is an important decision, what data would I actually want to have rather than what information did someone choose to put in front of me?

Now, I've delayed you a little bit from that April 30 moment where I was asked to amend my testimony, and I was confused, and I didn't really know what was going on. If there was something going on, I didn't know exactly what to do about it or who to call, and I think I'm guilty of what many of you are guilty of, and that is when something's off but you can't figure out what it is, you go back to solving problems that you know how to solve.

So what happened next was life moved on. The trial ended in early June. On June 17 I was sleeping in the early morning in a hotel in London, England. I was there working with a corporate client. I woke up at five a.m. with that kind of, "I can't believe I'm so alert and it's five a.m." kind of feeling that you've all had. And I opened up my computer and I turned to *The New York Times* web page. And on the front page of *The New York Times* was an article about a guy named Matthew Myers.

Now at the time of this story I knew about Matthew Myers. I had never met him. I now know him. At that time and still today, Matthew Myers was and is the president of Tobacco-Free Kids, one of the leading anti-tobacco organizations in the country. And he had also been an expert witness for the Department of Justice in this case

against the tobacco industry.

And what the article said . . . and you can find this, June 17, 2005 . . . was that Myers came forward with an accusation that the Department of Justice, going up to the number two official in the Department of Justice, had attempted to corrupt his testimony. And specifically he was asked to amend his testimony to note that it would not be relevant if any of four legal conditions existed.

And I'm reading this, thinking, boy did I blow it on April 30. It still wasn't clear to me what I was supposed to do, but nothing seemed like the wrong answer at this point. There was something wrong going on at the very highest levels of the U.S. Department of Justice, but it's 5:00 a.m., midnight in D.C. and Boston.

So I called Marla. Marla knew more about D.C. at that point than I did, and I said, "Wake up. This is important." I told her what I just kind of told you. And I said, "I think I'm supposed to do something. I have no idea what it is, and long before Washington wakes up I need to go work with my corporate client. So can you figure this out for me? I'll call you when I get back to the hotel this evening."

Now she was probably still in a groggy state and said okay. So, I go off and work. Come back to the hotel 12 hours later, five p.m. I call Marla, noon Boston/D.C. time, and I say, "Hi Mar. What's up?" She says, "We can't talk long. Louis Clark, the president of the Government Accountability Project—an organization that represents whistleblowers—he's your attorney. Here's his number. Call him. As soon as you're done talking to him, write down this number too, Max," and she gave me a second number. She said, "That's the telephone number for *The Washington Post* reporter who will cover your story," and all those things occurred.

I called Louis Clark and he represented me in this matter. And then I called *The Washington Post*, and they covered the story. But many of you would have been pretty comfortable with the notion that I said no to the request to amend my testimony. What else was my responsibility?

And my reaction is when something this strange has happened, it was my responsibility as a professional to go figure it out. And I didn't because I was overwhelmed and I was busy, and what Marla had demonstrated between nine a.m. and noon on June 17th is it wasn't that hard to figure out how to find the right people to talk to. She made a few phone calls to her lawyer buddies in D.C. and basically outlined a course of action.

I think that that was my job to do on May 2. April 30 is a little tough, it was a Saturday. But by May 2 it was my job to have this figured out and to have taken action to identify a situation where corrupt behavior was occurring at a fairly high level of action. I'd like to be a little bit more like Matthew Myers in the future.

There are lots of opportunities to notice that I think we should do a better job of. So, Iris shared with you our study, which is one of the most interesting studies that I've ever worked on. Now I want to share with you the most conceptually trivial result of my career. So here it is. I'm going to try to present it in an interesting way, but it really is conceptually trivial.

All right, so as background, there are two kinds of promises that we often do. Before we take the stand in a court of law: I'm about to tell "the truth, the whole truth, and nothing but the truth." And the other way we often make promises is we fill out a form, and at the end we sign it.

There are two differences here. One is that one's oral and one's written. But the other difference is one occurs before you provide the information and one occurs after you provide the information. Now, I don't want this kind of confound, so I want to change it to both are in writing. You're about to fill out a form.

Let's imagine that it's a form for something that you wouldn't lie about in massive proportion, but maybe you would exaggerate how big that office in your home is to increase the tax deduction. So we're talking about things where you probably know people who might commit these exaggerations. And I want you to imagine that

you are a government, and you would like people to tell the truth rather than engage in behaviors that would reduce their taxes below the true amount that they owe.

Here's the mental question for you. If you wanted people to tell the truth, does it make more sense to have people fill out a form and then sign saying I told you the truth? Or does it make more sense to have people start the process by signing a form saying I'm about to tell you the truth? So, to maximize honesty should you sign first or sign last? On the count of three, yell out "first" or "last." Everybody with me? One, two, three.

Audience: First.

Max: There we go. That was a demonstration of how conceptually trivial this is. Most of you don't have PhDs in social science, and you had no problem getting that question exactly right. And you had devoted a total of four minutes to think about this problem. So my colleagues and I had people solve math puzzles, and the problems come without the red circles—that's to keep you paying attention to me rather than trying to solve the puzzles.

The question is, in four minutes, in how many of the puzzles can you find the two numbers within the grid that add up to ten? We pay you a dollar a piece to do that. So we have people try to solve these puzzles, and after they solve the puzzles we have them report how many puzzles they solve. And we have them think that we'll have no way of knowing how many puzzles that they solve, but we have some sneaky ways that are moderately honest to [laughter] actually find out.

Specifically, if you want to know how we would do that, one irrelevant number is changed so that we can identify the person's form, but then they throw it into a bin with lots of other people's puzzles. So we can go in and get it later and find out the true answer. [laughter]

But they fill out a form, and they tell us how many puzzles they solved, and we pay them based on what they tell us. This is going to disappoint you, but some people lie. [laughter] Interestingly, they tend to not lie by an enormous amount. They lie by a little bit. It's kind of like they included the puzzle that they got wrong, but they think it was just a typo. Or they include the puzzle they were about to finish solving, but they didn't quite get to it.

A lot of people lie by one to three puzzles. What's interesting is that when we move the signature from the bottom to the top, we reduce cheating by 50 percent. Fifty percent reduction in cheating by moving the signature line. And we now have knowledge that it works on reporting your odometer reading with insurance companies, another place where people lie by a little bit.

And it works on Guatemalan taxpayers—not by 50 percent, by one to two percent. But if we can change the signature on the form and get an extra one or two percent on tax collection, that's a pretty good deal in terms of the trouble. What I want you to notice about this is that we've been getting it wrong for decades. There's stuff to notice. And if we can seize on the opportunity to notice what's wrong, we can make changes that can make us more effective.

So what can you do to be a better noticer? The first thing I want to encourage all of you to do is to put it on your agenda to become a first-class noticer. Warren Bennis. Some of you have read his books on leadership. Warren passed away last year, but among the many very interesting things that he wrote, he talked about a Saul Bellow fictional character by the name of Harry Trellman, who he described as a first-class noticer. And he argued it's a job of leaders to be first-class noticers, and too often leaders don't notice.

So, the leaders of the United States did not notice that there were an increasing number of people who hated America, who were willing to become martyrs for their cause, who had plans to turn an airplane into a missile aimed at the Eiffel Tower in 1994, who had plans to hijack 12 U.S. commercial airplanes in Asia on the same day in 1994, and that you could board airplanes with small items that could be turned into weapons. And when you put those together, I would argue we would want our leaders to know that we should have fixed airline

security long before 9/11 occurred.

Similarly, when we create an accounting system where we require firms to have external auditors but then we create incentives for the auditors to want to be rehired, to want to sell consulting services, and to want to take jobs with the firms that they audit, we know enough about psychology that when people don't want to see data, they're likely to not notice it. And we've created an industry in this country called independent auditing where the one thing that I'm very confident they can't provide is independence. Because auditors want you, the client, to be happy.

So we want to put it on the agenda of leaders to become first-class noticers. We want people to realize that when you're in the midst of the crisis, that's not the best time to notice information on the periphery. So we want to plan in advance. We want to be able to take an outsider's perspective. We want you to audit your organization and ask: are you creating the conditions under which you can expect your employees to notice critical information? From the prior study, this is number three, and this is the other number three. I'm noticing I'm doing a better job than I did before I proofed it.

We want you to realize that when something's wrong, it's your job to go figure it out as opposed to moving back to things that you know how to solve. This is my fundamental issue that I think I got wrong in the tobacco story that I told you. You want to identify predictable surprises.

And Michael alluded to this before. I would encourage all of you to think about whether or not there are problems in your organization that if left unattended will only get worse, yet you're ignoring those problems. And if the answer is yes, what are the barriers, and how can you get busy on these?

I think 9/11 was a predictable surprise. I think that Enron was a predictable surprise. I can't tell you that I wrote about airline security before 9/11. I can tell you that I wrote about the impossibility of auditor independence under current legislation long before Enron exploded. We can identify the conditions where bad things are going to occur, and I think that executives need to do a better job of doing that on a regular basis. Okay, now I short-circuited all that intentionally.

I also want to show you this picture of a young man. A few things I want to show you about this picture. One, notice that hair, that head of hair. [laughter] It's a full head of hair. Very thick glasses. This photo's a few years old. This is a fabric. Only the older members of the audience would know it. It was called Qiana. It had a slippery feel to it, so if you spilled anything on it, it would slide right off. [laughter]

And the last thing I want to tell you about this photo is that this is me. I'm guessing age 17. I'm playing in a bridge tournament. By the age of 20 I was a very, very, very good card player, both a highly-ranked tournament bridge player but also a gambler. And this picture is part of my defense of why I'm such a lousy noticer because I spent a lot of my time between 15 and 22 playing cards.

And when you're playing cards, either for significant stakes or in a competitive tournament environment where you want to win, you basically want to pay attention to 52 cards and the behavior of the other players. Everything else is a distraction. Everything in the environment, what's happening in the room, if you're paying attention to that, you're using cognitive energy that you could be placing on coming up with the right strategy with the 52 cards and the other players. I think that focusing rather than noticing is a really good strategy for being a good card player.

Now the next thing I want to highlight is the fact that leadership looks very little like playing cards. It is the job of leaders to identify information in the periphery that nobody told you is part of the problem. Your problems do not come perfectly specified. You do not know who all the players are. You do not know what all the tools are. And so often we make analogies from games to corporate life, and I think we're often missing a critical aspect of

Max Bazerman
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noticing information that's out there on the periphery.

All right, so this is Max as a 17-year-old. Could be 18 but I think 17. And it's really been the last dozen years that I've been trying to go through this noticing reform effort to become a reasonable noticer. It's a hard problem. I can report some success, but the success is limited. I want to highlight the limitations of my efforts by showing you a video. But before we start it I want to describe to you what's occurring.

First of all, this video was not made by Chris, who you'll be hearing from this afternoon. On the other hand, it's very clear that his work is the very clear flowchart of what you're about to see. So Chris deserves the intellectual credit with Dan Simons on what you're about to see. What you're going to see is the reception desk at a conference that was hosted by the Behavioral Insights Group that Iris and I directed at Harvard.

And I'm simply showing up this day. I think I'm the second character you'll see show up at the registration desk. Keep your eye on the woman who's registering the participants, the folks showing up. There are a number of well-known scholars who are showing up who are experts in social science. We're going to see them show up and get their folder for the day's events. I think that that'll give you enough to follow the video. Can we start that video, please?

[Video clip]

Max: That was Cass Sunstein by the way. Francesca Gino.

[Video clip]

Max: So in the defense of my colleagues and of myself, this might be in the category of things that we did not need to notice. But on the other hand, it does bother me. So I don't think I mind not noticing the switch. Other than, if I was paying enough attention to the person who was nice enough to be registering me, perhaps I would have been more aware, and I would have been more in the moment.

And I think a lot of us who are made fun of in that video would like to think that we notice more important things. We just don't quite know if that's right. And with that I want to open up the floor to your comments and your ideas. Yes, please.

Question: One question actually just about that. Have you tried anything like that with non-academics?

[laughter]

Max: Chris, you want to answer now or later?

Question: I mean, I know the gorilla study . . . But actually, *that* specific experiment with humans. Because I wonder if on the spectrum, academics are actually more inclined not to actually connect with other people and notice them.

Michael: Max, Apollo [Robbins] did it for his show too. Let's get the mic in front of Apollo Robbins. He can . . .

Max: So, I'm more used to hearing this question about college sophomores, and I often highlight that they're people too, which is controversial. Apollo.

Apollo: Chris's partner, Dan Simons, we did a show that was about just over an hour for National Geographic, and it was specifically a focus on paying attention, and we did it in Las Vegas. That's not to say that everybody was drinking there which would be the other equation. People say, "Does that only work on people that are in Vegas drinking?"

So, it's always contextual to whatever that subgroup of those people are. But generally it's exactly the point of what you were saying with noticing—across demographics, across cultures. I think one question that might be

interesting to tag on to what yours would be is, I've heard some studies that sometimes there's cultural differences of foreground and background, in priorities, does a foreground draw less with Asian cultures, that they appreciate everything on the same spectrum. There's a lot of questions in those areas. But generally people pretty much behave the same. It's more about what they're thinking about versus what they're actually seeing.

Question: Well, the real question I had was actually about when you were talking about noticing and you talked about 9/11. The obvious example for people in this room is the financial crisis. And one of the things you sort of alluded to but didn't really talk that much about in there is incentives, and I was wondering if you could speak some—I mean, with the auditing obviously that is all about incentives—but when you think about the decisions that banks made in the run-up, clearly a lot of that had to do with the fact that there was not an incentive in some degree to notice. In fact, there was arguably an incentive *not* to notice. So I'm just wondering if you could speak just about the role that incentives play inside organizations in terms of maximizing noticing.

Max: Okay, I think I heard about four questions, and I'm going to try to unpack and answer at least kind of a few of them. First of all, you're going to hear from Chris later on about particularly the visual illusions, and Chris and Dan talk about change blindness.

They also have some wonderful work on inattention blindness, and Ulric Neisser I believe came up with the term inattention blindness. Both of those terms have the word "blindness" in them. My colleagues and I who are very inspired by that work, we tend to use the word "bounded awareness." And the reason to create a new term—it's because academics need new terms of course.

But the more serious reason to create a new term is that so much of what we don't notice isn't just with our eyes. It's awareness that we need to look through the data to see things. Just a quick comment on the audit piece. And I just want to highlight that I think there are many, many honest auditors.

But if I ask you the question . . . I know that we have a lot of parents here because Iris had all the fathers of daughters raise your hands. If I asked you, "How smart is your oldest child?" I don't expect that you're going to be a great source. And the problem isn't integrity. The problem is when people want to see data in a particular direction, they're incapable of objectivity.

So I think that the leaders of the audit firms, I think that they are lobbying in ways that I find to be dysfunctional for the public good. I think a lot of the auditors are completely honest people who do want to do the right thing. But when you are rewarded for *not* doing the right thing, it affects your judgment in ways that you're not even aware of.

In terms of the financial crisis, there's a book about the people who did notice. It's Michael Lewis's book, *The Big Short*, and he identifies people who did notice. Unfortunately they did not work for the government. They basically became part of a very active short selling business. And they became very, very rich people.

But it provides some documentation that noticing is important. I think that you bring up a critical issue, and that is that so many people in the distribution chain of the investments having to do with mortgage-backed securities were doing just fine moving them on to the next layer. So that they were personally doing just fine. And even retrospectively a lot of people made a lot of money and did just fine.

That means that it becomes the obligation of senior executives to think about the systems that were created. Obviously it becomes sort of the role of government to intervene in a system where there are too many incentives for businesses to do the wrong thing. So I think that the intervention level is really senior executives of major corporations and government to fix these kinds of problems. And I think we could do a pretty similar analysis in terms of LIBOR. Yes, please.

Question: Missing in this case is all the instances where people do notice. So, it's a lot more enjoyable and

instructive I guess to learn where people don't notice, but what can we learn from where people do notice? And in particular can we learn things about individuals who don't notice sometimes and do notice other times? What's the temperature difference?

Max: Great question. It's a hard one to have a good response to. Iris and I are both laboratory experimentalists at heart, and yet we think that these messages have relevance to very real world problems that are often noisy. I can do noticing in the lab. We are studying a much more precise version of the Madoff investment task to look at a lot of those kinds of questions. We could do it in the lab.

It's tough to do it in the field for exactly the reasons that you specified. It's hard to document all the uneventful situations where executives notice that they should do something. They did something and therefore nothing happened. And that was a success. But you really don't get credit for keeping things from happening.

The most visible example of a problem that was identified—it was solved, at least according to many people—would be Y2K. A lot of people feared that Y2K was going to be an enormous problem. Money was invested. Some people would say we wasted our money. And I don't have the technical expertise to sort out those two different stories. So, I think that your comment is exactly on target. I'm not sure I have a great answer for you.

Question: Was that the full dataset, or were there a number of people who actually did notice? A *hundred* percent of the people did not notice the change? This is a Carter Racing question. Did you only show us the negative responses and there were positive responses as well?

Max: All I did was lift a video that other people had created but, Chris, do you want to answer now? What percent of people notice that kind of story?

Chris: 25 percent of the people noticed and three-fourths missed it.

Question: And then the question would be, was there a commonality in the people that did notice?

Max: I'm sure that the people who made the video I showed you did not study those people carefully. Whether Chris has or not, we'll delay that for his talk this afternoon.

Question: Why wouldn't they?

Max: Because they were trying to do something funny to make fun of the organizers [laughter] and show it as a closing element of that conference. So that was the main motivation. Social scientists, when they're running studies, are typically not going to do it in that kind of noisy environment. So it's not just that the people change, but you saw the male and then the tall person switch from being dark hair to blond hair. So, it's not the right condition to do a scientific study. Yes, please.

Question: If you're within an organization and you're trying to get a team to notice things better—and it could be something as simple as, are there errors in data to something much more complex—where should your focus be? I heard you say some things—the environment, people's habits, people's incentives. How would you guide a manager of a team to increase noticing?

Max: So, you did a good job of asking a good question, and then you started to answer that. All of the things you just listed are exactly right. What is your suspicion that something wrong is occurring? Go learn more about that, and identify what's at the root of it, but often at the root of it is, "we institutionalized a bad practice 13 years ago and nobody's ever rethought whether or not it's the right system."

So, I'm arguing that society has put the signature at the wrong place on forms for decades, and it just became institutionalized, and that's the way we do things. Lawyers tell me we can move the signature to the top, that there is not a massive legal reason why we don't.

So, we want to identify the cause, and sometimes there's a very easy structural change that can make all the difference. We want to grab that opportunity if we can. We want to think about incentives. And I think incentives have two parts to them. Incentives affect what people want to do in order to get their reward. But we also want to think about the aspects of how they will affect people's judgment in ways that aren't measurable.

In kind of any conflict of interest story where people are doing the wrong thing because of a conflict of interest, it's both bad people who are doing the wrong thing to collect more money, but it's also people's judgments are tilted in ways that they're not even aware of. So, we want to diagnose the specifics of the problem to figure out what a fairly easy intervention would be to find out how to get them to notice more.

The other thing I would say is start with the low-hanging fruit of very valuable fruit. I don't think that you need to become obsessed about noticing everything. When Marla continues to make fun of me for not noticing things that she notices despite the fact that I wrote a book called *The Power of Noticing*, I try to see the humor in it.

On the other hand, I'm actually okay with the fact that there are lots of unimportant things that I'm not going to notice. And what I want to do is have special effort for those things that are important to notice that could still easily escape my vision of the problem. I don't know if I'm answering your question or not. I'm doing my best. Going once. Going twice.

Question: I got one. Max, I want to ask you about goals.

Max: Okay, go for it.

Question: A lot of organizations, a lot of companies have specific goals. There are a lot of good things about goals. What are the limitations of goals?

Max: Some of you know the work of Ed Locke and Gary Latham and others who have written a lot about goals in the organizational behavior literature. I was at a conference a number of years ago, and somebody offered their work as a sort of testimony of a kind of great social science. I blurted out something that I think wasn't all that nice, and I basically argued that viewing the goal-setting literature in organizational behavior as a positive literature is what happens when you focus on an inappropriately narrow set of objectives.

So, we know that if you're doing a boring task in a laboratory and you give people moderately difficult, specific goals, you can do a pretty good job of increasing their performance. But Barry Staw also produced research that shows if you give people an incentive to increase the number of units that they produce, you'll also get lower quality units. So people don't perform all that well on the aspect that you don't reward.

The other thing that Lisa Ordóñez and Maurice Schweitzer and Bambi Douma find is that if you give people moderately difficult goals that they have trouble achieving, there's another way to get there. It's called cheating.

So, moderately difficult, specific goals increase cheating, and for me I'm a pretty goal-driven guy. I work hard. I want to accomplish things, but I think that moderately difficult, specific goals, if we can't capture the full array of what we want from the employee, are potentially dangerous because they tend to lead to underperforming on things that we forgot to put in the goals. And we also have the risk of an increase in cheating. And both of those effects turn out to be pretty well substantiated.

The paper we wrote is called *Goals Gone Wild* [laughter], and it got some visibility because goal-setting is a little bit like mom and apple pie. Who's against goals? And the answer is I think that we should be very concerned about inappropriately narrow goals. If we go back to some of the sort of ethical issues in the investment world, you can easily imagine how bad things can accrue over time if we focus on some narrowly-defined goals. Thank you all very much for your input.

Michael: Thank you, Max.



Christopher Chabris

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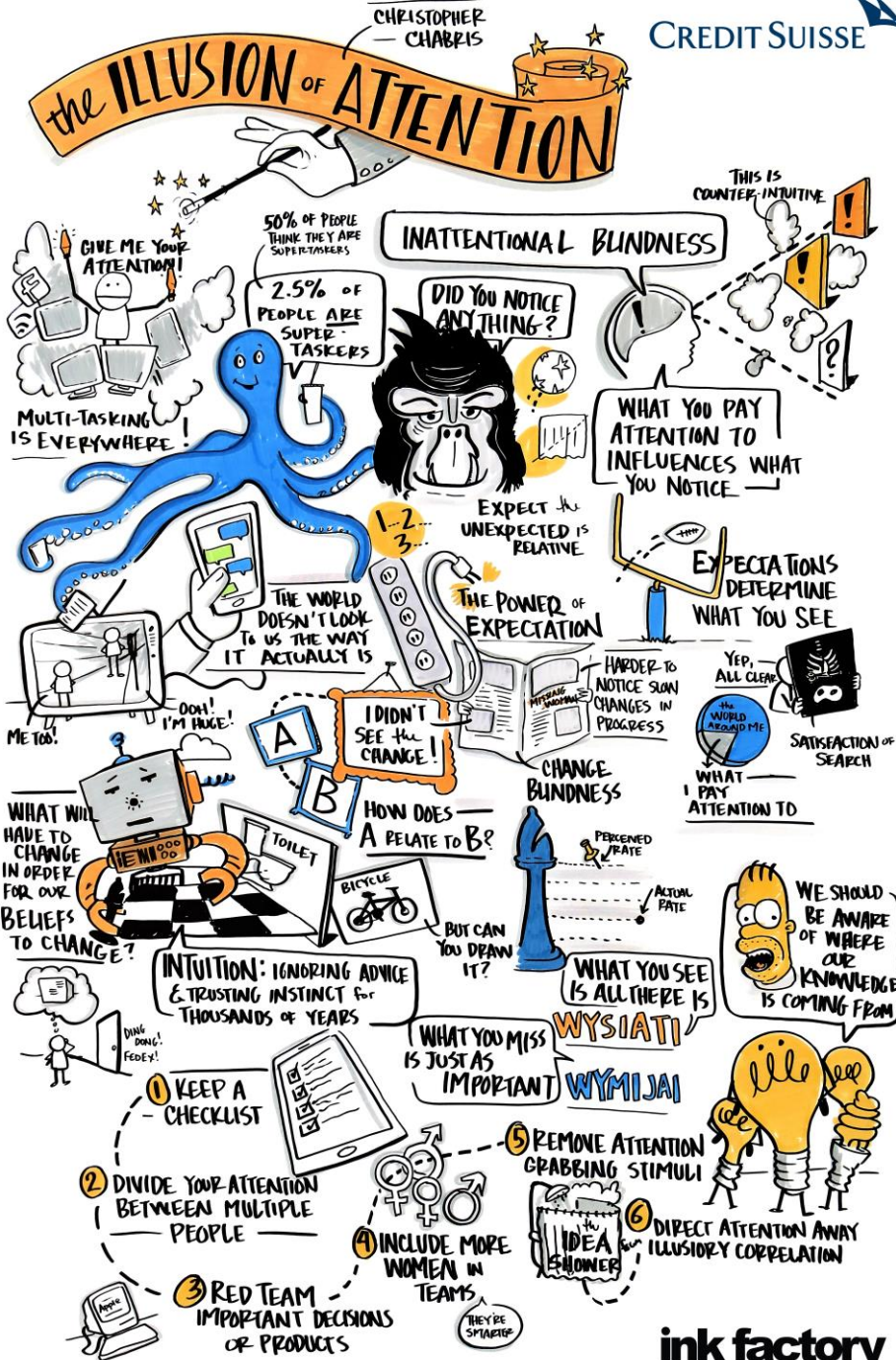
Christopher Chabris is co-author (with Daniel Simons) of *The Invisible Gorilla: and Other Ways Our Intuitions Deceive Us*, published by Crown/Random House in May 2010. This book explains six “everyday illusions,” which are intuitive but mistaken beliefs that we all hold about how our minds work. It shows how these illusions work, how we can spot and avoid them in our lives, and how relying on our intuition is a perilous decision-making strategy in law, medicine, business, politics, and other areas. Chabris and Simons are the creators of the world-famous “gorilla experiment” that shows how much we are missing in the world around us. This experiment is one of the most widely-discussed and demonstrated in all of psychology, and was covered by *The New York Times*, *The New Yorker*, *Dateline NBC*, *CBS Early Show*, *Scientific American*, *NPR*, and the *BBC*, among other media outlets. It appears in textbooks and museum exhibits, and was even discussed by characters on an episode of *CSI: Crime Scene Investigation*.

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Chabris conducts research on a wide range of topics, focusing on two general themes: how and why people differ from one another, and how cognitive illusions affect our decisions. His scientific articles have appeared in leading journals such as *Nature*, *Nature Neuroscience*, *Proceedings of the National Academy of Sciences*, *Psychological Science*, *Neuron*, *Cognitive Science*, *Perception*, *Journal of Risk and Uncertainty*, and *Social Neuroscience*. He has also written for *The Wall Street Journal* and other publications.

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Michael Mauboussin: I hope you all enjoyed lunch. It's my pleasure to introduce our next speaker, Chris Chabris. Even if you didn't know Chris before today, it's very likely that you have encountered his work through the now-famous "gorilla video." This is probably the best known study demonstrating inattention blindness — cases where you miss an obvious stimulus under certain conditions, absent any other cognitive impairment.

Chris works on a wide range of topics, but generally the work focuses on two themes: *how people differ from one another* and *cognitive illusions*. Over the years, I have had lots of great conversations with Chris, but I'll mention three areas that I have found particularly interesting.

First is the work on attention. It is astounding how much we miss in our day to day lives, as the gorilla video shows, and recognition of our cognitive abilities and limitations is fascinating and somewhat scary.

Second, Chris has collaborated with other researchers on some very cool work on teams and team effectiveness. Most of us work in teams, and you'll hear today what makes for a smart team.

Finally, Chris is a master chess player, and the lessons from chess — everywhere from how the game has evolved to the lessons from freestyle chess — are relevant for the world of business and investing.

Please join me in welcoming Professor Chris Chabris.

Chris Chabris: Okay. Well, thank you for that introduction. Thanks all for being here and coming back from lunch. I'm a cognitive psychologist and neuroscientist so I'm acutely aware that the blood's in your stomach and not in your brain right now. So, let's start trying to get it back with a brief memory test. Do you remember the name of the famous movie star that Iris showed a picture of this morning in her talk?

Audience Member: It was George Clooney.

Chris: George Clooney, right. Do you remember what he was wearing? Anybody?

Audience Member: A beard.

Chris: Facial hair, a grey jacket, and a white shirt open at the neck. So, please generalize from that example to me, apply the halo as you see fit. I'm going to talk today about the illusion of attention and a little bit at the end about how to see what we're missing and maybe overcome the illusion of attention a little bit. Let's switch over to the first slide.

I thought I would start with a picture of the environment for attention in parts of the finance world. As I found this with a Google image search, I take it that this is a pretty standard depiction of a trading floor. Look at all the people talking. There are so many screens, there's so much information to take in.

Each person has four screens. They've got a few telephones. They've got a cell phone, they've got a speaker in the wall, they've got monitors hanging from the ceilings, they've got all kinds of information.

All of this is competing for our attention, obviously. And information by itself seems to be rewarding for human beings and even for other primates. There are some very clever studies done with monkeys where they record from neurons in the monkey's brain, record electrical activity from the neurons.

They find that the neurons that respond normally to pleasurable stimuli, like water when you're thirsty or food when you're hungry, also respond to merely learning small bits of information about what's going to happen next.

For example, if the monkey is going to receive either water or juice in a very short period of time, and they're going to get that water or juice no matter what happens or what they do, they will still exert effort to find out which one it's going to be, even though that gives them no control over what it's going to be. So information by itself, even for primates, can be very rewarding. And that's part of the problem for attention in this environment.

Now, of course, I would submit that this environment is designed under the assumption that multitasking works and that people can actually multitask and correctly select the information they want to pay attention to without significantly reducing their performance. And of course it's not just finance, right?

In the modern world of medicine there are probably about as many screens if not more here, all kinds of devices, things making all kinds of noises. There are people talking, maybe five, ten people in there at once. And then of course there's the person on the table himself or herself who needs some attention paid to them every once in a while during the process.

So, multitasking is everywhere. I don't think it's quite gotten this far yet. I think this was an unmanufactured prototype, I believe, maybe from the 1980s judging by the vintage of the electronics. But technology has caught up with our needs. I won't ask you to raise your hand if you've ever done this. So, what's the problem here?

Well, the problem I think is not of course that we don't have enough hands to multitask, right? The octopus solution wouldn't work for human beings because the problem is we don't have enough brain. In essence, we don't have enough mental resources in our brain to handle multiple tasks at the same time or, even as was mentioned earlier, to rapidly switch between tasks without significantly reducing our performance.

And there are all kinds of reasons for that. Every time you switch tasks, there's a cost involved to reestablishing the mental state that's associated with the task you're switching to, and you have to switch back, and so on. Many experiments show this.

You may have heard about a line of research that suggests that about 2.5 percent of people are so-called supertaskers, which means people who can actually switch between two tasks rapidly without performing any worse than they would if they did the two tasks sequentially. I fear, however, that about 50 or 80 percent of people think they're supertaskers when in fact it's only 2.5 percent, if even that many.

Now, we don't actually need to do experiments like that to see the difficulty in multitasking. We can see it in the world all around us. For example, this is a security camera video from a shopping mall. Watch the woman in the middle as she walks through the mall looking down at her phone. Okay.

So, one lesson of this video is that pratfalls are always good for waking people up after lunch. You'll see that the people in the control room now show us the reverse angle replay, kind of like it's ESPN or something like that. So we can see what the other camera picked up of this action.

And you will see that she comes in from the right side on this next clip. Yep, she's going to come in from the right, helpfully indicated by the people filming this with their cell phone cameras. And she's going to still fall into the fountain. What's interesting about this view is that you can see what happens next. She quickly gets up out of the fountain, as we'll see—and it's extra poignant for having such a slow frame rate, it seems like inevitably time ticking forward—now she gets out and she walks into the store on the left.

And I used to wonder what store she immediately would walk into after having fallen into the fountain in the mall. And then someone suggested to me maybe she's going to buy a new phone. Because obviously the phone was so important to her that she couldn't be without it during that time, so she needs to get it replaced right away.

This is an example of the difficulty of multitasking. We have of course done research in cognitive psychology on this, as was mentioned or alluded to earlier. Dan Simons and I did an experiment about 15 years ago at Harvard University. Many of you may have seen this experiment or been a participant in it in some setting before. It was based on a study that had been done in the 1970s by Ulric Neisser, one of the founders of the entire field of cognitive psychology.

So I thought I would show you a version of this experiment. And what I want you to do is, even if you've done

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this before, I want you to try to do it again to see if you can see the effect that I'm trying to point to. As you may be expecting, you're going to see two teams of people passing basketballs back and forth on the screen. One of them is wearing white shirts and one of them is wearing black shirts. Stop me if you've heard this joke before. You're supposed to focus on the people passing the ball who are wearing white shirts and ignore the people wearing black shirts. And just count silently in your head—as Max said earlier, silence is enforced. Count silently in your head the number of times that the people in white shirts pass their ball. And then I will ask you afterward.

So what this is trying to measure is how well you are able to focus attention on a task you have been given, in this case by me. It's not a very long video, but keep your attention sustained throughout, and count the number of people, the number of times that people wearing white pass the ball. Here we go.

[Video clip]

Okay. Can I have a volunteer? How many did you count?

Audience Member: Sixteen.

Chris: Okay. Raise your hand if you got 16. Okay. Anybody get a different number? It's okay to admit it.

Audience Member: Fourteen.

Chris: Fourteen? Okay. Anybody get 15? Fifteen? Okay. Seventeen? Okay. So it's about 14 to 16 depending on your count, right? But the real question is did you see anything else besides the people passing the balls around?

Audience Member: A gorilla.

Chris: Somebody said a gorilla. Okay. Raise your hand if you saw a gorilla come across. Okay. Now be honest. Put your hands down. Raise your hand if you didn't see a gorilla come across. Be honest. Okay. So still, a few of you did not see the gorilla come across.

Now of those who raised your hands before because they saw the gorilla, all you people raise your hands again, the people who saw the gorilla. And now, keep them up if you knew to expect a gorilla.

Okay. There we go, look at that. So nobody really lowered their hand because everybody thought the guy's going to have a gorilla in the video, maybe even have seen that video before, and so on. So you knew to expect a gorilla.

For those of you who didn't see the gorilla by the way, you don't believe me, I'll show the video to you again in a second. But before that, did anybody notice anything else unusual happen besides a gorilla? Anybody? Yes?

Audience Member: Did somebody leave the stage?

Chris: Did somebody leave the stage? Yes. What kind of person left?

Audience Member: I think a person wearing black.

Chris: A person wearing black left. Okay. So, raise your hand if you honestly noticed a person wearing black left the stage. Okay. So if you look around you'll see maybe it's like five or ten percent of people noticed that. Anybody notice anything else?

Audience Member: The curtain changed color.

Chris: Yes. So, now, honestly raise your hand if you noticed that the curtain changed color halfway through. Okay, so again, like five of you or something like that. For those of you who saw the gorilla and knew to expect the gorilla, I congratulate you because you successfully divided your attention. So, it is possible to sometimes

divide attention between two different tasks. Those two tasks were doing the counting thing that I told you to do and observing to see if a gorilla shows up.

But the fact that you were expecting something to happen didn't mean that you were generally able to expect the unexpected and see all the other very salient changes that we made. This video is a follow-on made by Dan Simons, my research collaborator, for a video that we made 15 years ago at Harvard where there was no curtain change and nobody left. It was just the gorilla. And that's the video we used for our original experiments.

For those of you who didn't see the gorilla or the curtain change or the person leaving, watch it again. You have to trust me that this is the same video that you saw. I can't actually show you what keys I pressed and so on. It's the same video.

Don't count by the way just to make sure you see everything. When this has been done for TV shows like *Dateline*, they've often gotten people that accuse them of switching tapes and so on when they try to play it back and see what they missed. You can't just kind of expect the unexpected and think that you're going to see everything important that happens.

Logically speaking, you can really only expect what you expect. So, expecting the unexpected is a logically impossible thing to do. You can't just sort of be alert to anything that might happen. There's always some kind of filter and something that draws your attention more than others.

Interestingly, the slogan at the bottom of the notepads here says "Attention: Pay Now or Pay Later." So if you counted accurately and missed the gorilla, you paid both times, right? You paid attention the first time and you succeeded at a task that was temporarily important to you, at least, going along with my instructions. But you paid later because you missed something.

If you were one of those people or if you ever have been caught out by this test, it's completely normal and okay. It's not an IQ test. We actually studied that. There's no correlation between IQ and noticing the gorilla. Although, everybody who notices likes to believe that there is. I won't tell on you if you go and use it on somebody else and say it's an IQ test or something like that. I'd say wait until you see how they do before you tell them whether it's an IQ test or not.

This video and many other experiments like it illustrate a concept called "inattention blindness," which was built upon the work of Ulric Neisser in the '70s. But the term was actually coined by Arien Mack and Irvin Rock in the '90s. And it's a very robust phenomenon.

For example, people have studied tasks similar to this video using eye trackers, which measure every place your eyes look on a screen while you're doing a task. And they have found that people who don't see the gorilla actually look at it for an average of one second. So, looking is not the same as seeing. You can look at something and not actually see it, which most people find to be a very sort of counterintuitive and paradoxical fact about how vision works.

Another thing that I think is interesting about this is that it does not appear like this phenomenon is an artifact of our sort of Western, technologically-oriented culture. We watch video from an early age. We have devices. We learn to use computers. There are a lot of stimuli competing for our attention.

So, perhaps this ability to pay attention and therefore have inattention blindness for things you're not paying attention to, could be some kind of learned or acquired cognitive tic or something like that.

Well, I don't think that's actually the case. And one reason why I don't think so is that the publisher of the Korean edition of our book actually ran this experiment during halftime of an actual basketball game in Seoul, and had the video shown up on the jumbotron, and had everybody count and then raise their hands if they saw

the gorilla and so on. These are the people actually watching the video. You of course see that those two people in the middle there are not going to notice any gorillas or anything else because they're distracted by something else. But in fact, about 50 percent of people failed to see the gorilla in the original video in Korea, just the same results we had with Harvard undergraduates who were our original subjects.

We've taken this even further in more recent research. Here in the middle in the white cap is my collaborator, Corinne Apachelo, who's in the psychology department at Penn. And she goes periodically every couple of years to Tanzania and visits the Hadza people, who are a hunter-gatherer society thought to be the closest extant human population to human ancestral populations of Africa. And they don't have formal education. They don't even have permanent homes. They don't have much technology at all, although that's changing over time, of course.

But we got the exact same results with them. About 50 percent of them don't notice the gorilla. And also, more of them missed the gorilla when they are paying attention to the white-shirted people than when they are paying attention to the black-shirted people.

And the reason for that is that what you pay attention to influences what you notice. If I had asked you to pay attention to the people wearing black shirts, you would have been much more likely to see the gorilla because the gorilla shares the predominant color with the people wearing black shirts.

We have now tested this with the Shuar people in Ecuador, the Hadza people in Tanzania, villagers in India and Uganda, Zulu farmers in South Africa, and we're working to test other populations around the world.

And, so far, we think this is a universal aspect of human cognitive architecture. It's not some kind of artifact of Western technology. It seems to have fairly deep roots. So, using attention for one task or type of visual stimulation just takes it away from other things. That's just the brain we're stuck with.

So, that's inattention blindness. The "illusion of attention" that the talk is titled after relates to this, but it's not the same. The illusion of attention is the mistaken belief we intuitively have that we pay attention to and notice much more of what's going on around us than we actually do. Inattention blindness wouldn't be so bad if everyone were completely aware of it and acted accordingly and weren't surprised when they missed things like the gorilla and so on.

But one reason why this experiment has become popular is because people are surprised that they missed that thing. And that in fact reveals sort of the deeper problem—that this is a counterintuitive thing we're not aware of, and have difficulty taking account of, in our everyday behavior.

Every time, for example, you use your phone while you're driving, you are subject to the illusion of attention because you are implicitly acting on the belief that using your phone does not subtract significant cognitive resources that you might want to use for the primary driving task, which after all ought to be the primary task. Nothing you can do on your phone is probably going to bring you as much risk, or risk to other people, as what you can do behind the wheel. Well, maybe not all the time, but generally speaking, the car is more dangerous than the phone.

In fact, colleagues of ours have found that when they surveyed people who don't know about this gorilla experiment and tell them about it and say, "Imagine an experiment like this, there are these people and this gorilla and so on. Would you notice the gorilla?" Ninety percent or more of people say yes they would notice it, whereas in fact only 50 percent, depending on how you run the experiment, actually do.

That's the illusion of attention. And I call it an illusion to make an analogy with visual illusions like the checkerboard illusion that Iris showed you this morning. That's a classic visual illusion. The world doesn't look to us the way it really is in the sense that the light coming off of those two squares is the same color light, but it

looks different to us. Our brain corrects because we know that it's a checkerboard. So, it actually makes the light look different. That's a true visual illusion. And even once you know how it works, it still looks like a checkerboard to you. You can't go back into the low-level visual areas of your brain and say, "Wait a minute. Don't see that as white anymore. See it as gray." It just doesn't work that way.

Likewise, this illusion—the famous monsters in the tunnel illusion—which monster looks bigger? You said the one in the back, right? Okay. First of all there is no back. That's a flat screen up there so the back itself is an illusion. I tricked you. There are two illusions going on here. That's an illusion of depth. This is what the artists discovered in the Renaissance. That if you make a bunch of lines that all converge on one point, then we will see that as being farther away. And that creates the illusion of depth. So depth is an illusion here too.

But, also, the size of the monsters is sort of an illusion because they're actually the same physical size. I drew parallel lines connecting the same points on the two. And the objects on the screen are the same size, but our brain corrects for that and assumes that the one that looks like it's in the back is actually bigger because it's filling the entire height of the tunnel, unlike the first one.

So you can't really make yourself not see that. You can do things like sort of squint and try to focus on different parts of it and so on, but as soon as it flashes up again it looks like one of them is big and one of them is small because that's the best interpretation of the world you're looking at.

Likewise, illusions like the illusion of attention I don't think go away just from knowing about them. It's not like we've broken the spell or something like that. You may even get in your car on the way home today, pull out your phone and start texting or looking at Facebook or whatever, whatever you guys like to do. And I want to reinforce again the point that these illusions are not born of ignorance or stupidity.

So, people who are subject to illusions like the illusion of attention are not like this guy who just didn't know what surge protectors were for. This is pure lack of knowledge. Actually, he's very surprised that it turns out that it's electrical current that surge protectors deal with. And you can find this of course on the internet because this was the first question, and he went away with \$0. So he's sadly been immortalized for that.

Cognitive illusions like the illusion of attention are not like this. They're not things you can correct merely with knowledge of facts. The illusion of attention I think is also very related to the power of expectations. The way we think about expectations is often we think that things that we don't expect will grab our attention.

And in fact when we did a survey, a telephone survey of a representative sample of the U.S. population using a polling firm, we actually asked that question. And over 75 percent of people said, "Yes, if unexpected things happen in my field of view, it will grab my attention, and I will notice it."

But that's actually kind of backwards because expectations actually tend to determine what we see and what we miss, not what will grab our attention. So my favorite example of this comes from the following video. Just watch what the team in red does in this high school football play.

[Video clip]

An interesting thing about this video is of course nobody touched him until it was his own players mobbing him in the end zone. I noticed some of you applauding and laughing and so on. This, of course, the technical term for what you just saw is a trick play. So a trick play is a play that's not illegal. It technically conforms to all the rules or else it would just be an illegal play, but what it violates is all the expectations of the other team.

So, the expectations that were in the heads of the defending team determined how they interpreted what they saw or even what they paid attention to. Perhaps they didn't even notice the quarterback receiving the ball from the side of the center and just strolling through the line because they weren't paying attention for that kind of

thing.

Now, it's more than high school football where this can be a problem. Expectations can determine what we see in much more serious situations. For example, this lengthy title says, "Profiles in patient safety: Misplaced femoral line guidewire and multiple failures to detect the foreign body on chest radiography." What that means is a patient came into the emergency room in Rochester, and the patient had to have a central line put in because they couldn't get an IV in. And they needed a central line. And then they were admitted to the hospital.

And the central line guidewire was left inside their body by accident and was observed on several consecutive CT scans and X-ray scans . . . or maybe I should correct myself. It wasn't observed. It was visible on several CT scans and X-ray scans that were read by numerous radiologists but not actually seen until the patient had been there for several days.

Why was that? Well, when the radiologists were tasked with looking at these scans, they were not told look for anything you see that might be unusual. They were given a potential diagnosis. There was a reason why the woman was in the hospital. She was in the hospital because she was having problems with her lungs, and they were looking for issues with the lungs—pulmonary embolism and so on—and did not see the guidewire. This process of sort of stopping the search once you've found what you're looking for is called "satisfaction of search" in the cognitive psychology literature.

Satisfaction of search is when you have an attention-demanding search task, and you complete it, and then you stop without looking to see if there's anything else that would satisfy your search. So, if there are three things that satisfy the criteria you're looking for, you will often stop when you found one and not even realize that there were more going on, or that there were other unexpected things happening that you maybe should have paid attention to as well.

Now, Max showed you earlier the video of the registration counter. As he said, that was based on an experiment that Dan Simons and I did with a couple of colleagues at Harvard earlier. And I'm going to show you the predecessor of that experiment now. You can just watch and see how it works.

One thing I'd like to add to what Max said—the question was raised afterwards about whether it's just academics who make these kinds of mistakes and so on—well no, we've done them with lots of different people over the years, old and young, students and non-students.

Dateline NBC has run that experiment, and it works perfectly well. *Dateline NBC* actually ran it twice. They ran it once in a coffee shop in New York City where someone ducked behind the desk at the coffee shop and said let me get you your sheets and so on. It works fine.

The most interesting result I think was that inadvertently when we ran the experiment at Harvard one time, several of the subjects had come directly from a lecture on inattention blindness and change blindness and saw a sign saying be in an experiment, go up to the eighth floor. And they went up to the eighth floor, and they made exactly that mistake of not realizing that the person talking to them had changed into someone else.

So, here's the original version of that experiment. This was done by Dan Simons and Dan Levin. The guy in the center is the subject, although he doesn't know that yet. He's just been approached in the quad at Cornell and was asked for directions to a building, and watch what happens. He starts giving directions. The guy at the left is the experimenter.

[Video clip]

And you might call this now "the moving counter." But this was the way it started, with a door being carried by people. Now it's a completely different person talking to him. Incidentally, that's Dan Simons now talking, my co-

author and the co-author of this paper. And the interaction goes on just as it would have otherwise. And in fact, this gentleman did not notice at all that he was talking to a completely different person after the door went through. And about 50 percent of people in this experiment didn't notice that.

I don't have time to show you the video, but it's not an artifact of this gentleman being older. They ran another very, even more clever experiment where they approached students on the quad to do the same thing, but the experimenters disguised themselves as construction workers. So, they were still the same two people. They looked like different people—they had different heights, different sounding voices, and so on, but they were wearing construction worker-appropriate clothing.

The idea is that in everyday situations like this, you may only really be storing a few bits of information about the world around you. You have a rich perceptual experience of the world around you. You probably feel like you're processing a lot of details of my face and my voice and you're hearing me say a lot of words, and you feel like you're processing all those words. Sad to say, you're not retaining a whole lot of the information that comes in from the outside world and probably even less than you think.

So it may be rational in some sense to not pay attention to the exact details of the particular random student you're talking to or giving directions to. Maybe all that's important is are they male or female, young or old, and so on. And it's interesting that in Max's video they managed to change a man into a woman because I don't think that's ever been done in an actual academic study.

So, there could be some blindnesses that academics are especially prone to. Maybe it's changing men into women or something like that. That's why I asked him afterwards if he has data because I would really like to see what actually happened with that.

This phenomenon, as Max mentioned, is called change blindness. And I think this happens a lot in the world around us also. We just don't realize it. Here's an example that I found in the news. Missing woman unwittingly joins search party looking for herself.

Now, how could this happen? We can find the answer in the third paragraph: "One of the women on the bus left to change her clothes and freshen up" when the bus stopped for a break. "When she came back, her busmates didn't recognize her" because she was wearing different clothes. So, soon there was talk of a missing passenger, and she didn't realize that they were talking about her. So, she started joining the search for herself.

If you think this is an isolated event, the related stories on the very same webpage include a missing toddler found in her bed. No, the toddler was not out on the search party, but the toddler was apparently right where the toddler should have been and yet people didn't notice that.

Now, we're gradually going to get into questions of change blindness and inattention blindness that I think sort of focus more on the environments that may be of more direct relevance for you. And I'm going to try to get there a little bit by now showing you some other examples of change blindness that happen even when you know that something is changing.

So, in the counter example in the prank that Max's friends played on him, none of those people knew that something was going to change. But I'm going to tell you right now that something's going to change and hopefully show you how hard it is to see what's changing.

Here's a scene of soldiers boarding a plane, and what you're going to see happen—and this is done by Ron Rensink, by the way, who's a professor at University of British Columbia—what you're going to see happen is the screen is going to start to flash. And each time the screen flashes, the picture is going to change. And, in fact, it's going to change back and forth between two versions of the same picture.

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All you have to do is tell me what's changing during the flashes. And I don't want you to shout it out. Just raise your hand when you're sure you've figured it out. And we'll see how long it takes you all to raise your hands. Here comes the flickering.

[Video clip]

We've got three so far. Again, silence is enforced. Six, seven, eight, nine, ten, eleven, twelve, thirteen. I'm not keeping time but 15 seconds have elapsed already and still less than half of you have seen what's changing. Okay. We're getting closer to half. Some of you still have not noticed it. I'm not going to use up all the rest of my time waiting for everybody to raise their hand.

So, please pay attention to where the engine on the wing of the plane is. Look at that. As soon as you paid attention to the right thing, it immediately became apparent. Here's a case of what's sometimes called "explicit change detection" in the cognitive psychology literature. You know something is changing and yet you still have great trouble seeing it.

Why is that? Well, of course, in the real world the world isn't flashing at you all the time with things changing back and forth. What does the flash do? The flash in essence sort of destroys your short-term representation of what you were looking at and you've got to start all over again. Basically your attention is sort of re-diverted every half second or so to something new. And it's very hard to systematically deploy attention over a stimulus like that that's constantly changing.

Now, you don't often see data like this, but I would submit to you that it's a little bit like a situation of multitasking where you, for your own reasons, may switch your attention away from something important and then switch it back. And it's as though you're starting all over again often when you keep switching back and forth between multiple tasks.

Here's another example. Something is going to change now and I want you to raise your hand when you see it. Whoa, suddenly a whole bunch of hands went up. Okay, so about half of you have noticed it. What changed?

Okay. Two buildings disappeared. This is what happened. Except, very slowly. So, Photoshop—we morph them so that they change very slowly and in this case disappear. Let's try one more example. What's changing? Raise your hand when you can tell. Okay, about a third of you, maybe half of you this time. So here's what it was.

These are fairly salient changes. These are not like a few pixels here or there or something up in the corner that's irrelevant. Two buildings in the Chicago skyline disappeared, three paintings on Van Gogh's wall disappeared. I should say credit for these videos is to Jackie Mandart, my former research assistant who made them.

These are examples of gradual changes. And what the literature on change blindness shows us is it's especially hard to notice slow changes while they're in progress. And here's where I think the issue becomes sort of more clear for decision making and being smart about attention. In the real world, when you have to see something change, you usually have to watch it pretty closely.

That's the case in the case of vision, and I think it's also the case in a lot of other more abstract conceptual domains. So, if your attention is elsewhere, you won't see what's changing.

For example, in this article that I got from the *New York Times* from a few years ago—lots of quotes. You may not know that this is a bull market "from financial headlines that have often focused on weakness in the economy and on the myriad crises in Europe, the Middle East and Washington." So we saw from Max's graph that from the trough there was sort of a very steady run-up as run-ups go. Not a headline-grabbing kind of thing, but where there were a lot of other things going on that drew people's attention.

I think this relates also to the “topic of the day” issue that Michael brought up at the beginning. The daily topic draws our attention, right? A good rule of thumb to follow, I think, is that if someone ever says, “Today is all about X,” there's a pretty good chance you should be paying attention to something other than X. Or if someone says, “A all comes down to B,” well then there's some chance that A's related to B but you better not deploy all your attention looking for the relationship between A and B because you're going to be missing a lot of other important things that are going on besides how A relates to B. That kind of language I think mostly distracts our attention.

Another example. People used to say things like this. Nobody says it anymore, but people used to say that they sort of suddenly woke up to the idea that China was a powerful economic force. For example, in 2010 they were already the second largest economy ranked by GDP, according to the IMF. So I actually looked at this and I looked back at the chart—I just got it all off of Wikipedia, it's very easy to find—of where China ranked in previous years at five-year intervals.

It turns out it's about the smoothest rise through the rank tables that you can imagine, but people sort of act as though it was like that. Like as if all of a sudden Mexico became the second largest economy or something like that overnight, and we just suddenly realized it. Well, this I would submit is a form of change blindness but at a much more long-term and abstract level. I think this is one reason why we don't notice things like slow changes in financial indicators and other important facts about the world.

Now, I want to get a little bit philosophical here briefly. Well, I want to talk about something that in artificial intelligence used to be called “the frame problem.” Suppose you're a robot. Temporarily imagine you're a robot. Suppose you walk into a room and you look around. And what you see with your vision system in your robot brain is that there's a chess set on the table. I've got to work in chess somewhere there. There's a chess set on the table. So, being a smart robot with good AI algorithms, you enter the fact into your database that says I can play chess in this room. Now you're aware that you can play chess in that room, and you can use that in your reasoning process going forward.

Now, suppose a human walks in, and perhaps out of fear that the computer will crush it in chess and the desire to protect its fragile human ego, it picks up the chess set and leaves. Well now, if you're the robot, how do you know that the fact I can play chess here is no longer a valid statement about the world? That used to be considered a very difficult problem for artificial intelligence. Basically to get computers to represent the relationship between things they believe and the information that causes them to believe those things. And how do I know when to delete beliefs when the information no longer supports them?

It used to be thought that this was a significant problem for AI in part because it was assumed that humans did this very well. But I think change blindness and inattention blindness actually show us that often humans don't even notice the information that's changing that should affect their beliefs. So, any conclusions drawn from those facts might not any longer be true after time passes or something happens. And the problem is how to update your database of things you think are true about the world when some of those things change.

I think the relevance of this is that we often form beliefs that can animate a lot of actions we take. It might be a view on a particular company or industry or economy or currency or whatever. How often do we write down or formalize in some way the reasons for our beliefs or what would have to change in order for those beliefs to change? How often is that formally represented?

I don't think it actually is very often. At least I never do, but I'm not a professional in this field. But I have not heard too many stories of this happening. I think if it's something that does happen I would love to hear more about it, but it seems to me like something that should happen more.

There's another further problem in our knowledge base, and it's that we think it's more complete than it really is. So, we think we know more about how the world works than we really do. I can't prove to you anything about your knowledge about markets or currencies or economies or anything like that, but I can show you that most people don't understand things that are vastly simpler than financial markets and complex organizations.

For example, almost nobody knows how a toilet works. Everybody knows how to work a toilet but very few people know how a toilet actually works. I won't challenge you to explain how a toilet works. There's probably someone here who could explain that very well. But what about this? How well do you understand how a bicycle works?

So, Rebecca Lawson, a British psychologist did an experiment where she asked subjects this question and she had them rate their own knowledge on a scale of one to seven. So, one meant I have no idea how a bicycle works; seven meant I have a very good understanding of how bicycles work.

And then she surprised them with the follow-up question: draw a bicycle being sure to show the wheels, pedals, and chain. And she actually gave them a head start by drawing the frame of the bicycle. So all they had to do was put in the chain, the pedals, and the wheels. And here's some of what she found. These are actual drawings by her subjects as reproduced in her journal article.

I would like to observe a couple of things. First of all, in all four of these cases if you look closely, you will see that the chain connects the two wheels. If you can visualize yourself trying to ride a bike where the chain connects the two wheels, as soon as you turn left, the chain is going to crumple and the whole thing is going to fall over and I'd be down there right on the floor.

Also interestingly, the hammock pedal up there where the pedal is not connected to anything that could actually drive anything. It's just kind of like a little spinning child's toy in the middle of the bike or something like that. There are various interesting features. The pedal on the front wheel is especially good. That'll break your shin very quickly. Interestingly, drawing C was made by someone who rode her bike to and from work every day.

So, I think the problem with our sort of attention to knowledge in the world around us is that we assume our knowledge is actually greater than it is. This relates to the well-known phenomenon, "unskilled and unaware of it," which was coined by Justin Kruger and David Dunning. In fact, this is called the "Dunning-Kruger effect" sometimes. You may have heard of it under that name.

Dan Simons and I, and our collaborator, Dan Benjamin, did an experiment on this. And one thing we were worried about in demonstrations about people's overconfidence about their own knowledge is that often the knowledge is random trivia facts in the experiments that are used, sort of "how long is the Nile River" or something like that.

Or in the one that Michael mentioned earlier, a whole bunch of questions about factual knowledge. Maybe people don't really have such a great idea of what their factual knowledge is. But here is a domain where people do really get very precise information about how good they are at something. Even in the field of finance, it's hard to know how good someone really is as an investor.

But in chess, everybody does know exactly how good they are. Chess has a rating system. The rating system is actually the most accurate rating system that I'm aware of for any kind of game or sport. It's designed by a guy named Arpad Elo, and it basically calibrates very well to people's skill. And everybody knows their rating and they follow their rating and so on.

So we went to a couple of big chess tournaments, and we asked two simple questions of the players. The first question was, "What's your rating right now?" And it turned out when we looked at this and we looked up their ratings after they told us—because they gave us their ID numbers and everything too—that everybody pretty

much knew their rating. It within one or two points out of 3,000, which is awfully close.

Then we said, "What should your rating be to reflect how good you really are at chess?" Now, the correct answer, sad to say, is "Exactly what my current rating is," or at least that's the most rational answer.

However what we got looked like this. On the x-axis is their actual chess rating plotted against, on the y-axis, what they think their rating should be to reflect how good they actually are. And you'll notice that almost every dot is above the 45-degree line.

So, almost everyone in the sample thinks they're better at chess than they actually are. And this is in a domain where they get perfect feedback or near perfect feedback about how good they are. That poor guy over there, the outlier to the right, I don't know what's wrong with that guy, severe lack of confidence or something like that.

But otherwise, another interesting thing to note is that if you go up and to the right on the actual chess rating scale—this is up to Grandmaster level over here—those people up there are not too far above the line. But if you go over here to the weaker players—I mean and these are very competent tournament players, but they're still not as strong as the Masters and Grandmasters—their dots are much higher above the line.

So, in fact, the weaker you are as a player, the more you overestimate your skill. I can obviously sense some analogs in the world of stock market investing and so on here. But it's hard to measure actual skill there. Here we have an actual measure of skill.

Okay. So, moving along, I have to talk briefly about Oprah Winfrey because everybody has to have a celebrity in their slides apparently. We're often told that the solution to all this complexity of the world, and what to pay attention to and what grabs our attention and whether our knowledge is adequate and so on, is just not to worry about it. Instead, rely on your intuition.

And unfortunately, we really do believe that this works for ourselves, but even more so we often tend to believe it works for other people. We have this sort of belief that there are special people who really do have special intuition who can do things that would seem supernatural to the rest of us.

So Oprah advised, in her magazine: "Learning to trust your instincts, using your intuitive sense of what's best for you, is paramount for any lasting success. I've trusted the still, small voice of intuition my entire life. And the only time I've made mistakes is when I didn't listen." So, don't take Oprah's word for it. On her website, she published a list of great moments in intuition. A timeline. I'm going to share two of them with you right now.

The first one was in 1940 when Winston Churchill was dining at 10 Downing Street and a German bomb hit nearby. He orders his staff to leave the kitchen. Moments later another bomb falls obliterating, you guessed it, the kitchen. Okay. Brilliant intuition, went with his instincts, saved the staff of the kitchen of 10 Downing Street.

Or, what about this one, also from Oprah's timeline. In 1961, Ray Kroc's funny bone instinct—and this is much more relevant for investing—becomes the stuff of business legend when he ignores his lawyer's advice and borrows \$2.7 million to buy out the modest fast food franchise he helped build. Now, more than 47 million people a day eat at McDonald's, whenever this was done.

So I think you will find the problem with this line of argument pretty obvious. It's a little bit of a Carter Racing problem. It's very obvious that you may wonder how it's possible to even miss this, yet there's business book after business book written exactly on this premise of telling us about great success stories, picking out great success stories, and retrospectively looking at what they have in common.

In this case, it's they ignored advice and went with their instinct. And there are no books, unfortunately, or pages on Oprah's website about all the people who rejected the legal and financial advice they got and borrowed \$2.7 million and went into business and lost it all. None of those people are memorialized with pages on Oprah's

website or stocks in the Dow Jones Industrial Average or wherever McDonald's is these days.

In fact, I think that happens a lot more often, actually. I have a feeling there are more people who reject a lawyer's advice, borrow a large sum of money, and lose it than people who reject a lawyer's advice, borrow a large sum of money, and become billionaires. I don't have the data on that, but I'm guessing that that's the case.

This is the same error that happens when you're thinking about an old friend or something like that and then suddenly an email comes right from that person. Wow, what a coincidence. People attach great significance to those salient coincidences, but we never think backwards about all the times we thought about our friends and they didn't email us or call us right then. Or all the times that our friends surprised us with an email and we weren't thinking about them. Or, of course, all the times we weren't thinking about our friends and they didn't email us, which is 99 percent of life.

These are not great moments in intuition. They're great moments in what cognitive psychologists call "illusory correlation," and they're another example of how we can pay attention to the wrong things often to our detriment. Very similar to the Carter Racing case of not thinking about the information you don't have and asking for it even after Max reminds you three times that you can go ahead and ask for that information. Nobody went to Oprah's website probably and typed in, "What about all the people who lost money?"

Again, I feel like everything in my talk has been alluded to earlier, but I've got to mention now Mr. Madoff because I think it's very relevant to how believing in the power of intuition can get us into big trouble. We saw that the returns were very smooth and upward-trending and so on for a long period of time. And you all know all about this so I'm not telling you anything you don't know. But a lot of people think to this day that the SEC never looked into Madoff. But in fact, as we all know, they looked into him on multiple occasions.

And the Inspector General's report after the fact tried to answer the question: How did they not see what was going on? And of course, there were many reasons. But the most interesting reason to me is described in the following quote from the Inspector General. He wrote in one of the examinations that the SEC conducted that they asked Madoff how he was able to achieve these returns. Madoff's returns were extraordinary and always consistent. He never had a down period no matter how bad the market, as we saw in the graph.

And they asked him: "How are you able to do this?" Bernie Madoff said to them that he had a "gut feel" of how to time the market. They asked him what the basis was for this gut feel, and he said it was his observations of the trading room. He said he could actually sit on the trading room floor and "feel the market" and know exactly when to buy and exactly when to sell. And Madoff always bought at the right price and always sold at the right price day after day, year after year.

The most important sentence in this quote that I'm reading you is the next one: "Inexplicably, the SEC just accepted these answers and went on." I would submit to you that this sort of false belief in the power of intuition, or the idea that there are special people who can—even if I can't do it, there are special people who can—access these feelings and this information in an unconscious way and achieve otherwise mathematically impossible levels of success, can do us real harm. It really distracts us from what we should be paying attention to.

Now, there have been no cartoons up until now except for those little stick figures in the first talk, so I'm going to give you *The Simpsons* to help me drive this home.

[Video clip]

Now, again, I won't try to explicitly highlight the relevance of this to what goes on in business. But I think most of us most of the time are like Homer Simpson. We kind of grope around in a complex world. We see these cause and effect relationships and draw simple inferences about how things work. And based on what we pay attention

to, namely, we see the bear patrol going around. We don't see any bears. Of course, some people then have the insight that they can monetize that kind of thinking, and there we see it right there in Lisa. We see this kind of thinking all the time. "It is inarguable, though, that Geithner's stabilization plan has proved more effective than many observers expected, this one included."

Well, of course, there's no proof that anything was effective. All we know is the way things were beforehand and the way things were afterward. And we like the way things were after better than we like the way they were before. Now it could be true that the stabilization plan had a lot to do with it. You guys would be the experts on that, not me. I would never say that expert opinion isn't relevant.

But in many cases we can't run the right experiments or analysis to really answer these questions. And at least we should be aware of that. We should be aware of what our knowledge is based on when it comes from intuition and expertise and not from actual data. It's inarguable that Homer's bear patrol has proved more effective. It wouldn't really make any sense in that way.

So I'm going to skip the next couple of slides. I've got to tell you of course it seems like from what I've been discussing you've already all read Danny Kahneman's book, but if you haven't you should really get it and read it: *Thinking, Fast and Slow*. Danny Kahneman is in fact not just a Nobel Prize winner in economics, but he's the second most influential psychologist ever after Freud. And Kahneman's influence has been *positive*.

So there's a lot to him. And one of his best sayings from that book is that the human mind operates on the principle—especially when we're thinking intuitively—that he calls "WYSIATI."

WYSIATI stands for what you see is all there is. So, the assumption we often make is that what we see before us, in other words, what our attention has been drawn to, is all that's relevant. I mean, think of the Carter Racing example again. You're given this chart of numbers. You really focus on that chart of numbers. You do a lot of analysis on that chart of numbers, not thinking about the information that you *weren't* given. If you operate on the assumption of what you see is all there is, you can make significant mistakes.

So, trying to gain some immortality myself, I decided to coin WYMIJAI. Try to use it in your everyday conversation as much as you can: what you miss is just as important. I'm going to finish up the talk now, thankfully, with a few tips on seeing what you're missing.

So, in fact, Dan Simons and I wrote a book called *The Invisible Gorilla*, which we published, and now we're thinking about a sequel called *Seeing What You're Missing*. So, this is maybe a little bit of a preview of what we've been thinking about.

One, I alluded to earlier—there might be value in formalizing and recording the web of assumptions behind your thinking. This is not often done but I think it can actually have value. One thing you might do is create a checklist of things you might want to pay attention to in the future to see if they've changed.

Checklists are a great way to externalize processes of memory and cognitive control that are really hard to keep going in your brain at all times, especially with all those distractions we've been going through the entire talk so far. So, keeping a checklist that could be derived maybe from some kind of formal explicit reasoning about the reasons for your thoughts may also help people from, in the future, changing the reasons once the thoughts turn out to be unpleasant or incorrect. Then you can just go back and change the reasons. Better not to do that.

Second, as you saw in the gorilla analogy, it's kind of hard to divide your attention between, on the one hand, a focused task like counting the number of passes as I asked you to do, and on the other hand, general awareness of things that might be changing. Change detection is hard enough even when we're looking for it, but just being generally aware of what might be changing, like the curtain in the background or the person walking off the stage, is hard.

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So, a good strategy to do this is to divide attention between multiple people actually. Use two brains or more. One person or group can focus on a specific task. Another can focus on the broader picture. But not both. Incidentally, police officers have often adopted this tactic when they go to an unknown situation and there's a subject that they're supposed to be investigating.

Often, what they will do is one officer will approach the subject while the other one stays farther back, because he knows that if they both get close to the subject they're both going to focus on him and what's going on right there. And if there are other people around or other things happening, they're not going to notice. So that's a good practice, I think, to adopt more broadly.

The third one is to “red team” important decisions or projects. If you have the resources — since groups tend to focus so explicitly and doggedly on the tasks they're given — it's a good idea to give different tasks to different groups and have some people try to do the opposite of what the first group is doing, or try to disprove the conjecture of the first group.

My favorite example of this is the Macintosh computer. The Macintosh computer was in essence a red team that was trying to show that the Lisa and the rest of Apple's product strategies sucked and they could do better. And now they're the basis for the entire company going forward since then.

And then not quite finally, but finally for this slide: include women on any decision-making team because teams with more women are smarter. And I say that deliberately. I deliberately use the word smarter because of another line of my research that Michael alluded to, and Iris also — we've been essentially trying to develop an IQ test for groups.

Often nowadays, major decisions, even minor decisions, are made by groups. And when groups of people work together, we can think of them in some ways like a single person — just a mind composed of multiple different minds. And it turns out that groups vary quite a bit in how intelligent they are.

So we did develop an IQ test for groups. This means the group works together to answer the questions — we're not giving IQ tests to the individual people in the group. And one of the things we found is it's good to have smart people in your group. But it's also good to see how the group works together. So, groups that are smarter, meaning they make better decisions and solve more problems when working together, tended to have more women.

Here's a graph to show you that. The groups that we were using were between two and five people. So, the percentages on the x-axis are only the possible percentages that you can divide two, three, four, or five people into. The pattern is a little bit messy as you can see, but the only significant fit to this is a linear increase with the number of women.

Some people like to say, “Wait a minute, this point is lower over here when you've got 100 percent women.” True, but not significant in our data so far. So, it could be that exclusive, all-female teams maybe are not the best, but certainly it seems like up until that point, adding women makes teams smarter. That's of course all else being equal. So this does not mean ignore expertise, ignore intelligence, ignore other issues of fit and background, and so on. But it does mean that it seems like teams with more women make better decisions.

And by the way, we replicated this finding many times, including teams that work exclusively online. So, we have tested people where they're only communicating through chat. The effect of women is still significant. And also in Germany and Japan we also got significant effect too.

Now, one reason why it's good to have more women on your team is that women tend to score higher on tests of social intelligence or social perception, and we used that also. We found that it's good to have people on your team who have greater social intelligence, probably because they are better at thinking about what the other

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people on the team are thinking about and keeping track of what the other people know and don't know and how they think. And also perhaps slightly better at decoding non-verbal information. So, more information can be exchanged in a group faster.

If I think Michael just said something stupid, and we're working in a group together, I can just raise my eyebrows at you and eye roll and then we know that what he said is nonsense. I don't have to say, "Hey, Michael just said a really stupid thing, didn't he?" So, that saves a lot of time and feelings and so on if we can communicate better non-verbally in a group. If you want to read more about this research, the easy way is we wrote an op-ed in the *New York Times*. And then you can link from there to the other papers that we wrote.

I want to cram a couple more little facts in here. One is that cognitive diversity is also important, as was mentioned earlier, and we're still working on that in our research group. And finally, two bonus ways to see what you're missing.

Remove attention-grabbing stimuli. So what does that mean? Of course, get in the shower. So when you're in the shower or doing something else, you do not have stimuli competing with your attention. Does anybody ever survey people about how happy they are in the shower? Because I would put that at almost the highest level for me. Literally. Being in the shower. And maybe it's tied to the extra creativity that comes from being in the shower.

It turns out there are products that can help you. If you feel like you get your best ideas in the shower, you can write them down in the shower now with waterproof notepads. In fact, a student of mine actually did a survey of this. We found that 33 percent of people do believe they get their very best ideas in the shower.

And, for example, one of them typed into our survey two years ago: "I decided to give my husband of 37 years the divorce he wanted. I didn't want to get a divorce, but while showering it occurred to me that it was futile to try to force him to stay." So it takes all kinds of creativity I guess.

And then finally, direct attention to information that breaks illusory correlations. Illusory correlations are all around us. Often, paying attention to failure I think is one way to get at that. And my favorite example of that is the Bessemer anti-portfolio. How many of you are familiar with the anti-portfolio? Well, if you go to their website, they have a page which lists all the investments they turned down that would have been extremely profitable.

For example, eBay: "Stamps? Coins? Comic books? You've GOT to be kidding...No-brainer pass." FedEx: "BVP passed on Federal Express seven times." Of course, this is a little bit of marketing. This makes them look cool and so on, but they are in a way memorializing things that might have been mistakes so they don't forget about those things and only focus on successes. They still have 115.5 IPOs, apparently, despite all that bad decision making.

So I guess I'll conclude here. Woody Allen in his famous standup comedy routine said, "I would like to end with an affirmative message to share with you, but I don't have one." So, would you settle for two negative messages? So, there's a lot of negativity here. It's an illusion, attention is an illusion, intuition is a myth, we don't know as much as we think we do, and so on. But I think there are some ways we can try to work on that. And I'd really love to talk about that or anything else with all of you now. Thanks a lot.

Question: Chris, in that study showing that a group with more women does better, it didn't look monotonic. It looked like it maxed around 60, 70. So, granted, maybe women are slightly better at this. Was that more of the diversification effect? One hundred wasn't the right number or is that not significant?

Chris: Well, if you try a curvilinear fit, like if you hypothesize that it's best at the midpoint and lowest at the endpoints, that does not explain as much variance as a simple linear fit. Now, maybe there's something much more complicated going on but we don't really have the data to say.

Christopher Chabris

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So, I don't think I'm ready to say we have proved that the best thing to do is to fire all your men and put all women on your team or something like that. Obviously, that would be a premature conclusion, not to mention the fact that this is holding all else constant and this is in a laboratory experiment. Those caveats aside, I just don't think we have the data to tell apart those two hypotheses.

I do agree that it seems logical that you wouldn't want to max out *either* way. However, I also do believe that cognitive diversity and other kinds of diversity are probably more important for effective problem solving than demographic diversity. I don't have any data on that. Iris would probably know better than I would.

It's kind of hard to measure cognitive diversity. There are very simple measures of it. We're trying to do more sophisticated things like measure thinking styles. Do people like to think verbally or visually or spatially and so on?

And it turns out, it seems in the data so far, but this is very preliminary, if you put people together in a team who all have a similar thinking style, that's not very good because you sort of lack for paying attention to different kinds of things that nobody's paying attention to.

But if you have too much diversity, that's not so good either because it's harder for people to exchange information. Like if I'm a very visual thinker and you're a very verbal thinker, we might not communicate as well as we would have if we were more mixed and our team were more in the midpoint of that. But this is, I think, very early days for that kind of research.

Question: Have you tried the gorilla test on children?

Chris: I haven't, but it has been done. And it turns out what happens is little kids miss the gorilla a lot, like eight-year-olds and ten-year-olds. But as they get older they tend to increase their noticing. And I think that's because the main task becomes a little easier. So when you're eight, just focusing on that ball passing around and so on consumes more cognitive control, more mental resources, and therefore you are less likely to notice unexpected things. I think it goes down with aging as well, where again it becomes kind of harder to focus on the main task as well. So, noticing then starts going back down—noticing the unexpected thing.

Question: A question on intuition, and I'll overlook the fact that you dissed Oprah on that one.

Chris: Sorry.

Question: Yeah. Do you discount it entirely? I've always assumed that intuition can . . . not always, but if someone has cumulative experience in a field, and they can't articulate why they feel a certain way, but it's hitting them . . . In our businesses, I certainly look to people with experience—and especially if they can articulate their reasoning—but even if they can't, it's just their intuition. Do you discount that entirely, or do you think there's something to it?

Chris: I would not discount that at all. For example, if there were a chess Grandmaster who was very bad at explaining verbally what he's doing, but he told me this is the right move, I would go with him 100 percent of the time, even if he couldn't explain it, and I knew that he was that good and he had that experience. That to me is expert pattern recognition or expertise, and that's a real thing. That's a very important thing, and all of you have it to some extent in different fields.

The problem I have is with this generalized concept of intuition. Oprah's telling us to trust your instincts. Well, unfortunately, I have no good instincts about mortgage backed securities, or I have no good instincts really even about which house to buy or how big a mortgage to take or so on. I need to do something other than just trust my instincts in that case. So, for any low frequency decisions, novel situations, and so on, intuition is way overvalued in those cases. In a highly structured environment like playing chess or bridge or whatever, then yes.

And we know cognitive psychologists have essentially figured out how that works. We have a very good idea of how that actually works.

Michael: I have one thing to add, Chris. I think it's very domain-specific. And actually Danny Kahneman wrote a paper with Gary Klein talking about where intuition works and where it doesn't. And I think it's got to be fairly stable environments, fairly linear environments where it's going to work well. The psychologist Greg Northcraft has a line which I love. He says, "You have to distinguish between experience and expertise." We often think they are the same thing but they're different, right?

Chris: Yep.

Michael: And the key to an expert is he or she has a predictive model that works. So you could do something for a long time, have a lot of experience, but no predictive model.

Chris: Surviving in a field could be an indication of expertise because you might have washed out at some point or something like that, but of course not necessarily. That's probably, that's one reason why I like to study chess players because we know if a 12-year-old is rated 2500, that means he's exactly as good at chess as a 50-year-old rated 2500. They may be vastly different in what they can articulate and explain, but at least we know their skill is the same. I don't think there's any other field where we really know to that great of an extent what that skill is.

So, the further away we get from a field like that, where there's all this constant feedback and a really perfect rating system, the more we should be suspicious of instinct and so on, and at least go in with our eyes open about what we're doing. If we're going to go interview Madoff, and Madoff's going to say I do it all by gut feel and so on, well, we need to keep in the back of our mind the possibility that that's bullsh**. And not just say, "Okay, good, thank you very much," and then go on like, "Have another five years."

Question: I want to ask you a question about the chess players and their perception of being better than they are. That seems like a very rational optimism bias to me. They seem to be pretty sensible in thinking that they were slightly better than they are. So there are very good reasons why you might be optimistic, so you don't really want them to be having the same ranking perception as they actually have.

Chris: I'm not sure that's . . . so I'll divide that into two answers. One is, we sort of tested for a form of optimism bias by looking at whether they were accurately forecasting their own future improvement—you could actually sort of know in some sense, you could know that you're better than your rating, and your rating still hasn't caught up. Or you know that it's going to catch up soon or something like that because you're really improving.

So we looked at that. We actually extended out five years and looked at their rating one, two, three, five years afterwards. And they did catch up a little bit but not nearly . . . they caught up maybe one-third of the amount that they were overestimating.

The second question then is, is it adaptive to have this rosy view of your own expertise? Is there some value in it? And I'll agree that there might be if it motivates you to practice more and play more. But I think it also may motivate you to not work hard enough. If you think you're actually better than you are but that somehow the world is not recognizing that, you may not actually do the work. So, there's very little research on this that I know of. I think there should be more.

The one study I can point to is children playing chess—I think they were maybe 10 to 15 years old, I don't know the exact age range. They were asked similar questions to the ones we used. And then they were followed afterwards to see who improved and who didn't.

And the ones who improved more were the ones who had a better idea of exactly how good they were to start with, kind of suggesting that thinking you're better than you are is not a recipe for improvement in the future. It might be some kind of recipe for motivation in the present, but maybe not for improvement in the future. But I'd love to talk more about that and see if there's better research on that that we can think about.

Question: Is there any research on the differences between men and women?

Chris: Oh, in the overconfidence of chess players? Well, sadly no, because there are almost no female chess players who go to chess tournaments — maybe five percent or something. I'm not sure we had a single female player in our sample just because of sampling. But that would be interesting to look at. And there are more women playing nowadays.

One thing we have found, by the way, is that although women on average are rated much lower in chess than men, it's probably somewhat due to the fact that there are a lot more boys than girls in most locales where kids start playing chess. So, there could be some sort of stereotype threat things going on, and competition things going on.

We looked at some locations where there are as many girls as boys starting, like in elementary school or something like that, and in that case, they actually start with equal ratings. And overall, they don't drop out at different rates or anything like that. So, it could be something about drawing girls in, something that's perceived as an all-boy activity, maybe, that changes the pool of girls who get into it or something. Obviously an area where a lot more needs to be learned.

Question: Have you ever done the gorilla experiment and stopped it right after the gorilla came on stage and then left?

Chris: To see if they forget the gorilla?

Question: Yeah. Is it a retention problem or is it an actual attention problem?

Chris: We haven't done that. But some other collaborators of ours by themselves have done that and other versions of that, looking basically for the inattentional amnesia hypothesis, which is sort of like we have this rapid amnesia, we forget about it. And so far there's no support for that.

We also tried a kind of priming study, as Paul alluded to earlier, where we looked to see if people who didn't see the gorilla could still pick the gorilla out of a lineup. Like, what did you see? And we did this a long time ago, and we didn't find anything. It was as though it never happened to them.

But I think that research could be done again maybe more effectively. But it's a very strange thing that you can look at it for a second, I agree. It's very counterintuitive, and yet it doesn't seem to form an accessible memory trace of any kind. It's weird.

Question: So, the second thing is in terms of the workplace itself. You show the trading floor, and I assume you have some thoughts about how you could rearrange or redo the workplace maybe to do that. But along those lines, is there research on the impact of say, fatigue, on this kind of stuff? Because you would think that that would make it even harder to actually pay attention.

But maybe not. Maybe it actually makes you less good at picking the number of passes. I'm trying to think about the modern workplace, which is so much about, in a sense, burdening people with so much information, with asking them to work when they're tired, et cetera. And I'm wondering, it seems like all that would make it even harder to recognize what you're not actually seeing.

Chris: Well, I think that's probably right. Fatigue in general is a big downer for cognitive performance of all

kinds. And there's a lot of literature on that. Although, it's kind of hard to measure people's cognitive ability moment to moment because things like IQ tests are designed to tell me how I'm different from you rather than how you're different now than you were three hours ago.

I'm actually working a little bit on that too, hoping to make a map of how it changes. I think clearly it changes a lot from fatigue and coffee and things like that. Now, as far as noticing unexpected things, the main thing that guarantees that you're going to notice the gorilla is if you stop doing the counting task. So, everyone who stops the counting task but still looks at the video sees the gorilla. It does grab your attention then.

Maybe there's some kind of interaction with fatigue where, as you suggest, fatigue or other distractibility makes you just give up on the main task sooner. I'm not sure whether that's a good thing or not because, as we know, switching from a main task and then switching back to it has its own costs. I'm not sure I have any really deep thoughts about how to fix things. There's probably some clever technological design that we could do to do this.

One of my favorite examples is—I read about this in some book somewhere—a guy has two computers at home. One of them has no internet connection, has no Wi-Fi or anything like that. And when he wants to write, he goes into that room—it's in another room—and turns on that computer. He can't lock himself in, obviously, but he does a lot of things basically to make it a little bit harder for him—just like Iris said earlier, “make it easier to do things”—he makes it harder to distract himself.

But I'm not sure you can redesign a trading floor so that everybody's got an isolation booth that they could go into when they really need to think, but maybe something along those lines with a better technological solution to it.

Question: There's been a lot of popularizing, I would think, over the past 10 years of some of these concepts, with a lot of books and so forth. Where have you seen the applications of this in industry? I mean it's obviously very applicable to investing. I could rattle off a number of other verticals. But are you seeing real attention in the government or in other places, financial services, healthcare?

Chris: Well, certainly, one area of regulation that I think has been influenced by this, at least conceptually, is the regulation around cell phone use while driving and so on. That's an obvious sort of direct example. But they don't quite get it right. The first movement was hands free. So, in fact, New York would give you a bonus if you bought a hands free headset or something like that.

And that's a little baby step in the right direction, but it's really not the hands that are the problem. It's the mental distraction. But I think that's becoming more and more known, and in fact I should give kudos to Oprah because she has been trying to popularize that. So, it's not like Oprah's the worst person in the world or anything. She just got it wrong on one thing. So that's one obvious example. I haven't really compiled a list in my head, but I think it's really interesting to think about—where has this kind of thing had greater influence?

Question: Is there awareness of how to make groups perform better?

Chris: I think there's some awareness. But, that's what we're working on for our next project, is to figure out what more detailed advice we can give on how to solve this problem. So, I'm thinking about it. And I think maybe part of it is really recognizing that it's in groups that we do a lot of important work. And getting the group to structure better might be easier than getting individuals to structure their own mental life better.

Paul has good advice, but it's hard to get people to change the way they behave. But groups can, in a way, have more structure imposed on them externally and by the tools they use. That might be the way to go.

Michael: On that note, we'll call it. Thank you very much, Chris.

Chris: Thank you very much.



Apollo Robbins

Apollo Robbins is a performer, speaker, consultant and one of the world's leading experts on pickpockets, confidence crimes and deception. A pioneer in the application of deception to operational environments, Robbins uses pick-pocketing and sleight-of-hand to demonstrate perception management, diversion techniques and self-deception.

Known as "The Gentleman Thief," Robbins first made national news as the man who pick-pocketed the Secret Service while entertaining former U.S. President Jimmy Carter. He has picked the pockets of more than 250,000 men and women. *Forbes* has called him "an artful manipulator of awareness," and *Wired Magazine* has written that "he could steal the wallet of a man who knew he was going to have his pocket picked."

In 2006, Robbins and his partner Ava Do, co-founded Red Handed Media, which quickly became a go-to expert for the science community, law enforcement and government agencies studying human behavior. Drawing from his 20-plus years of experience as an entertainer and trainer, Robbins and Red Handed Media use transmedia and live event production to develop immersive training modules with a focus on experiential learning.

Robbins has been featured in *The New Yorker* and in numerous publications such as *The New York Times*, *Los Angeles Times*, and *The Wall Street Journal*. He produced and co-hosted the *National Geographic* program *Brain Games*, which was nominated for an Emmy as an Outstanding Informational Series. His popular appearance on *The Today Show* is a YouTube favorite at more than seven million views. The TED editors described Robbins's talk at TED Global 2013 as a revelation in the flaws of human perception. His latest project, a Warner Brothers film starring Will Smith, opened in international theatres in February 2015.

Note: No transcript available.



Apollo Robbins



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Understanding Skill

A Paradox Plus Qualitative and Quantitative Approaches

July 22, 2015

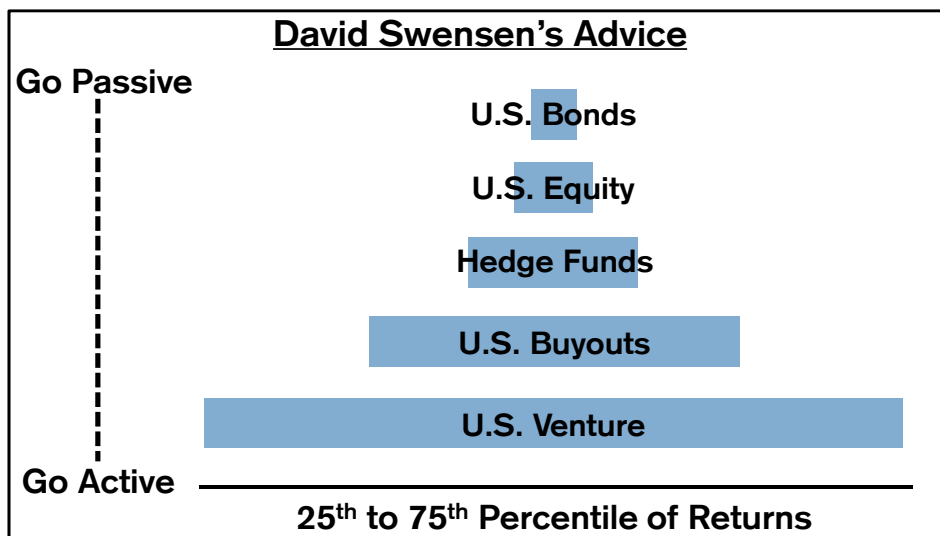
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Source: Based on Andy Rachleff, "You Can't Get Access to the Best Alternative Assets," Wealthfront, February 5, 2015; Cambridge Associates.

Presentation given to the Greenwich Roundtable, July 16, 2015

- The challenge in finding differential skill among active managers reflects a surfeit, not a dearth, of skill. Skillful managers offset one another, leaving more to luck. This is the major lesson of the paradox of skill. And it applies well beyond the world of investing.
- The key to making money is not just proficiency, but also finding games where you can be the best player. In investing, it's giving a great deal of thought as to why you are on the correct side of the trade. As Napoleon was reported to say, "Ability is nothing without opportunity."
- A useful statistic is persistent, which means it indicates skill, and predictive of the outcomes you are trying to achieve. We are awash in statistics, and we know that they are not created equally. Run that little test by the statistics you see. Active share appears to be potentially interesting as a measure, but we should continue our search.

Good morning. It's a real pleasure for me to join you today, as these roundtable sessions always prompt me to organize my thoughts on an important and topical theme. This morning's topic—understanding skill—is near and dear to my heart since I wrote a book about skill and luck!¹ But it's also a trickier topic than most people think, and it has some counterintuitive aspects.

I will break my comments into three parts:

- First, I want to discuss what I call the “paradox of skill.” When we think of investing, most of us think there's a dearth of skill. But, in fact, the problem is the exact opposite: there is too much skill.
- Second, I'll discuss some qualitative ways to think about where excess returns may come from. These are broader ideas but may still be a useful way to frame investment decisions.
- Finally, I'll touch on some more quantitative ways to think about identifying skill. Well, I'll try to lay out a framework for doing so and then apply an idea or two to the framework.

I. Let me start at the top and discuss what I call the paradox of skill. Now, I want to be clear that it's not my idea, but I did give it that name. The paradox of skill says that in many activities where both skill and luck contribute to outcomes, it's often the case that as skill increases, luck becomes more important in shaping results. More skill leads to more luck? That doesn't make sense on the surface.

I learned about this idea from the famous Harvard biologist, Stephen Jay Gould, who liked to write about evolutionary theory and baseball. One of my favorite pieces is about Ted Williams, the last player in Major League Baseball to hit over .400 for a full season—he hit .406 in the 1941 season. Gould wrote about Williams in his book, *Full House: The Spread of Excellence from Plato to Darwin*.² Gould asked why no player has been able to replicate this feat. A few have come close, including Tony Gwynn, who hit .394 in 1994, and George Brett, who hit .390 in 1980.³

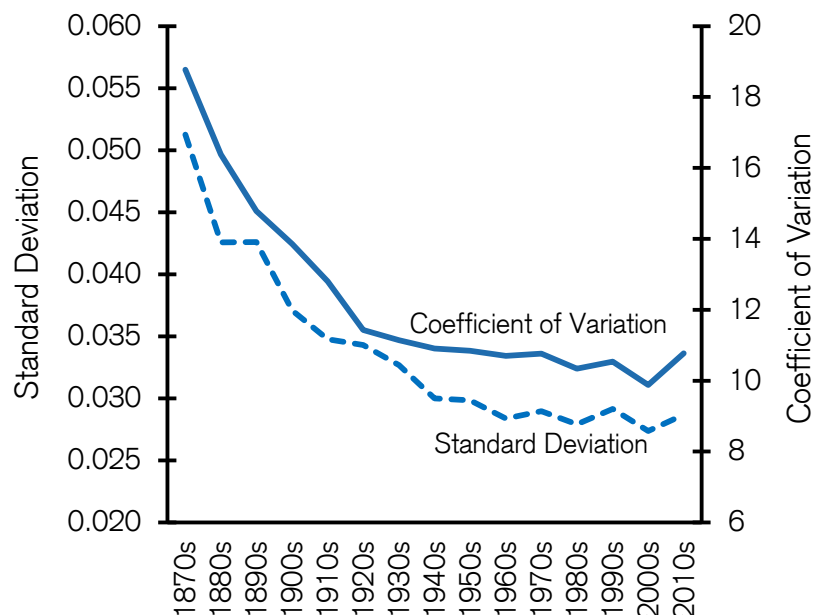
To understand the answer, you have to think about two dimensions of skill: absolute and relative.⁴ Let's start with absolute skill. I think it'd be fair to say that in baseball, as in other professional sports, the level of absolute skill has never been higher. You can attribute that to larger populations who can participate—most professional leagues are truly international—as well as better training, better coaching, and better nutrition. Put a contemporary ballplayer in the past and he'd clean up. This is also true for business and investing.

The problem is that this absolute improvement is obscured by the fact that there are interactions. Pitchers and hitters get better roughly in lockstep. It's an arms war—and that pun is intended. And if one side gets too far ahead, the powers that be at Major League Baseball change the rules to level the playing field. So, even as the averages look about the same from year to year, the underlying skill to achieve those averages is markedly higher today than it was in the past.

The second dimension of skill is the crucial one, and that's relative skill. Perhaps you can imagine the skill of players falling along a bell-shaped distribution. The point is that the bell is getting skinnier in a lot of domains, which means that the difference between the very best and the average participant is less today than it was a generation or two before. A fancier way of saying this is that the standard deviation of skill has declined over time. If you accept that a player's batting average combines both skill and luck, as the standard deviation of skill shrinks, the standard deviation of batting average should follow—even if you assume the distribution of luck stays the same.

That is indeed what we have witnessed. The standard deviation of batting average was .0326 in the 1940s and .0274 in the first decade of this century (see Exhibit 1). Saying this differently, Ted Williams was a four standard deviation event in 1941. To be a four standard deviation event in 2011—exactly 70 years later—a player would have to hit 0.380. Now 0.380 is obviously awesome, and would easily win the batting crown (Jose Altuve won it in 2014 hitting .341). But it doesn't get you over the magic .400 level. And I should add this is not limited to batting average. It applies to other relevant statistics, such as earned run average for pitchers.⁵

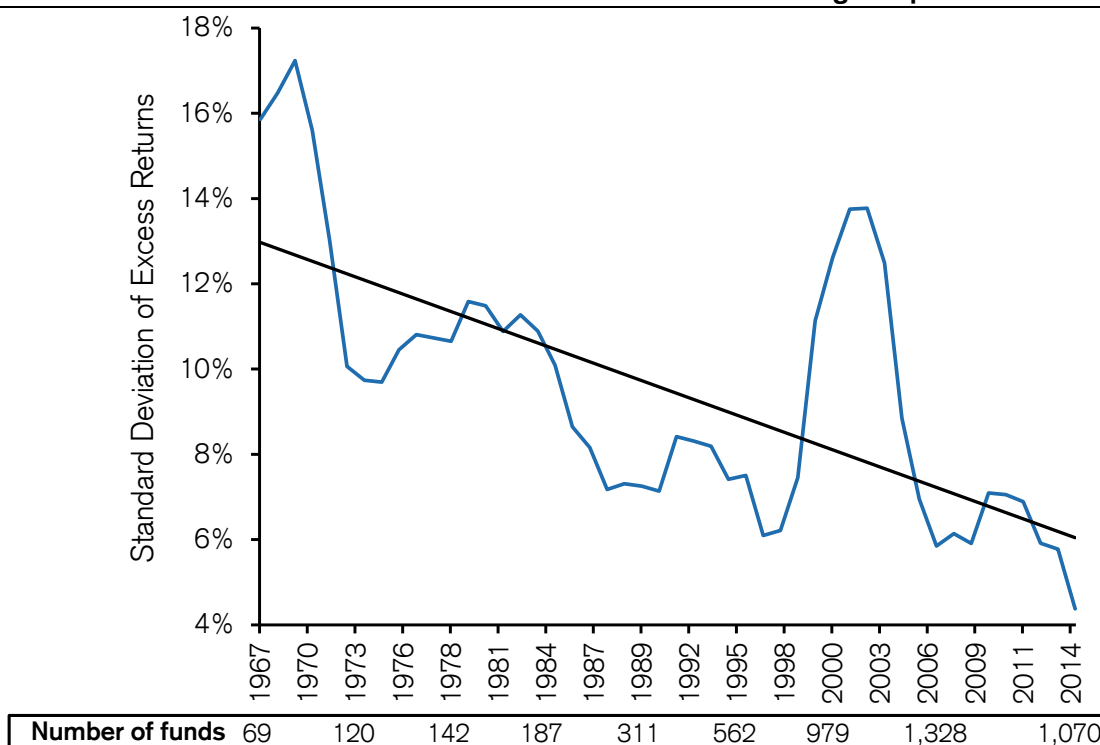
Exhibit 1: Decline in Standard Deviation of Batting Average



Source: Michael J. Mauboussin, *The Success Equation: Untangling Skill and Luck in Business, Sports, and Investing* (Boston, MA: Harvard Business Review Press, 2012), 55; Credit Suisse.

Hopefully, it's not too hard to see the relevance in investing. Certainly, skill has never been higher. Investors today have access to vast quantities of information and powerful computers, and are better trained than ever before. An investor today, put back into the 1960s with today's tools at his or her disposal, could run circles around the competition. But, of course, that skill is obscured by the fact that every investor competes with the market, which embeds information from lots of investors.

The relative skill of investors has declined over the decades. One way we can measure that is through the standard deviation of excess returns. Imagine, again, a bell-shaped distribution. The standard deviation for active mutual funds was about 12 percent in the 1960s and just 3.6 percent last year. The trend, after a brief spike around the dot-com era, has been steadily down. Just as in baseball, the difference between the best and the average has dwindled over time (see Exhibit 2).

Exhibit 2: Decline in Standard Deviation of Excess Returns for U.S. Large Capitalization Funds

Source: Markov Processes International, Morningstar, and Credit Suisse.

Note: Chart shows a five-year rolling average.

Now, the standard deviation of excess returns is an important concept because it defines the amount of available excess return, or alpha. For some market participants to generate excess returns, other investors have to lose an equivalent amount because the sum of positive and negative excess returns must be zero. A low standard deviation says that there are not a lot of winners or losers. So, picking winners is hard.

Let me emphasize that the problem in investing is not a lack of skill, it is the exact opposite: there's too much skill. But the discussion also places the emphasis—properly—on the distribution of skill. And that has gotten narrower virtually everywhere we look.

II. Let me now turn to the second issue I'd like to address, and that's some qualitative ways to think about where you might get excess returns.

Jim Rutt is the former CEO of Network Solutions—which was sold in March 2000 right at the peak of the NASDAQ—and preceded me as chairman of the board at the Santa Fe Institute. He told a great story.

When he was young, he played a lot of poker. Now this was before the recent poker craze, so it was much less mainstream. Jim honed his skills by day, learning the probabilities for various hands and studying common poker tells. Then he found games at night. He said he became pretty good and started playing with better competition. He won some and lost some, but on balance he made money.

At that point, an uncle pulled him aside and offered some advice: "Jim, I wouldn't spend my time getting better; I'd spend my time finding weaker games." In other words, instead of finding players who are as skilled as you are, you want to find players who are not as good as you are and who are rich. That way, you have a better chance of walking out of the room each night with cash stuffed in your pockets.

Let me see if I can make this lesson more relevant for investing. One way to do this is to consider the “fundamental law of active management,” described by Richard Grinold more than 25 years ago.⁶ The fancy version says that the information ratio equals the information coefficient times the square root of breadth.

In plain language, it says that excess returns equal skill times opportunity. So, to make money, in poker or investing, you need skill but you also need opportunity. And that was what Jim’s uncle taught him: Sometimes the key to making money is not getting smarter. It’s finding games where you’re the smartest player. Speaking of poker, Warren Buffett has a great saying: “If you’ve been in the game 30 minutes and you don’t know who the patsy is, *you’re* the patsy.”⁷

So how do you find games where you have an edge in relative skill? It’s a complex answer, but let me focus on three areas in public markets:

- **Institutions versus individuals.**⁸ This is similar to a professional poker player competing with an amateur. Research shows that institutions tend to come out on top in these situations. Let me give you a couple of examples. Institutions tend to fare better than individuals in initial public offerings. In other words, the institutions are better at discerning which deals are fluffy. Institutions are often more sophisticated and hence make fewer mistakes than mom and pop investors. One study of the Taiwanese market showed that institutions had positive alpha and individuals had negative alpha over the same period. So, in effect, the institutions were winning at the expense of individuals.
- **Taking advantage of people who need to buy or sell for non-fundamental reasons.**⁹ A classic and persistent example of this is spin-offs. Spin-offs are often small and debt-laden businesses that large mutual funds have no interest in owning. So, they basically jettison them indiscriminately. This creates an opportunity for excess returns for those willing to scoop them up. Another example is the unwinding of the leverage cycle, where holders have to sell assets to meet margin requirements. Again, they don’t have the luxury to be price sensitive, creating opportunity.
- **Diversity breakdowns.**¹⁰ Markets tend to be efficient in a classic sense when certain conditions prevail, including diversity of the investor base. When investors correlate their behavior, we can see big moves up or down and a resulting departure between fundamentals and expectations. Any time you hear concern about a “crowded trade,” you are hearing about a potential diversity breakdown. Obviously, the dot-com boom is an extraordinary example.

But the very factor that causes market inefficiency—correlated beliefs—makes exploiting that inefficiency difficult. The desire to be part of the crowd is powerful, and being apart from the crowd is scary for most.

If you observe the behavior of investors—institutions as well as individuals—they tend to want to do today what they should have done two years ago. The key is to keep your eyes on the future and to think about where inefficiencies may exist.

David Swensen, the chief investment officer of Yale University’s endowment, uses the dispersion of active managers as a proxy for market efficiency. He measures the dispersion by examining the difference between the first and third quartile results in various asset classes (see report cover). The idea is to index where the opportunities are modest and to seek skill where they are abundant.¹¹

He told his students, “You want to spend your time and energy pursuing the most inefficiently priced asset classes because there’s an enormous reward for identifying the top quartile venture capitalist and almost no reward for being the top quartile of the high-quality bond universe.”¹²

Now, one area that is of interest to me that is getting some more attention is whether the rise in passive investing is itself creating opportunity for active managers.¹³ We do know, for example, that the trading characteristics for stocks change after they have been added to an index such as the S&P 500. But it remains to be seen whether indexing itself becomes a source of edge for active managers.

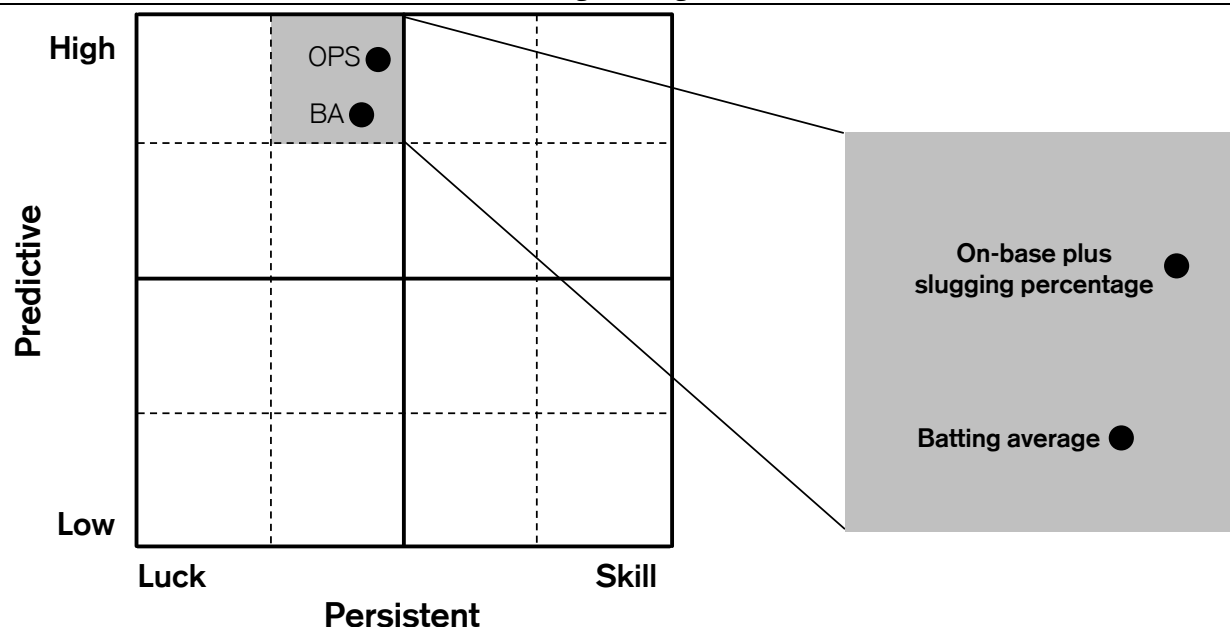
III. Let me now wrap up with a more quantitative approach to thinking about skill. Whether it's sports, business, or investing, we'd all like to come up with statistics that are indicative of a good process and hence give us a good chance of achieving attractive outcomes over time.

What makes for a useful statistic?¹⁴ Well, you generally want two characteristics. The first is that it is persistent—or what statisticians call “reliable.” That means the outcome correlates highly with itself over time. High persistence is generally indicative of skill.

The second characteristic is that it is predictive. In other words, it correlates highly with what you are trying to achieve. Statisticians call this “validity.” So, you want a statistic that is persistent and predictive.

Let me go back to the world of baseball for a moment to make this point more concrete. One of the statistics featured in Michael Lewis's book, *Moneyball*, was on-base plus slugging (OPS) percentage.¹⁵ The Oakland A's thought that was a better statistic than batting average. Well, let's run it through our test. First, it turns out that OPS is more persistent than batting average. Second, it also has a higher correlation with run production. So it is a better statistic—and, of course, the A's thought it was undervalued in the market.¹⁶

Exhibit 3: OPS Is a Better Statistic Than Batting Average



Source: Michael J. Mauboussin, *The Success Equation: Untangling Skill and Luck in Business, Sports, and Investing* (Boston, MA: Harvard Business Review Press, 2012), 141; *Baseball Prospectus*.

Unfortunately, we have no similar measures in the investing world that are super clean. There is one I'll mention because it has made a bit of a splash in recent years, although it remains controversial. And that is active share.¹⁷

I suspect most of you have heard of active share, but let me offer a brief definition so that we're all on the same page. Active share is the percentage of a fund's portfolio that is different from the fund's benchmark index. So, a fund with a zero active share is an index fund, and a fund with an active share of 100 percent is completely different than its benchmark. To give you some sense of the measure, Fidelity's Magellan Fund has an active share in the range of 60-65 percent. A fund can have a high active share by owning the stocks within the index but weighting them very differently, or by owning stocks that are not in the index at all.

Researchers have suggested that a combination of high active share and low tracking error, or low portfolio turnover, has led to excess returns.¹⁸ Active share itself is persistent—this comes as no surprise, as it is largely within the portfolio manager's control. And portfolios with these characteristics have generated excess returns, on average.

Let me make a couple quick final points on active share. The first is that active share has been in steady decline in the last 35 years. Active share in 1980 was around 80 percent, and it's down to about 55 percent today. That, of course, excludes index funds and exchange-traded funds. So, more of the market today is hugging the benchmark than in the past.

Second, active share is a nice way to think about fees. Say you are examining a mutual fund with an active share of 50 percent and total expenses of 125 basis points per year. If you work out the math, that fund has to generate excess returns in its active component of about 250 basis points in order to get to alpha of zero (see Exhibit 4). That's a difficult task, even for a skilled manager.

Exhibit 4: Closet Indexers Need Large Returns on Their Active Investments To Break Even

	<u>Percentage of Portfolio</u>	<u>Excess Return</u>	<u>Weighted Return</u>
Passive	50%	0.00%	0.00%
Active	<u>50%</u>	2.50%	<u>1.25%</u>
	100%		
Gross return			1.25%
Less expenses			<u>-1.25%</u>
Net return			= 0%

Source: Credit Suisse.

On the topic of fees, I'll also mention that there is no simple relationship between fees and results. In fact, we find the correlation between annual net expense ratio and excess returns to be close to zero.

So what do you do about all of this? Let me offer three takeaways:

- Recognize that the challenge in finding differential skill among active managers reflects a surfeit, not a dearth, of skill. This is the major lesson of the paradox of skill. And it applies well beyond the world of investing.
- Remember the story about Jim Rutt: the key to making money is not just proficiency, but finding easy games. In investing, it's giving a great deal of thought as to why you are—or think you can hire—the smartest person at the poker table. As Napoleon was reported to say, "Ability is nothing without opportunity."¹⁹

- A good statistic is one that is persistent and predictive. We are awash in statistics, and we know that they are not created equally. Run that little test by the statistics you see. Active share appears to be potentially interesting as a measure, but we should continue our search.

Thank you very much.

Endnotes:

¹ Michael J. Mauboussin, *The Success Equation: Untangling Skill and Luck in Business, Sports, and Investing* (Boston, MA: Harvard Business Review Press, 2012).

² Stephen Jay Gould, *Full House: The Spread of Excellence from Plato to Darwin* (New York: Three Rivers Press, 1996), 98-121.

³ See http://www.baseball-reference.com/leaders/batting_avg_top_ten.shtml.

⁴ Phil Rosenzweig, *The Halo Effect . . . and the Eight Other Business Delusions That Deceive Managers* (New York: Free Press, 2007), 111-121.

⁵ Wilbert M. Leonard II, "The Decline of the .400 Hitter: An Explanation and a Test," *Journal of Sport Behavior*, Vol. 18, No. 3, September 1995, 226-236.

⁶ Richard C. Grinold, "The Fundamental Law of Active Management," *Journal of Portfolio Management*, Vol. 15, No. 3, Spring 1989, 30-37; Richard C. Grinold and Ronald N. Kahn, *Active Portfolio Management: A Quantitative Approach for Producing Superior Returns and Controlling Risk, Second Edition* (New York: McGraw Hill, 2000), 147-169; Roger Clarke, Harindra de Silva, and Steven Thorley, "The Fundamental Law of Active Portfolio Management," *Journal of Investment Management*, Vol. 4, No. 3, Third Quarter 2006, 54-72.

⁷ A person who is easy to take advantage of is called a "patsy." Quote is from Warren E. Buffett, "Letter to Shareholders," *1987 Berkshire Hathaway Annual Report*.

⁸ Laura Casares Field and Michelle Lowry, "Institutional versus Individual Investment in IPOs: The Importance of Firm Fundamentals," *Journal of Financial and Quantitative Analysis*, Vol. 44, No. 3, June 2009, 489-516. Also, Randolph B. Cohen, Paul A. Gompers, and Tuomo Vuolteenaho, "Who underreacts to cash-flow news? Evidence from trading between individuals and institutions," *Journal of Financial Economics*, Vol. 66, No. 2-3, November-December 2002, 409-462. Also, Brad M. Barber, Yi-Tsung Lee, Yu-Jane Liu, and Terrance Odean, "Just How Much Do Individual Investors Lose by Trading?" *Review of Financial Studies*, Vol. 22, No. 2, February 2009, 609-632. For a current example, see Rob Copeland, "Hedge Funds Gear Up for Another Big Short," *Wall Street Journal*, July 22, 2015.

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¹⁵ Michael Lewis, *Moneyball: The Art of Winning an Unfair Game* (New York: W.W. Norton & Company, 2003), 127-128. On-base plus slugging percentage equals on-base percentage plus slugging percentage. On-base percentage equals hits + bases on balls (walks) + hit by pitch divided by at-bats + bases on balls + hit by pitch + sacrifice flies. Slugging percentage equals total bases divided by at-bats.

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¹⁹ We could not find an original source. The quotation has also appeared on the paper label of Salada tea bags.

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Total Addressable Market

Methods to Estimate a Company's Potential Sales

September 1, 2015

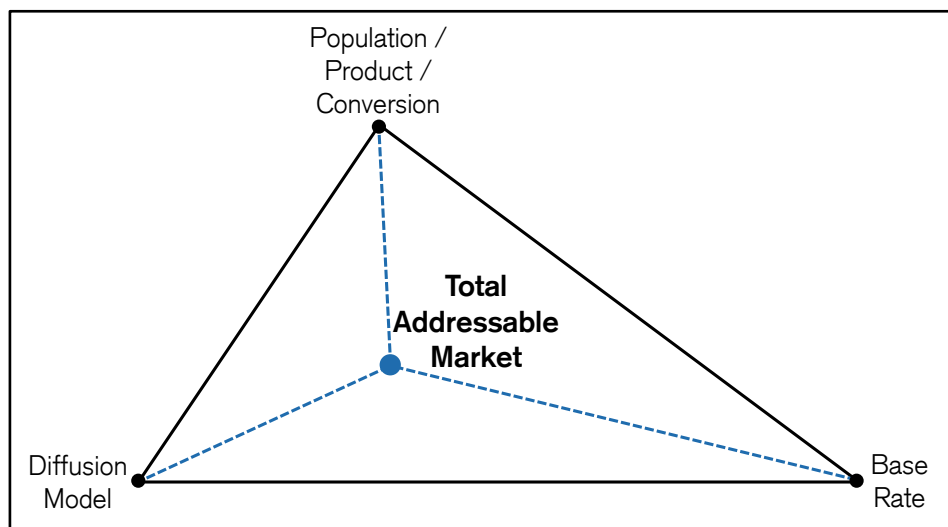
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- The ability to calibrate the total addressable market (TAM) is a major part of anticipating value creation. Assessing value creation requires understanding how much a company can invest and the returns those investments will earn.
- We define TAM as the revenue a company could realize if it had 100 percent share of a market it could serve while creating shareholder value.
- This report provides a framework for estimating TAM through the process of triangulation using three methods. The first is based on population, product, and conversion. Next we examine a diffusion model, which not only addresses the absolute size of the market but also the rate of adoption. Finally, we discuss the usefulness of appealing to base rates as a reality check for optimistic estimates of TAM and growth rates.
- Companies can expand their TAMs through business category evolution, hence placing their products or services at the heart of an ecosystem. Done successfully, this allows the company to take advantage of network effects, encourages customers to remain within the ecosystem, and extends a company's period of competitive advantage.
- We include a checklist to guide analysis and discussion.

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Executive Summary

- The ability to calibrate the total addressable market (TAM) is a major part of anticipating value creation. Since 1960, about one-third of the value of the S&P 500 Index has been attributable to the anticipated payoff from future investment. Assessing value creation requires understanding how much a company can invest and the returns those investments will earn.
- We define TAM as the revenue a company could realize if it had 100 percent share of a market it could serve while creating shareholder value. You should recognize up front that TAM is not about how large a firm can grow to be but rather how much it can expand while adding value.
- This report provides a framework for estimating TAM through the process of triangulation using three methods. The first is based on population, product, and conversion. Next we examine a diffusion model, which not only addresses the absolute size of the market but also the rate of adoption. Finally, we discuss the usefulness of appealing to base rates as a reality check for optimistic estimates of TAM and growth rates.
- Estimating TAM is trickiest when both the market and the technology are new.
- The first approach to assess TAM is to estimate the absolute size of the market, which has three parts: estimates of the broad population, the percentage likely to use the good or service, and the revenue potential. An in-depth analysis of the absolute size of the market also requires careful consideration of factors that shape demand and supply.
- The workhorse for forecasting the rate of adoption for new products and services is a model developed in the 1960s by a marketing professor named Frank Bass. The Bass model allows for a prediction of the purchasers in a period, say for each year, as well as a total number of purchasers. The model helps calibrate TAM as well as the rate of growth in getting to TAM.
- The Bass model relies on three parameters: the coefficient of innovation (p), the coefficient of imitation (q), and an estimate of the number of eventual adopters (m). The primary way to estimate parameters is to use analogies from the diffusion of similar products or services.
- In cases where network effects are strong, it is common for one network to become dominant. For most consumer products, the market share of the leading company rarely tops 40 percent, but in businesses with strong network effects, market shares are generally well above 50 percent and commonly closer to 90 percent.
- Base rate analysis refers you to what happened to other companies when they were in a situation similar to the one you are examining. No reference class is perfect but the base rate of performance can lend a vital point of view of the plausibility of a TAM estimate. Indeed, research shows that using base rates generally improves the accuracy of forecasts.
- Companies can expand their TAMs through business category evolution, hence placing their products or services at the heart of an ecosystem. Done successfully, this allows the company to take advantage of network effects, encourages customers to remain within the ecosystem, and extends a company's period of competitive advantage.

Introduction

The ability to calibrate the total addressable market (TAM) is a major part of anticipating value creation. Since 1960, about one-third of the value of the S&P 500 Index has been attributable to the anticipated payoff from future investment. Assessing value creation requires understanding how much a company can invest and the returns those investments will earn.¹

We define TAM as the revenue a company would realize if it had 100 percent share of a market it could serve while creating shareholder value. TAM is a concept that executives and investors use frequently, but that few define properly or thoughtfully. You should recognize up front that TAM is not about how large a firm can grow to be but rather how much it can expand while adding value.

An exchange in 2014 between Aswath Damodaran and Bill Gurley over the prospects for Uber, the transportation company, brings TAM into sharp focus. Damodaran, a professor of finance at the Stern School of Business at New York University and a recognized expert in valuation, suggested the company was worth about \$6 billion, a fraction of the \$17 billion value implied by a round of financing the company had completed at that time.² (A round in the summer of 2015 valued the business in excess of \$50 billion.³)

Gurley, a highly successful venture capitalist with Benchmark Capital and an early investor in Uber, responded with an article called “How to Miss By a Mile: An Alternative Look at Uber’s Potential Market Size,” in which he argued that Damodaran’s valuation grossly underestimated the magnitude of Uber’s potential TAM.⁴ Both men are believers in using discounted cash flow to value the business so the crux of their disagreement, which was refreshingly civil, sat squarely on the perceived size of Uber’s opportunities.

Damodaran calculates Uber’s TAM based on the taxi and car service business, which he estimates to be \$100 billion. He then assumes the company can reach a market share of 10 percent, and proceeds to calculate the value of the business. Gurley suggests that Uber’s TAM is in the range of \$450 billion to \$1.3 trillion, and argues the company can capture a market share of up to 25 percent. Gurley comes to a wildly different conclusion about value because the high end of his estimate for addressable TAM is more than 25 times larger than what Damodaran assumes. To buttress his case, Gurley notes that Uber’s revenue in San Francisco, one of its early markets, is already “multiples bigger” than the \$140 million of total revenue from the taxi and car service industry. And business is still growing rapidly in that region.

After a brief discussion of product categorization, this report provides a framework for estimating TAM through the process of triangulation. We use three methods. The first approach is based on population, product, and conversion. Next, we examine a diffusion model, which not only addresses the absolute size of the market but also the rate of adoption. The key is to come up with sensible parameters to inform the model. Finally, we discuss the usefulness of appealing to base rates as a reality check for optimistic TAM estimates and growth rates.

In the last section of the report we discuss TAM in the context of business category evolution. Increasingly, companies seek to build ecosystems around their goods or services that can expand their addressable market. This is relevant in understanding the popular topic of the “internet of things,” where people or objects are nodes of an interactive network and information is freely transferred between the nodes.

Categorizing New Products

The categorization of products is a logical starting point in assessing market size.⁵ There are several categories of products, but we can arrange them based on whether the product technology and customers are new or current (see Exhibit 1). This allows us to appraise a company's strategy to promote the product and provides guidance about which forecasting method is likely to be most effective.

For current technologies with current customers, captured in the bottom left corner of exhibit 1, the basic analysis boils down to how much the market will grow and how market shares will change. These are not new products, so a TAM analysis is of limited use. Companies can influence their TAM through pricing strategy and product enhancement.

Exhibit 1: Classification of New Products

		Current Technology	New Technology
New Customers	Product Strategy	Market Development	Diversification / Disruptive
	Forecast Method	Customer and Market Analysis	Scenario Analysis (What If)
Current Customers	Product Strategy	Market Penetration	Product Development
	Forecast Method	Sales Analysis	Product Line / Life Cycle Analysis

Source: Kenneth B. Kahn, *New Product Forecasting: An Applied Approach* (Armonk, NY: M.E. Sharpe, 2006), 9.

On April 2, 1993, Philip Morris cut the price of Marlboro cigarettes by 20 percent in an effort to prop up its market share. This is an example of a pricing strategy. The stock market didn't like the decision to trade higher market share for lower profits, and the shares of Philip Morris stock lost almost a quarter of their value. Product enhancement can reflect improvement in the product itself or in elements of design or packaging. Think of the evolution of packaging for Heinz ketchup.

There is a positive correlation between market share and profitability, which encourages some executives to focus on market share goals. However, evidence from academic research shows that corporate objectives focused on competitors, including targets for market share, are generally harmful to profitability.⁶

Current technologies that have applications for new customers (upper left corner of exhibit 1) and new technologies used by current customers (bottom right corner) are the categories where a TAM analysis is most relevant. Current technologies for new customers include geographic extension and novel applications of existing products. The classic example of the latter is the use of Arm & Hammer baking soda as a means to manage odor in a refrigerator. Pharmaceutical products with therapeutic applications beyond their initial target are another case in point.

New technologies for current customers fall in a range from the prosaic, such as line extensions, to disruptive innovations. An instance of a line extension is the launch of Colgate Total toothpaste, which included novel antibacterial technology, in 1997. That product quickly gained one-tenth of the U.S. toothpaste market.

The theory of disruptive innovation was formalized by Clayton Christensen, a professor at Harvard Business School. Part of the theory describes the process by which products enter a market using a new “value network,” essentially a different business model. The introduction of electronic books and the interplay between Amazon.com’s e-book inventory and the Kindle, its reading device, is an example of an innovation that disrupted the book industry.

Estimating TAM is trickiest when both the technology and the customers are new. Here, the number of ultimate adopters, as well as the rate of adoption, is unknown. This is where forecasters have made some of the most embarrassing blunders of all time. The market for computers? Maybe five, said the head of IBM in the early 1940s. How about personal computers? “There is no reason anyone would want a computer in their home,” said the founder of Digital Equipment Corporation, a maker of minicomputers.⁷

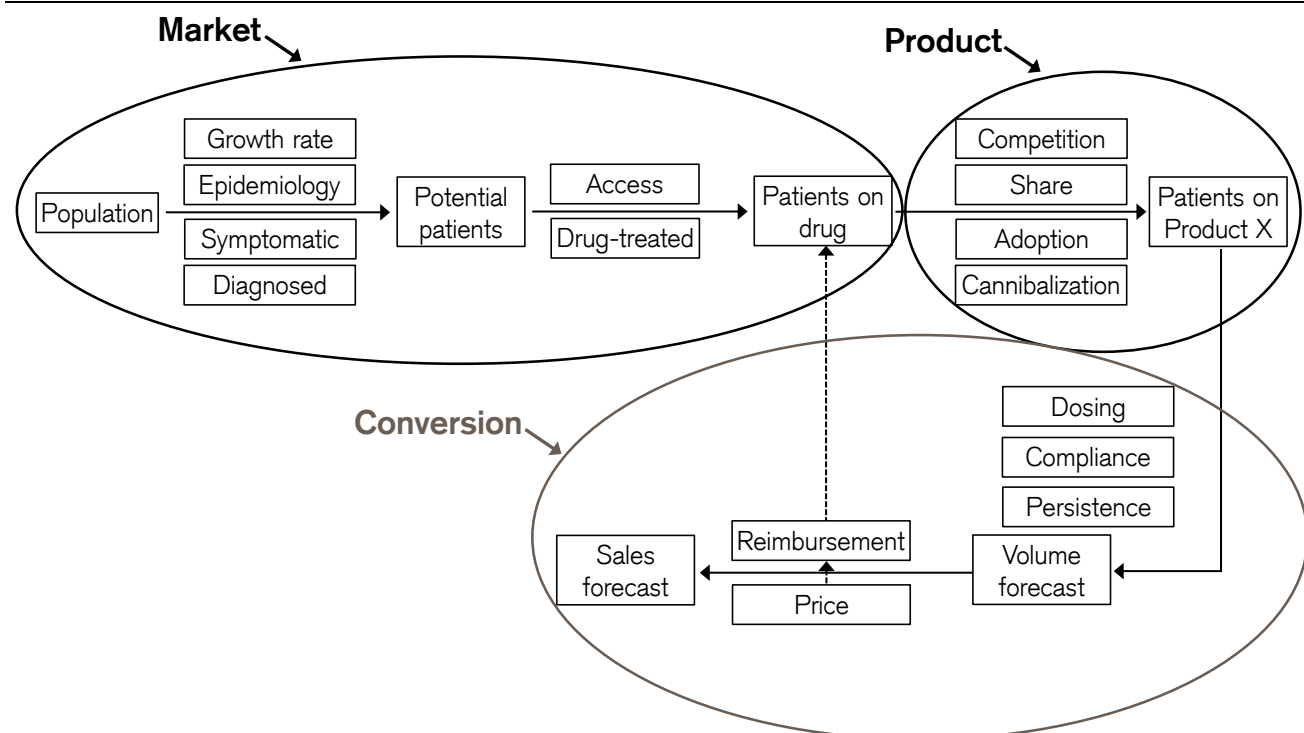
The value in categorizing new products is to get a sense of the best way to forecast the TAM. In some cases the process is as straightforward as counting potential users and estimating market share and pricing. In other cases, especially in those dealing with novel goods or services where network effects are relevant, the range of outcomes is much wider and less certain. Let’s take a look at some specific ways to estimate TAM.

Market Size: Population, Product, and Conversion

The first approach to assess TAM is to estimate the absolute size of the market, which is simply the number of potential customers times the expected revenue per customer. This model is popular for estimating the sales potential for a new drug.⁸ Exhibit 2 shows the components of the TAM estimate. There are three parts to this analysis: estimates of the broad population, the population likely to use the good or service, and the revenue potential. Here’s an examination using statins, cholesterol-reducing drugs, as a case study.

- **Population.** The analysis begins with the population of individuals who may have a particular disease. Those patients must consult with a health care provider, be properly diagnosed, and seek treatment. More than 20 percent of the 320 million people in the United States have high cholesterol. A joint study by the American College of Cardiology and the American Heart Association suggests that 56 million Americans between the ages of 40 and 75, roughly three-quarters of those with high cholesterol, are eligible to consider a statin. About 25 million Americans are currently taking statins.⁹
- **Product.** There are about a half-dozen prescription statins available in the U.S. They vary in efficacy. Factors that determine market share include the characteristics of the drug itself, marketing, pricing, and patent protection. For other pharmaceutical products, additional factors in determining the rate and likelihood of adoption include method of delivery, frequency of use, and dosage.
- **Conversion.** Just because a patient is prescribed a drug doesn’t mean that he or she will take it as suggested. Compliance is a large issue. For example, studies suggest that about half of the patients who receive a prescription for a drug to lower lipids stop taking it within six months. Only 40 percent still take the drug after a year, and roughly one-quarter after five years.¹⁰ The main reasons patients are non-compliant is that they don’t know they are supposed to refill their prescription and they don’t like the side effects. After you come up with a forecast for volume, you can consider the price for the product. This ultimately allows for an estimate of the sales for the product.

Exhibit 2: Components of Total Addressable Market Forecast



Source: Based on Arthur G. Cook, *Forecasting for the Pharmaceutical Industry: Models for New Product and In-Market Forecasting and How to Use Them* (Burlington, VT: Gower Publishing Company, 2006), 36.

Researchers at McKinsey & Company, a consulting firm, studied the sales forecasts for new drugs made by analysts at brokerage firms.¹¹ The data included more than 1,700 individual forecasts on 260 drugs over a recent ten-year span. The researchers found that the median error of all analysts for a drug's peak sales was only four percent. But the average error was large. Almost two-thirds of the estimates missed the peak revenue amount by 40 percent or more. Further, forecasts for follow-on drugs were no better than the first launches within a therapeutic class.

A more in-depth analysis of the absolute size of the market requires careful consideration of factors that shape demand and supply. We'll start with demand.

From the outset, it is useful to distinguish between the user and the payer. They may not be the same. For example, parents buy goods and services for their young children, and pet owners purchase on behalf of their pets.¹² This point is especially relevant in health care, where the consumers and payers are separate. In these cases, you need to consider the needs of the user as well as the incentives of the payer.

Other factors to consider in assessing demand include:

- **Financial resources.** How much money do the buyers have? Are their resources growing or shrinking?
- **Physical limitations.** This includes a consideration of how much a person can eat, drink, wear, or use a product. A market becomes saturated when most people are using as much of the product as they can. For instance, shifts in how consumers allocate their time are having a profound effect on the media and advertising industries, and the dust has yet to settle.

- **Elasticity of demand.** Elasticity measures the change in demand as a function of a change in price. Inelastic goods show little decrease in demand as prices increase, whereas demand drops more rapidly for elastic goods. So as prices rise, TAM may grow for an inelastic good and shrink for an elastic good.
- **Cyclical.** Some products have cyclical demand, which cautions against extrapolating short periods of results into estimates of TAM.
- **Substitution and substitution threats.** Substitution is a big deal in assessing TAM. How does a consumer allocate his or her time and money today and how might that change over time? This factor appears at the center of the disagreement between Damodaran and Gurley on Uber: Damodaran considers only that Uber will be a substitute for taxis and limos, whereas Gurley assumes that it will be a substitute for the ways we move people and things from point A to point B.

Value creation is at the center of a careful definition of TAM. The question is not how big the company can get, but rather the revenue potential assuming the company can generate a return on investment excess of the cost of capital.¹³ This is relevant as we consider TAM from the supply side.

Similar to the case with users and buyers, we must recognize that suppliers may be different than sellers. For example, most automakers use a network of dealers to sell their cars. So, the TAM for the automakers reflects, at least to some degree, the location and quality of their dealer network.

Other factors to consider in assessing supply include:

- **Ability to supply.** Considerations include a business's production capacity, the infrastructure to get goods to market, and its geographical footprint. A company's ability to supply a good or service is commonly limited to a fraction of the market it can theoretically access.
- **Unit growth and pricing.** You want to consider carefully where the industry is in its life cycle and what that implies about the rate of growth and pricing flexibility. Assess how well capacity, whether based on manufacturing, service, or knowledge production, matches the rate of demand growth. Ask whether the company uses pricing as a lever to drive scale or to increase profitability. As we will see, this is relevant for businesses seeking to capture network effects.
- **Regulatory constraints.** Regulations can play a large role in shaping TAM. Economic regulation creates rules that limit which companies can participate in an industry. These include capital requirements, tariffs and quotas, price or rate of return caps, and licenses. Social regulation attempts to address potential market failures. Emission standards and mandated information disclosure are examples. Changes in regulation can shrink or expand TAM.
- **Incentives.** This discussion can start with the classic principal-agent problem, where management may make choices that increase their utility at the expense of shareholders. For example, companies in the U.S. are investing in their businesses at a very measured rate. Shareholders may want to see the companies invest more aggressively, and some have said as much publicly.¹⁴ Ironically, the increase in compensation in the form of restricted stock units, meant to make the interests of executives more aligned with those of shareholders, may be encouraging risk aversion. Conflicts can also happen within the business. For example, a traditional brick and mortar retailer may fear too much success with an online offering as the customer migration may harm the economics of the physical stores.

- **Scale.** Economies of scale are often crucial for sustainable competitive advantage. But most companies can only achieve scale advantages on a local basis. Few can do it nationally or internationally.¹⁵ Since creating value is in the definition of TAM, addressable TAM is commonly smaller than total TAM because of the difficulty of gaining scale.
- **Niches.** If two or more competitors are in the same market, they often concentrate on different segments so as to reduce competitive conflict. As a consequence, the TAM is not as large as it appears.

Estimating the absolute size of the market by considering population, product, and conversion is a solid foundation for assessing TAM and will likely remain so. However, we can add richness to our analysis by considering a social dimension.

TAM and the Bass Model

The workhorse for forecasting the rate of adoption for new products and services is a model developed in the 1960s by a marketing professor named Frank Bass.¹⁶ Bass was influenced by Everett Rogers, a professor of communications and sociology, who wrote the seminal book, *Diffusion of Innovations*.¹⁷ The Bass model allows for a prediction of the purchasers in a period, say for each year, as well as a total number of purchasers. So the model helps calibrate TAM as well as the rate of growth in getting to TAM. This rate of growth is essential to valuing a business.

A simple version of the Bass model relies on three parameters:¹⁸

- **The coefficient of innovation (p).** This captures mass-market influence. The parameter p is at play if you are excited about buying a good or service even though you don't know anyone who has it yet, or if advertising has influenced you.
- **The coefficient of imitation (q).** This reflects interpersonal influence. It's basically the power of word of mouth or social contagion. You want something because all of your friends have it.
- **An estimate of the number of eventual adopters (m).** A parameter that determines the size of the market.

The key to a model's usefulness is coming up with thoughtful inputs for the parameters. We'll discuss how to do that in a moment.

Say we want to determine the number of adopters (N) during a specific period. The equation for the Bass model is as follows:

$$N(t) - N(t-1) = [p + qN(t-1)/m] \times [m - N(t-1)]$$

The equation looks intimidating, but we can break it into parts to make it a lot easier to grasp. It basically says that new adopters equal the adoption rate times the number of potential new adopters.

$N(t) - N(t-1)$, the number of adopters during a period, is simply the difference between the users now, $N(t)$, and the users in the prior period, $N(t-1)$. So if there were 110 users at the end of period t and 100 at $t-1$, there would have been 10 adopters during the period ($110 - 100 = 10$).

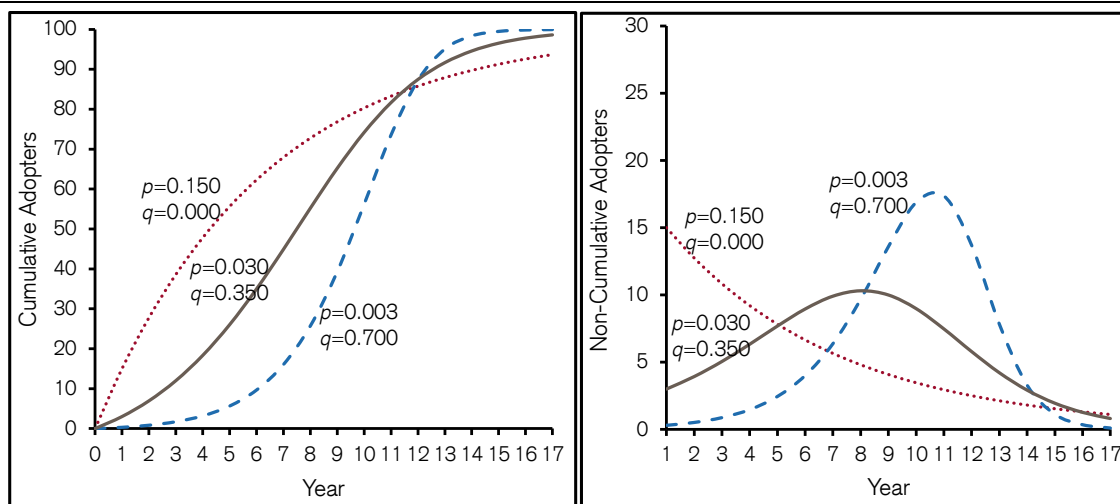
The first term on the right side of the equation, $[p + qN(t-1)/m]$, spells out the rate of adoption. People are more likely to adopt a product or service if lots of other people are already using it. So the coefficient of imitation, q , is applied to the proportion of users, which is $N(t-1)/m$. Let's say the number of eventual users is 500. That means that if $N(t-1)$ equals 100 and m equals 500, then $N(t-1)/m$ is 0.20 ($100/500 = 0.20$). You multiply q by that penetration rate. The coefficient of innovation, p , is independent of the number of users.

The second term on the right side is the number of users who have not yet adopted the product. It's the total number of eventual adopters, m , minus the number of adopters in period $t-1$. With an m of 500 and $t-1$ of 100, we know the number of people who have yet to adopt the product is 400 ($500 - 100 = 400$).

One study of diffusion found that the average coefficient of innovation, p , was 0.037, significantly smaller than the average coefficient of imitation, q , of 0.327. Appendix A shows the empirical parameters for more than 50 products.¹⁹

Exhibit 3 shows the output of the model assuming an m of 100, and a range of values for p (from 0.003 to 0.150) and q (from 0.000 to 0.700). In cases when q is larger than p , the penetration of users follows an S-curve, as the left side of the exhibit shows. Thus, when the coefficient of imitation is greater than zero, the proportion of users that adopt follows a pattern similar to a normal distribution. You can see this on the right side of the exhibit. This is very consistent with the work of Everett Rogers.²⁰

Exhibit 3: Output from the Bass Model



Source: Credit Suisse.

Investor application of the Bass model. Investors can use the model in a couple of ways. The first is to estimate product potential based on the parameters from historical diffusions. Bass's model of the adoption of satellite television is an example of this approach.²¹

In 1992, Bass forecasted the number of satellite television subscribers for 1999 based on market research, past diffusion patterns, and management guidance. In the model he assumed that m , the number of eventual adopters, was 16 percent of homes with television sets and that the coefficients for p and q were similar to those for cable television in the 1980s. The result was a prediction of 9.4 million adopters in 1999. The actual number was just under 10.0 million (see Exhibit 4).

Exhibit 4: Bass Model Forecast for Satellite Television

	1992 forecast of homes acquiring satellite TV	Actual number of homes acquiring satellite TV	1992 forecast of penetration (%)	Actual yearly penetration (%)
1995	0.875	1.150	0.92	1.21
1996	2.269	3.076	2.37	3.21
1997	4.275	5.076	4.42	5.25
1998	6.775	7.358	6.95	7.55
1999	9.391	9.989	9.55	10.16

Source: Frank M. Bass, Kent Gordon, Teresa L. Ferguson, and Mary Lou Githens, "DIRECTV: Forecasting Diffusion of a New Technology Prior to Product Launch," *Interfaces*, Vol. 31, No. 3, May-June 2001, S90.

A second way to use the model is to start with a company's stock price and work backward. This allows for an assessment of what the market anticipates for the rate of growth in adopters as well as the total number of adopters. You can then compare the parameters imputed from the market price with empirical results to judge the likelihood of achieving those levels. This expectations approach trades the need for specificity for a general sense of plausibility.

The Bass model has another nice feature: it allows you to solve for the size of peak sales.²² An estimate for this outcome can be very relevant for gauging expectations. You can calculate the size of peak sales with this equation:

$$\text{Size of peak sales} = m \left[\frac{(p+q)^2}{4q} \right]$$

This measure is relevant because companies and investors are tempted to extrapolate the growth rates they see in the steepest part of the S-curve, and hence anticipate too much growth. For instance, color televisions were launched in the 1950s and reached peak sales in 1968 (color televisions didn't outsell black and white models until the early 1970s). As the industry was growing rapidly in the 1960s, manufacturers extrapolated that growth and added capacity accordingly. The result was manufacturing capacity in 1968 of 14 million units, while sales topped out at 6 million.

Researchers have added a number of refinements to the Bass model in an effort to address the model's limitations.²³ But since its introduction 45 years ago, the basic model has been reasonably robust in explaining the pattern of sales for products as varied as videocassette recorders, color television sets, and personal computers.²⁴

The goal of a diffusion model is to understand the shape of consumer adoption and hence the evolution of the industry. Naturally, there can be many competitors in an industry jockeying for market share. A diffusion model shows TAM, which assumes that one company can garner all of the market. How the market is divided is also crucial.

Detailed studies of product and industry life cycles show that there are typically three stages in industry evolution.²⁵ During the first stage, the number of competitors grows. For example, the number of firms grew from a handful to about 75 in the U.S. automobile industry in this stage. In the second stage there is a large shakeout as the result of a high number of firms exiting, which means that the number of competing firms declines sharply. In autos, the number dropped to about 20. Finally, the number of competitors, and often market shares, stabilize in the third stage.

This can be relevant for an assessment of a company's potential because in stage two, a company's sales can grow faster than the market itself if the number of competitors declines. Consider a new industry that has sales of \$100 split equally among 10 competitors. Say that as the industry goes through stage two, sales rise to \$200 while the number of firms drops to 5. As the industry's sales doubled, the potential amount of sales quadrupled for the survivors.

Estimating parameters for the Bass model. The output of any diffusion model is only as good as the parameters you use, so we now turn to an approach to estimating the parameters of the Bass model. The primary way to do this is through analogy. For example, you might assume that the adoption of satellite television is analogous to the adoption of cable television.

Of course, finding proper analogies is tricky. Even if products are alike in some regards, they will be different in other ways. There should be no expectation that the diffusion process of one product will comport exactly with another.

Exhibit 5 summarizes various microeconomic factors that provide a solid basis for finding appropriate analogies.²⁶ The specific process is to select a handful of products that are candidates as good analogies, and score them on the factors in the exhibit. The score allows you to assess which products or services are most akin to the one you are modeling and therefore provides a starting point for the appropriate parameters. It may also be useful to weight multiple products to reflect the blend of their characteristics.²⁷

Exhibit 5: Basis for Comparing Products to Identify Strength of Analogy

Basis of Analogy	<u>Candidates</u>		
	Product 1	Product 2	Product 3
Economic situation			
Economic			
Technological			
Political			
Regulatory			
Ecological			
Social			
Market structure			
Market potential			
Sales history			
Barriers to entry			
Number of generic competitors			
Type of generic competitors			
Segmentation			
Buyer behavior			
Buying situation			
Decision process			
Choice attributes			
Buying center			
Marketing strategy			
Product			
Price			
Promotion			
Distribution			
Characteristics of innovation			
Relative advantage			
Compatibility			
Complexity			
Divisibility			
Communicability			

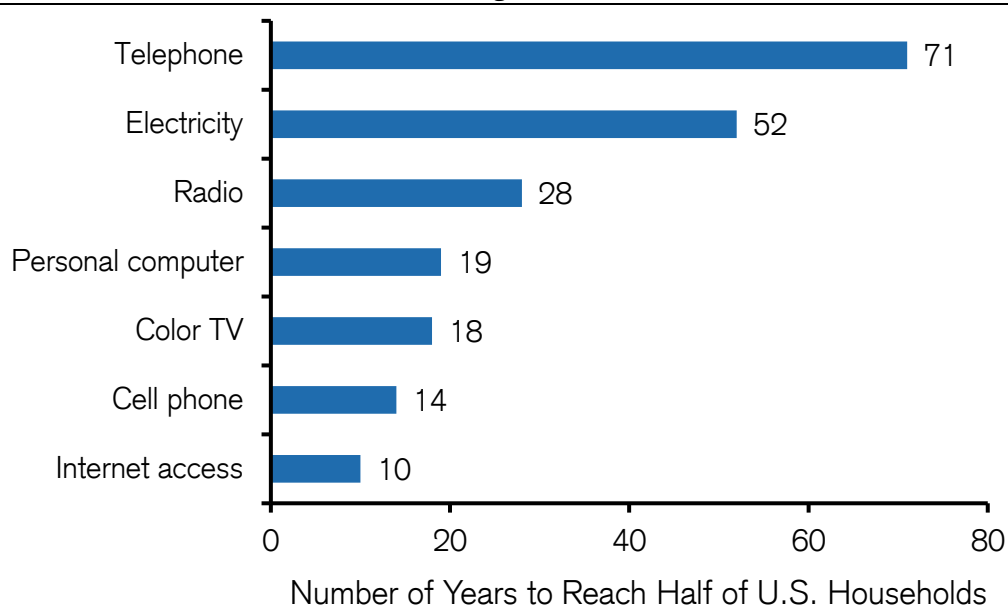
Source: Robert J. Thomas, "Estimating Market Growth for New Products: An Analogical Diffusion Model Approach," Journal of Product Innovation Management, Vol. 2, No. 1, March 1985, 48.

Appendix B summarizes a case study on the adoption of satellite radio.²⁸ The authors, Elie Ofek, a professor of marketing at Harvard Business School, and Peter Wickersham, a research associate, estimate the size of the market, m , based on assumptions about radio and subscription prices and calculate weighted averages for p and q based on the characteristics of analogous products.

We have a lot of data on the parameters for past diffusions, but many of those cases are dated. Further, research shows that there has been an acceleration in the rate of diffusion. For example, an innovation that reached 5 percent household penetration in 1946 took an estimated 13.8 years to go from 10 to 90 percent adoption. Innovations reaching 5 percent penetration in 1980 took only 6.9 years to achieve the same level of penetration.²⁹ And these are both before the advent of personal computers, the Internet, and mobile communication.

Exhibit 6 shows how long it took half of U.S. homes to adopt a number of significant new technologies. For example, it took 71 years for half of U.S. households to have a telephone and 52 years for electricity, but only 19 years for a personal computer and 10 years for Internet access.³⁰ New technologies not only have obvious primary benefits but also ancillary effects that ripple through the economy.

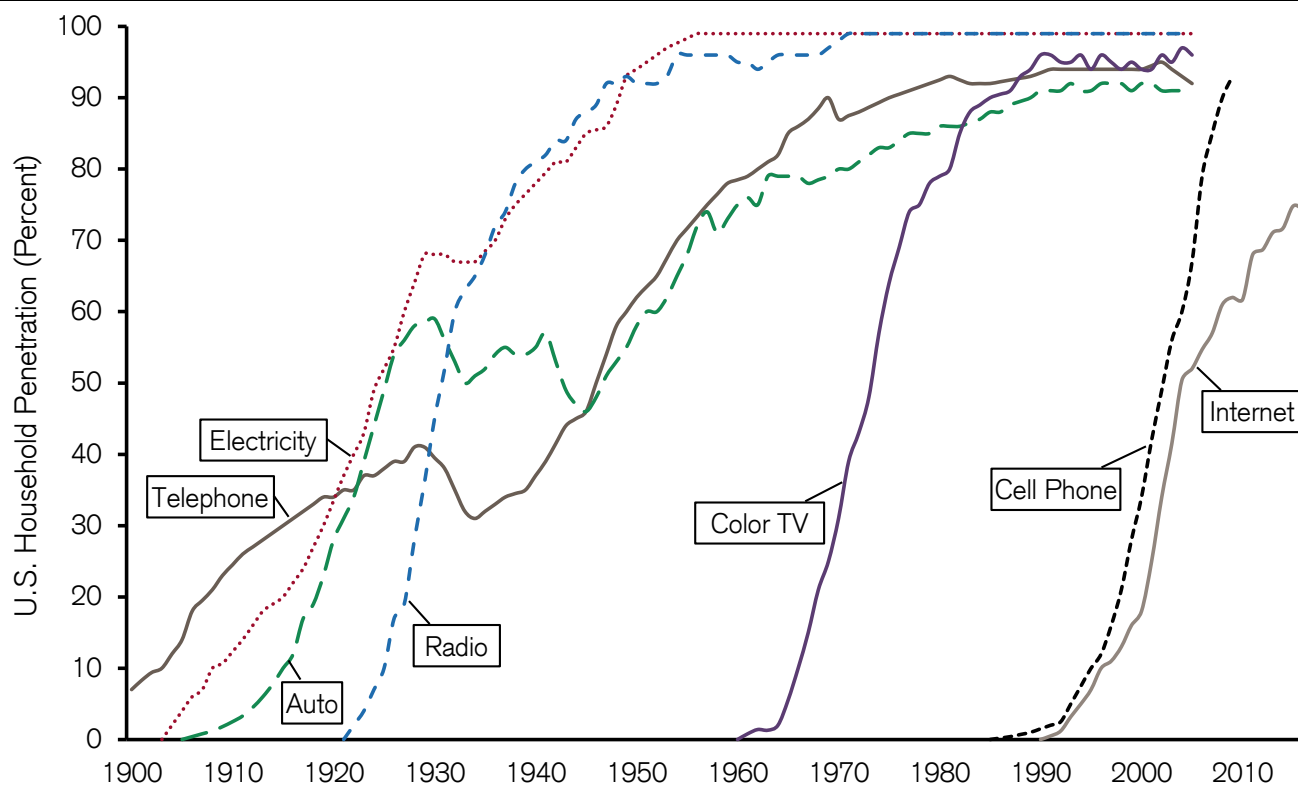
Exhibit 6: The Rate of Diffusion of New Technologies



Source: Adam Thierer and Grant Eskelsen, "Media Metrics: The True State of the Modern Media Marketplace," The Progress & Freedom Foundation, Summer 2008, 18.

Exhibit 7 shows the full rate of diffusion for seven important goods and services. Casual visual inspection shows that the slope of S-curves is steeper in recent times than it was in the past. The acceleration is especially pronounced for services. Consider that WhatsApp had 419 million users only 4 years after its launch. That compares to 145 million for Facebook, 123 million for Gmail, 54 million for Twitter, and 52 million for Skype over the same amount of time.³¹

Exhibit 7: The Rate of Diffusion Is Speeding Up



Source: Asymco, see: www.docs.google.com/spreadsheets/d/1uvn7o1X19Equ5EDvjXEMxpziAEAsXTJK9Xbf8NwYiAo/htmlview.

Limitations of the Bass Model

Use of a diffusion model can be very helpful in judging the TAM and the rate of adoption of a new good or service. Academics and consultants have shown the model's value in forecasts and have established a solid foundation of empirical parameters to guide judgments. But the model does have some limitations that don't allow it to capture certain considerations that are vital to anticipating corporate results.

We will focus on three areas. The first is the importance of replacement cycles. This is especially relevant in forecasting revenue growth. Next we consider economies of scale. As we have emphasized all along, TAM is not about size, it's about the size at which a company can create shareholder value. And finally there is the role of network effects. Here, we see lopsided market share distributions and increasing returns for the winners.

Replacement cycle. The Bass model is used primarily to forecast adoption of a product. But once a consumer buys something once, the next question is how frequently he or she will replace the product. Do you get a new smartphone every time a new product is announced? Or are you content to hold on to last year's model so long as it's working fine?

Frank Bass discussed the repurchase rate in his early research, but the topic has drawn less attention than the basics of the diffusion model itself.³² Appendix C has a detailed discussion of the role of replacement cycles in product demand. The main point is that unit demand can fall, even with a rise in population and penetration rate, if the replacement cycle lengthens. At a certain point of maturity, the replacement cycle becomes an essential component of demand. This is relevant for TAM as companies and analysts seek to assess total sales potential.

Economies of scale. A company enjoys economies of scale when its cost per unit for key tasks, including purchasing, production, distribution, sales, and service, declines as volume increases.³³ Economies of scale can be a vital source of competitive advantage, and therefore value creation, but you must be mindful of its limits. Getting bigger isn't always consistent with greater economies of scale. This means that companies commonly fail to create value beyond a certain size, practically limiting the level of TAM.

In this context, Bruce Greenwald, a professor of finance and economics at Columbia Business School, stresses that "all strategy is local."³⁴ By this he means that companies can enjoy economies of scale on a local or regional basis, but as the company grows, fulfilling its theoretical TAM, its ability to create incremental value dissipates rapidly.

Greenwald uses the retail industry as an example, and Wal-Mart is his primary case study.³⁵ The company established its strength in the 1970s through the mid-1980s by being superior to its competitors in inbound logistics, advertising, and executive supervision. These advantages were largely the result of geographic concentration. This allowed the company's stores and distribution centers to be tightly clustered, the advertising dollars to have an impact on lots of stores, and the management to have the ability to effectively oversee operations without having to span the country. The case study shows that when Wal-Mart expanded beyond its local strengths, its return on capital and competitive advantage eroded.

Greenwald shows that there is a high correlation between local market share for retailers, reflecting geographic concentration, and profitability. This lesson is relevant not only for retailers that rely on physical stores, but also for any business that relies on local distribution. If a company rolls trucks to serve its customers, geographic concentration is important.

A separate issue, although with similar implications, is when companies "overshoot" their markets.³⁶ This relates to the theory of disruptive innovation that Clayton Christensen developed. One of the concepts of the theory is that companies improve their product or service at a rate that is faster than what the market demands. Eventually, customers get more than they need and are therefore unwilling to pay for additional product enhancements. Two symptoms of an overshoot market are that customers use only a fraction of the functionality the product offers, and they are averse to paying for new features.

Companies serving overshoot markets are vulnerable in two ways. The first is companies that are investing to improve performance, if even for competitive reasons, find that the customers are reticent to pay for such improvements. This crimps profitability. Second, the market becomes open to what Christensen calls "disruptive innovations." These innovations are typically cheaper and simpler, and satiate the demands of only the least discerning customers. But the performance of these innovations improves rapidly, allowing them to appeal to mainstream consumers quickly. Disruptive innovations rely on a different business model than the incumbents and almost always have a lower cost structure.

As a result, companies in overshoot markets eventually get into a bind. They can't go upmarket to achieve greater profitability because the customer won't pay more. At the same time, they can't go downmarket because they run into the disruptive innovators that have lower costs. These companies are stuck.

A proper consideration of TAM includes the potential size of the market as well as the constraints to creating value. To add value over the long run, a company must have a competitive advantage. Economies of scale are one source of competitive advantage, but it is extremely difficult for companies with physical assets to achieve scale on a national or international basis. Further, companies can get to the point where they have overshoot the market, which precludes them from moving upmarket while creating value.

Network effects. Network effects exist when the value of a good or service increases as more people use that good or service.³⁷ The classic example is the telephone. If you are the only one with a phone, it is of no value. But as more people acquire one, the value of each phone rises. Metcalfe's law, which is more a guideline than a law, suggests the total value of a network, where n is the number of members, is proportional to $n^2 - n$.

Most of the products in Appendix A do not benefit from network effects in a meaningful way. Whether your neighbor has a blender or air conditioning doesn't affect the value of those products for you. Even hub-and-spoke networks, such as airlines, have limited network effects. However, the rise of the Internet and mobile communications has made network effects more relevant in recent decades. The key is that these are combinatorial networks, where the nodes can communicate with one another.³⁸

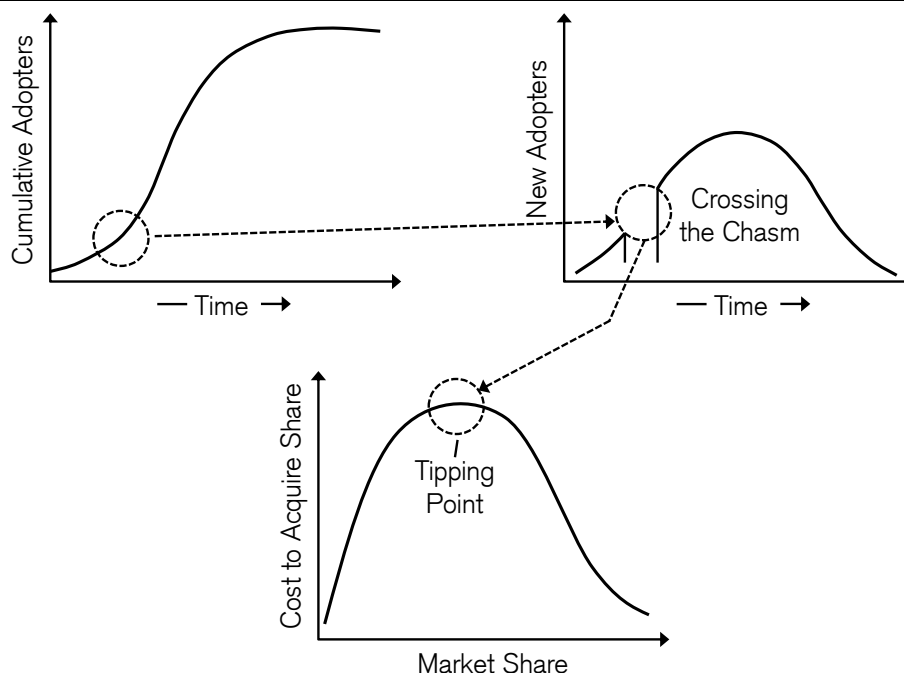
Consider the back-and-forth between Aswath Damodaran and Bill Gurley on the value of Uber. You can best describe Uber as a platform company that derives its value from network effects. For example, more users attract more drivers, and more drivers create more coverage and lower prices for the users, which creates additional demand, and so forth. Other classic examples of companies benefitting from network effects include Visa, eBay, Instagram, and Skype.

In cases where network effects are strong, it is common for one network to become dominant. For most consumer products, including athletic shoes, soft drinks, and automobiles, the market share of the leading company rarely tops 40 percent.³⁹ But in businesses with strong network effects, market shares are generally well above 50 percent and commonly closer to 90 percent. Examples include Microsoft's historical share of personal computer operating systems, eBay's share of online auctions, and Google's share of Internet searches.

W. Brian Arthur, an economist who has studied the networked economy extensively, likes to say, "Of networks, there will be few."⁴⁰ From a practical point of view, this means that companies will fight early on to become the network of choice, often spending great sums of money to do so.

Companies allocate resources in the hope that their product will beat their competitors and diffuse through the population. But Geoffrey Moore, a consultant to technology companies, has shown that in sectors with strong network effects, most companies fail to go from early adopters to mainstream users. Using Moore's memorable phrase, they are unable to "cross the chasm."⁴¹

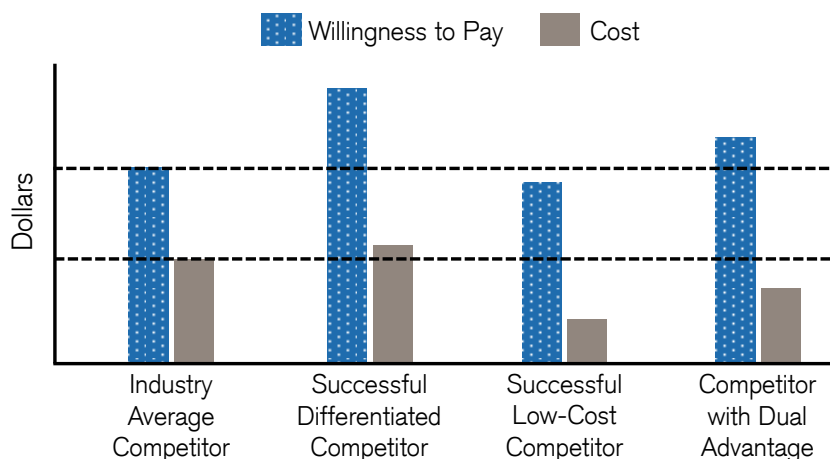
Exhibit 8 adds two elements to the diffusion process we have discussed. This is relevant where strong network effects are in place. The first, in the upper right corner, is the fact that the products of most companies don't diffuse through the population. The second, at the bottom, is that while the cost to add users may be high in the early phase of network formation, the cost per user drops rapidly once a network becomes dominant.

Exhibit 8: Network Effects: The Cost to Acquire Users Drops for the Winner


Source: Credit Suisse.

Why are Uber and its competitors, including Lyft, spending so aggressively today to attract users to their networks? Because these companies realize that one network is likely to emerge as dominant, which will allow for rapid growth and high returns on invested capital. This is what Brian Arthur calls the “active management of increasing returns.”⁴²

Central to the emergence of such an attractive business model is the fact that the winner benefits from economies of scale on both the supply and demand side. A company’s ability to create value is the difference between its sales and costs, including the cost of capital.⁴³ As exhibit 9 shows, a company can increase value by reducing costs or raising prices. Research shows that differences in the prices customers are willing to pay better explains profit variability among competitors than differences in cost structures.⁴⁴

Exhibit 9: Cost and Differentiation


Source: Pankaj Ghemawat, *Strategy and the Business Landscape*, Third Edition (Upper Saddle River, NJ: Prentice Hall, 2010), 51.

The concept of economies of scale has been around for a long time. The standard cost curve shows that as a manufacturing company increases output, its marginal and average unit costs decline up to a point. For these companies, the positive feedback is driven by increased sales. This is called supply-side scale because the more the company supplies, the lower is its cost per unit. This is classic increasing returns to scale.

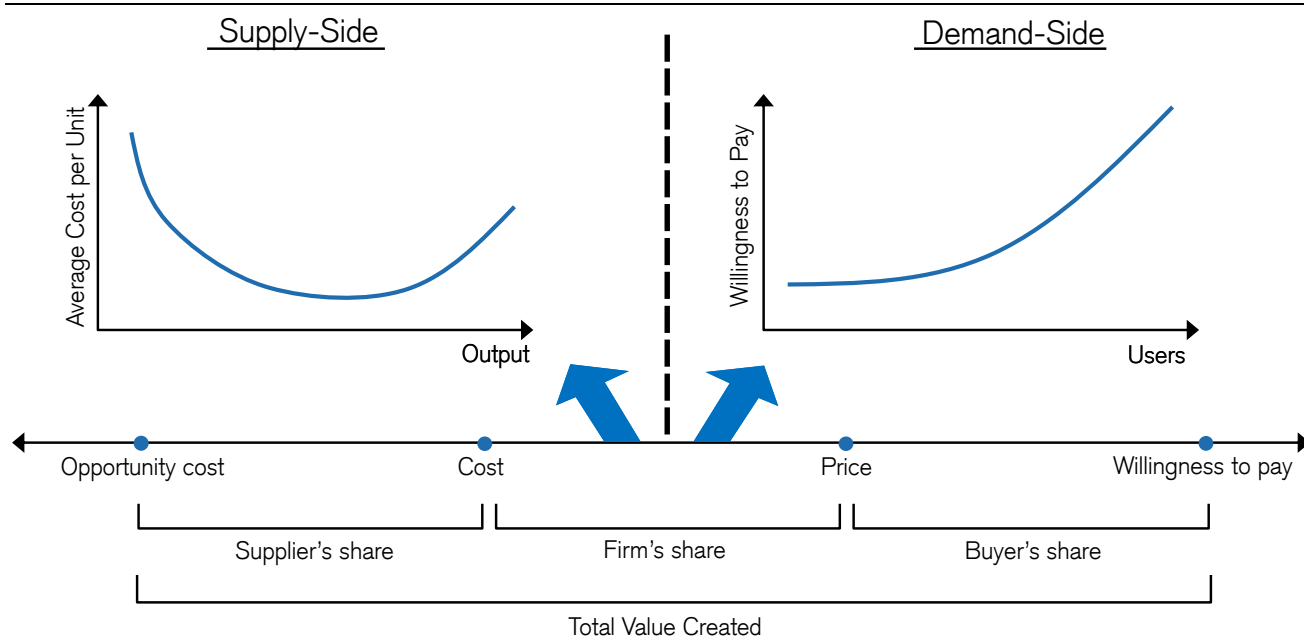
This positive feedback tends to dissipate as the result of growing bureaucracy and complexity, or input scarcity. (See the left side of Exhibit 10.) This generally happens at a level well before dominance. As we have noted, market shares in the industrial world rarely top 40 percent.

For combinatorial networks, network effects are the primary source of positive feedback. Rather than being driven only by supply, network effects are driven by demand as well. Specifically, the value to the users increases sharply once a network passes critical mass. Regardless of the cost of the supplier, customers are willing to pay more for the good or service because the network is more valuable to them.

Companies that win network battles enjoy lower costs as the result of supply-side scale and increase the value to the users as the network grows. If the company chooses not to raise prices in line with the increased willingness to pay, the company creates large consumer surplus. These are the dual advantages in exhibit 9. Exhibit 10 shows how these drivers affect a company's total value created.

Take Google as an example. Charlie Munger, vice chairman of Berkshire Hathaway, said, "Google has a huge new moat. In fact I've probably never seen such a wide moat."⁴⁵ Google's market share of global internet searches is close to 70 percent on all devices, and is about 90 percent on mobile and tablet devices. The vast number of queries provides strong advertising revenue, which in turn allows the company to enjoy economies of scale. At the same time, the business can invest in search technology and hence add value for users.

Exhibit 10: Supply- and Demand-Side Economies of Scale



Source: Credit Suisse.

The value of the networks that have been successful in recent years relies more on information than physical assets. This is significant for considering the nature of costs. Information goods generally have high upfront costs but very low incremental costs. Think of software. Writing code the first time is costly. But once finished, the cost of replicating and distributing the code is modest.

The combination of network effects and the cost characteristics of information goods can create a large amount of value in a relatively short period of time. A surge in sales, driven by network effects, along with low incremental costs can lead to substantial cash flow using only a modest amount of capital. A handful of network-based businesses have garnered valuations in the billions relatively quickly.

Networks based on information also benefit from classic economies of scale. The combination of network effects and low variable costs is what creates substantial positive leverage in operating profit margins. Exhibit 11 offers a simple example. Company A has low fixed costs but high variable costs. As sales volume grows, the operating profit margin rises, but the total gain is limited to 30 percentage points. Company B, has high fixed costs but enjoys substantially more leverage in operating profit margins, which improve by more than 50 percentage points.

Exhibit 11: Cost Structure Composition and Operating Profit Scalability

Company A				
Cost structure: 25% fixed, 75% variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Units	500,000	1,000,000	1,500,000	2,000,000
Sales (\$10.00 per unit)	5,000,000	10,000,000	15,000,000	20,000,000
Fixed costs	2,000,000	2,000,000	2,000,000	2,000,000
Variable costs	3,000,000	6,000,000	9,000,000	12,000,000
Total costs	5,000,000	8,000,000	11,000,000	14,000,000
Operating profit	0	2,000,000	4,000,000	6,000,000
Operating profit margin	0.0%	20.0%	26.7%	30.0%

Company B				
Cost structure: 75% fixed, 25% variable	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Units	500,000	1,000,000	1,500,000	2,000,000
Sales (\$10.00 per unit)	5,000,000	10,000,000	15,000,000	20,000,000
Fixed costs	3,500,000	3,500,000	3,500,000	3,500,000
Variable costs	583,330	1,166,660	1,749,990	2,333,320
Total costs	4,083,330	4,666,660	5,249,990	5,833,320
Operating profit	916,670	5,333,340	9,750,010	14,166,680
Operating profit margin	18.3%	53.3%	65.0%	70.8%

Source: Credit Suisse.

Note: Cost structure based on 1 million units.

Base Rates as a Reality Check

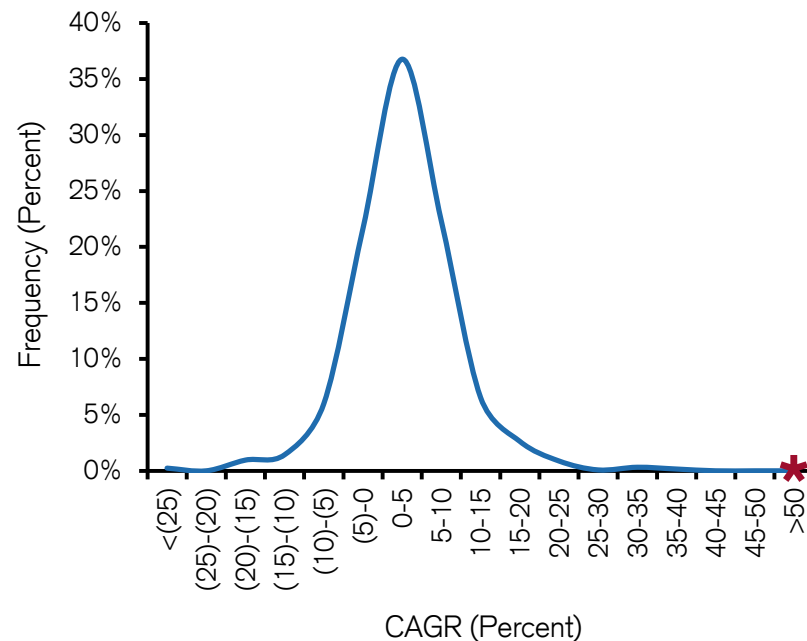
The third method in the triangulation process to estimate TAM is a careful consideration of base rates. The idea is to refer to what happened to other companies when they were in a situation similar to the one you are examining. No reference class is perfect, of course, but the base rate of performance can lend a vital point of view on the plausibility of a TAM estimate. Indeed, research shows that using base rates generally improves the accuracy of forecasts.⁴⁶

Here's an example of how the base rate approach can figure into your judgment of TAM. During a conference call in February 2015, Elon Musk, the chairman and chief executive officer (CEO) of Tesla Motors, suggested the company might be able to achieve a 50 percent compound annual growth rate of sales for the next decade off of a roughly \$6 billion revenue base in 2015.⁴⁷

You can start checking the plausibility of that growth rate by considering the population, product, and conversion method. You would consider the size of the global automobile market, estimate the share for electric cars in ten years, project Tesla's market share, and make some assumptions about vehicle prices. You would go through a similar process for the company's battery business. In other words, you would do a reality check through a bottom-up analysis.

Next, you might consider the diffusion literature. The automobile industry has a rich history, including the rate at which innovations such as automatic transmissions, air conditioning, and radial tires have permeated the industry.⁴⁸ You might complement these analogies with transformations in other industries, including the migration from traditional handsets to smartphones.

The base rate method takes a totally different approach. It simply asks: "What happened to other companies when they were in a comparable position?" Exhibit 12 shows the distribution of 10-year sales growth rates for more than 1,200 instances of companies of a similar size as Tesla is now, measured by sales. The average growth rate, adjusted for inflation, is less than three percent, with a standard deviation below eight percent. Further, no companies achieved a compound annual growth rate (CAGR) in excess of 40 percent (and the difference between 40 and 50 percent is enormous over a decade). We have placed a star at the growth rate Musk mentions.

Exhibit 12: 10-Year Growth Rates for Companies with \$6-13 Billion of Sales

Source: Michael J. Mauboussin and Dan Callahan, "The Base Rate Book – Sales Growth," Credit Suisse Global Financial Strategies, May 4, 2015.

Even in cases where the first two approaches to estimating TAM would seem to justify rapid growth, you should temper the forecast against what experience shows is plausible. Might Tesla achieve this growth rate? Of course, it's possible. But what probability is reasonable to assign to such a scenario? A prudent investor would keep it very low. Such a growth rate is about six standard deviations away from the average, given the sample of recent history. Base rates provide a check on the output of the first two approaches to estimating TAM.

TAM and Ecosystems

When Jack Welch retired as the CEO of General Electric (GE) in September 2001, the company had a lower share of its TAM than when he assumed the job 20 years before. Executives estimated that GE's share of its TAM in 2001 was less than 10 percent, half of what it was in the early 1980s.

GE's businesses performed well during Welch's tenure. The drop in share was the result of redefining the TAM to be much larger in 2001 than it was in 1981. The key to the expanded definition is the notion of "linking and leveraging," or "transferring a user base built up upon one node of the ecology (one product) to neighboring nodes or products."⁴⁹ The phrase the "internet of things" reflects this opportunity.⁵⁰

Increasingly, companies seek to place their products or services at the heart of an ecosystem. Done successfully, this creates three specific benefits. First, it allows the company to take advantage of network effects. Second, it encourages customers to remain within the ecosystem, making the customer economics attractive.⁵¹ Finally, it extends a company's period of competitive advantage.⁵²

One way to assess a company's ability to link and leverage is to consider three distinct business categories: physical, service, and knowledge.⁵³ Although the activities of most companies fall into more than one category, our objective is to understand the economic characteristics of each and to consider how companies can expand across them. Here are the categories:

- **Physical.** Tangible assets, including manufacturing facilities, stores, and inventory, are the main source of cash flows for these businesses. Think of steel producers and retailers. Sales growth is tied closely to asset growth.
- **Service.** People are the main source of competitive advantage for service businesses. The essential element is that companies in this category deliver their services on a one-to-one basis. Examples include law firms, advertising agencies, and consulting firms. Sales growth is tied to the number of employees and productivity.
- **Knowledge.** Knowledge businesses also rely on people as the main source of competitive advantage. Unlike service businesses, however, these companies create intellectual content once and then reproduce it. Think of software or biotechnology companies. Because the cost of replication is often low, there is no direct link between sales and costs, which creates the potential for the business to scale rapidly.

It is important to consider carefully how these business categories differ in their economic characteristics (see Exhibit 13). Some salient considerations include the following:

- **Source of advantage.** While physical companies depend on tangible assets, both service and knowledge businesses rely on people. So, as a business extends beyond its reliance on physical assets, it must learn to manage physical and human capital. Further, employees who are integral to the process of value creation commonly want to share the upside of the value they create. So, appropriate compensation arrangements and mobile internal labor markets are essential elements in achieving success.
- **Investment trigger.** Physical and service businesses grow by adding capacity, whether through capital expenditures or new employees. For instance, a retail chain must build new stores to generate sales growth in excess of what the current stores can deliver. Or a law firm needs new lawyers to produce additional sales. Naturally, physical and service businesses seek to maximize productivity, but the nature of the businesses limits the ability to scale.

By contrast, knowledge businesses generally invest to deal with obsolescence. While there are generally few constraints on selling more of a current product, the rate of change for knowledge industries is typically high. This means that there is little or no residual value for an outdated knowledge good.

Software is a good example. A company that comes up with a popular product can fulfill demand cheaply and profitably, and enjoys substantial economies of scale. But the value of the old product plummets when a better one comes out. Companies with an established user base can migrate their customers from one of their products to the next, therefore mitigating the risk of obsolescence.

- **Products and protecting capital.** Economists distinguish between rival and nonrival goods. A rival good is one where one person's consumption reduces the consumption of others. Pens and shirts are rival goods, because only one person can use them at a time. In jurisdictions with strong property rights, rival goods are straightforward to protect. A nonrival good is one that many people can use at the same time. It is essentially a formula or recipe. Think of a song on iTunes. Nonrival goods are generally difficult to protect because they are relatively easy and cheap to replicate. So the creator of a nonrival good often has difficulty capturing the value that he or she produces. Again, the music industry is a good example.

Exhibit 13: Characteristics of Various Business Categories

	Physical	Services	Knowledge
Source of advantage	Assets	People	People
Investment trigger	Capacity	Capacity	Obsolescence
Scalability	Low	Low	High
Products	Rival	Mixed	Nonrival
Protecting capital	Easy	Hard	Hard
Economies of scale	Supply-side	Supply-side	Demand-side

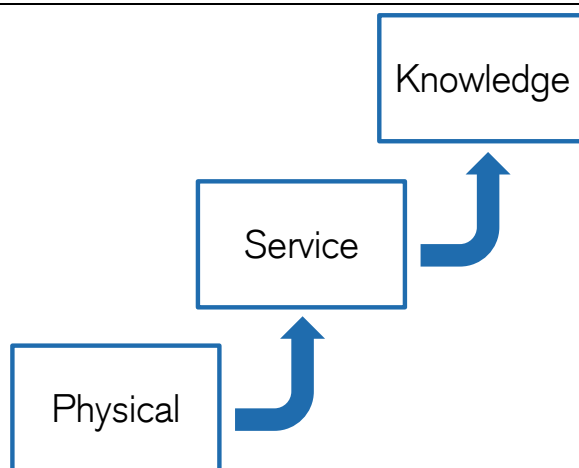
Source: Alfred Rappaport and Michael J. Mauboussin, *Expectations Investing: Reading Stock Prices for Better Returns* (Boston, MA: Harvard Business School Publishing, 2001), 139.

One strategy companies have used to increase their TAM, especially those reliant on physical assets, is to extend into new business categories (see Exhibit 14). This is how GE's share of TAM dropped even as its business was growing. GE Healthcare, for instance, expanded beyond selling x-ray, computerized axial tomography, and magnetic resonance imaging machines by offering multi-vendor service and, ultimately, remote diagnostics.

Deere & Company is another case in point. Deere is known for its tractors, mowers, and combines with the signature green bodies and yellow wheels. That is the physical category. But the machines are getting much smarter. As one Deere executive noted, "Today's large John Deere tractors have more lines of software code than early space shuttles [and Deere's] GPS technology can guide a tractor and implement in the field with near-perfect precision."⁵⁴

In recent years Deere has reached beyond the machines into the service and knowledge categories. The company launched MyJohnDeere.com to allow farmers to be more efficient. The site helps farmers manage their equipment (service) and provides information about irrigation systems, nutrient sources, weather conditions, crop prices, and commodity futures (knowledge).

Exhibit 14: Business Category Evolution



Source: Credit Suisse.

Business category evolution not only has important implications for understanding TAM, it also presents a number of important strategic challenges for businesses.⁵⁵ These include trade-offs between open and closed systems, functionality in the product or in the cloud, determining which party owns the data, and whether or not to monetize data by selling to outside parties.

Summary

Total addressable market is a vital indicator of a company's potential, as it measures how large a company can grow to be while still creating shareholder value. TAM is a concept that is commonly discussed by companies and investors but is rarely thoughtfully quantified.

We use the process of triangulation to estimate TAM, with methods that include a basic assessment of the population, product, and conversion, a diffusion model, and a check through the application of appropriate base rates. Indeed, approaching the problem from multiple points of view likely provides valuable context and prevents common errors.

Companies are increasingly seeking to build ecosystems around their goods or services, which if successful take advantage of network effects, improve customer retention, and extend the competitive advantage period. But it is important to bear in mind that few companies win the battle of networks. Most fail.

Business category evolution is one way to think about how companies can build ecosystems around existing products or services. For example, manufacturers of physical goods, such as Deere & Company, are extending into service and knowledge businesses. Or think of Google, primarily a knowledge business, purchasing Motorola Mobility, a physical business, to extend its ecosystem.

TAM is an area where overconfidence and optimism are rife. We have provided some analytical approaches to check these biases and to come up with a reasonable assessment of whether the market's expectations are reasonable.

Checklist for Estimating a Total Addressable Market

Categorizing New Products

- ☐ Is the product technology new or current?
- ☐ Are the customers new or current?

Market Size

- ☐ Are the users and payers of the good or service the same?
- ☐ How much money do the buyers have?
- ☐ Are the resources of buyers growing or shrinking?
- ☐ Are there physical limitations, such as how much one can eat or use a product, that can curb demand?
- ☐ What is the elasticity of demand?
- ☐ How cyclical is demand?
- ☐ How do consumers allocate their time and money now and how might that change?
- ☐ Are the suppliers and sellers of the good or service the same?
- ☐ What is the business's production capacity?
- ☐ Is there a reliable infrastructure to get the goods or services to market?
- ☐ How broad is the geographical footprint?
- ☐ Where is the industry in its life cycle? What does that imply about the growth rate and pricing flexibility?
- ☐ Does manufacturing capacity match the rate of growth in demand?
- ☐ Is the company using pricing as a lever to drive scale or to increase profitability?
- ☐ Are there existing or potential economic or social regulations that could limit TAM?
- ☐ What are management's incentives and are they aligned with shareholders?
- ☐ Are there economies of scale? Local? National? International?
- ☐ Are there two or more competitors, which could push each company into a separate niche?

TAM and the Bass Model

- ☐ Which stage of the life cycle is the company's industry in?
- ☐ What analogous products can inform your estimates for the Bass Model parameters?

Limitations of the Bass Model

- ☐ When a consumer buys something once, how frequently does he or she replace it (repurchase rate)?
- ☐ Has the company's good or service overshot the market? Might that happen soon?
- ☐ Does the company have a competitive advantage that will allow for value creation over time?
- ☐ Do network effects exist?

Consider Base Rates

- ☐ What happened to other companies when they were in a situation similar to the one you are examining?
- ☐ Are your TAM estimates plausible when considering these base rates?

TAM and Ecosystems

- ☐ Does the company operate primarily a physical, service, or knowledge business?
- ☐ What is the company's source of advantage?
- ☐ What are the investment triggers?
- ☐ Does the company sell rival or nonrival goods?
- ☐ Are there opportunities to extend into new business categories?

Appendix A: Sampling of Factors That Explain Historical Diffusion Processes

Exhibit 15: Empirical Parameters for Bass Model

Product/Technology	Period of Analysis	<i>p</i>	<i>q</i>	<i>m</i>
<i>Agricultural</i>				
Tractors (thousands of units)	1921-1964	0.000	0.134	5,201.0
Hybrid corn	1927-1941	0.000	0.797	100.0
Artificial insemination	1943-1959	0.028	0.307	73.2
Bale hay	1943-1959	0.013	0.455	92.2
<i>Medical Equipment</i>				
Ultrasound imaging	1965-1978	0.000	0.534	85.8
Mammography	1965-1978	0.000	0.729	57.1
CT scanners (50-99 beds)	1980-1993	0.044	0.350	57.9
CT scanners (>100 beds)	1974-1993	0.036	0.268	95.0
<i>Production Technology</i>				
Oxygen steel furnace (USA)	1955-1980	0.002	0.435	60.5
Oxygen steel furnace (France)	1961-1980	0.008	0.279	88.4
Oxygen steel furnace (Japan)	1959-1975	0.049	0.333	81.3
Steam (vs. sail) merchant ships (UK)	1815-1965	0.006	0.259	86.7
Plastic milk containers (1 gallon)	1964-1987	0.020	0.255	100.0
Plastic milk containers (half gallon)	1964-1987	0.000	0.234	28.8
Stores with retail scanners (FRG, units)	1980-1993	0.001	0.605	16,702.0
Stores with retail scanners (Denmark, units)	1986-1993	0.076	0.540	2,061.0
<i>Electrical Appliances</i>				
Room air conditioner	1950-1979	0.006	0.185	60.5
Bed cover	1949-1979	0.008	0.130	72.2
Blender	1949-1979	0.000	0.260	54.5
Can opener	1961-1979	0.050	0.126	68.0
Electric coffee maker	1955-1979	0.042	0.103	100.0
Clothes dryer	1950-1979	0.009	0.143	70.1
Clothes washer	1923-1971	0.016	0.049	100.0
Coffee maker ADC	1974-1979	0.077	1.106	32.2
Curling iron	1974-1979	0.101	0.762	29.9
Dishwasher	1949-1979	0.000	0.213	47.7
Disposer	1950-1979	0.000	0.179	50.4
Fondue	1972-1979	0.166	0.440	4.6
Freezer	1949-1979	0.019	0.000	94.2
Frypan	1957-1979	0.142	0.000	65.6
Hair dryer	1972-1979	0.055	0.399	51.6
Hot plates	1932-1979	0.056	0.000	26.3
Microwave oven	1972-1990	0.002	0.357	91.6
Mixer	1949-1979	0.000	0.134	97.7
Power leaf blower (gas or electric)	1986-1996	0.013	0.315	26.0
Range	1925-1979	0.004	0.065	63.6
Range, built-in	1957-1979	0.048	0.086	21.7
Refrigerator	1926-1979	0.025	0.126	99.7
Slow cooker	1974-1979	0.000	1.152	34.4
Steam iron	1950-1979	0.031	0.128	100.0
Toaster	1923-1979	0.038	0.000	100.0
<i>Consumer electronics</i>				
Cable television	1981-1994	0.100	0.060	68.0
Calculators	1973-1979	0.143	0.520	100.0
Camcorder	1986-1996	0.044	0.304	30.5
CD player	1986-1996	0.055	0.378	29.6
Cellular telephone	1986-1996	0.008	0.421	45.1
Cordless telephone	1984-1996	0.004	0.338	67.6
Electric toothbrush	1991-1996	0.110	0.548	14.8
Home PC (millions of units)	1982-1988	0.121	0.281	25.8
Radio	1922-1934	0.027	0.435	100.0
Telephone answering device	1984-1996	0.025	0.406	69.6
Television, black and white	1949-1979	0.108	0.231	96.9
Television, color	1965-1979	0.059	0.146	100.0
VCR	1981-1994	0.025	0.603	76.3
<i>Average</i>		0.037	0.327	
<i>Median</i>		0.025	0.280	

Source: Gary Lilien, Arvind Rangaswamy, and Christophe Van den Bulte, "Diffusion Models: Managerial Applications and Software," ISBM Report 7-1999, May 20, 1999.

Appendix B: Satellite Radio Case Study

We show how to use the Bass model to forecast total demand for an industry by sharing the key findings of a Harvard Business School case study. Professor Elie Ofek and Peter Wickersham, authors of the case, explain how to forecast demand for the U.S. satellite radio industry by coming up with appropriate approximations for the parameters of the Bass model. They estimate the size of the market, m , based on assumptions about radio and subscription prices, and then establish the coefficient of innovation (p) and coefficient of imitation (q) using judgments about satellite radio's degree of similarity to related products. We compare these forecasts in the case study to the actual demand for satellite radio in the industry's first 13 years.

Estimating Market Size (m). The first step is to estimate the total market size, or m . Some markets are easier to assess than others. An example of a straightforward estimate is a new drug therapy that targets a specific disease (consistent with Exhibit 2). You can confidently estimate the size of that market by figuring out how many people have the disease and how many are likely to be diagnosed. The potential demand for most products or services is not as clear, particularly for those based on new technologies.

A useful place to start is a survey that gauges consumer interest and the likelihood of purchase. Robert Acker, the director of strategic planning for XM Satellite Radio (XM) in the late 1990s, commissioned this market research for the U.S. satellite radio industry. The national telephone survey included more than 6,000 people. Acker designed the survey to provide useful information for XM's general strategy. For example, he sought input on how best to target customers and how to position the service to be attractive.

The survey also provided crucial insight into who might pay for the service and how much they might be willing to pay. XM had yet to determine its primary market, so Acker conducted the survey for radios in the car and at home. Ofek and Wickersham's case study focuses on the car radio, then seen as the most likely market to succeed.

Based on the survey results, Acker was able to make reasonable estimates for total demand based on the cost of the radio in the car and the monthly subscription fee. We summarize the results in exhibit 16. For example, the projected demand is about 49 million customers for a radio price of \$150 and a subscription price of \$5 per month. The wide range of outcomes shows the importance of sensitivity analysis. In the case, Ofek and Wickersham assume m is 30 million based on a radio price of around \$250 and a subscription price of about \$10.

Exhibit 16: Projected Demand at Different Price Levels for Car Radio and Subscription

Demand in millions Radio Price	Subscription Price				
	\$2	\$5	\$8	\$10	\$12
\$100	77.8	68.3	58.7	54.0	45.7
\$150	53.0	49.1	44.1	41.6	35.6
\$200	42.8	40.5	37.8	36.5	31.5
\$250	32.6	31.8	31.2	30.7	26.6
\$300	29.1	28.9	28.7	28.5	24.8
\$400	27.7	27.6	27.5	27.4	23.7

Source: Elie Ofek, "Forecasting the Adoption of a New Product," Harvard Business School Case Study 9-505-062, December 12, 2013.

Estimating p and q . The next step is to estimate the coefficient of innovation (p) and coefficient of imitation (q). One common approach is to identify similar products and assume that the parameters will be comparable for your product.

As exhibit 5 shows, there are multiple characteristics you can use to assess comparability. Ofek and Wickersham advise that you should at a minimum choose analogies based on product and market characteristics. Additional elements to consider include the overall economic conditions, buyer behavior, marketing strategy, and characteristics of the innovation. If no product serves as a perfect analogy, it is useful to consider several similar products. This is the approach the authors follow for satellite radio, and they ultimately settle on three products: the portable CD player, the automobile radio, and the cellular phone.

The next step is to search for the published estimates of the parameters for the analogous products. Appendix A provides estimates for a wide range of products, and you can find additional figures in other studies.

In the case study, Ofek and Wickersham weight the importance of market structure and product characteristics to come up with estimates for p and q . Specifically, they weight product characteristics 60 percent and market structure 40 percent. This weighting assumes that physical features and content (product) are more important than a revenue model based on subscription (market). Exhibit 17 summarizes the assumptions of the authors.

Exhibit 17: Bass Model Forecast of Total Demand for Satellite Radio

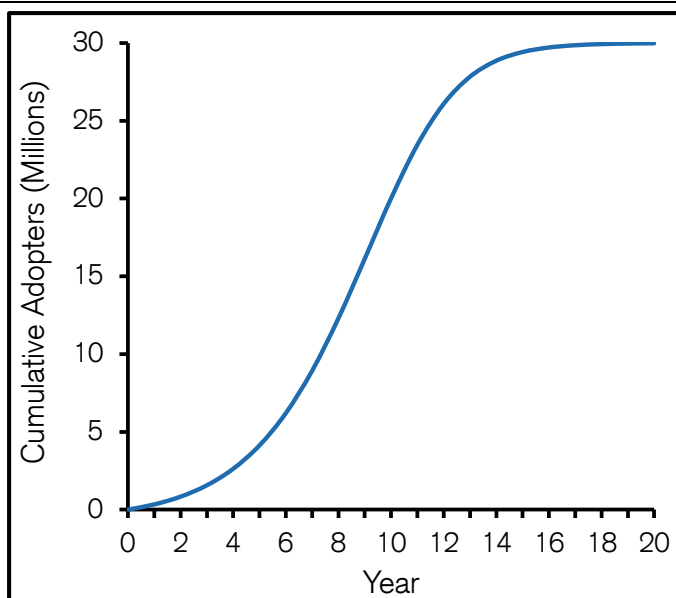
Product	Market Structure (Similarity to Satellite Radio)			Product Characteristics (Similarity to Satellite Radio)			Weighted Score	Contribution	Weighted		Weighted	
	Weight	Value		Weight	Value				<i>p</i>	<i>p</i>	<i>q</i>	<i>q</i>
Portable CD Player	4 out of 10	0.4	1.6	7 out of 10	0.6	4.2	5.8	31.9%	0.006	0.002	0.660	0.210
Automobile Radio	8 out of 10	0.4	3.2	9 out of 10	0.6	5.4	8.6	47.3%	0.016	0.008	0.410	0.194
Cellular Phone	8 out of 10	0.4	3.2	1 out of 10	0.6	0.6	3.8	20.9%	0.008	0.002	0.421	0.088
Sum							18.2		Sum	0.011	Sum	0.492

Source: Elie Ofek, "Forecasting the Adoption of a New Product," Harvard Business School Case Study 9-505-062, December 12, 2013; Credit Suisse.

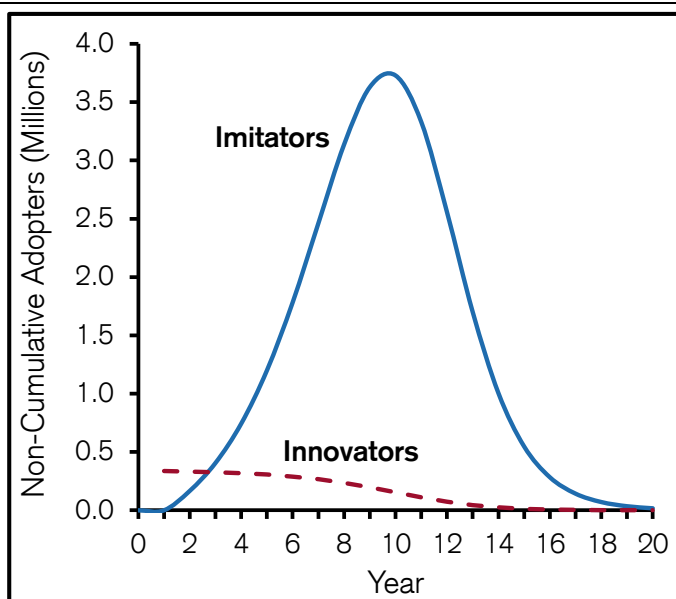
To clarify the approach, let's use the example of the portable CD player. Ofek and Wickersham believe that based on market structure, the CD player has a similarity score of 4 out of 10. This means the weighted value is 1.6 (4.0×0.4). The score of similarity on product characteristics is 7 out of 10 for a weighted value of 4.2 (7.0×0.6). Combining the market structure and product characteristics gives the CD player a total weighted score of 5.8.

The authors follow the same approach for the other two products, and come to a total weighted score for all three products of 18.2. The weighted contribution of the CD player is 31.9 percent ($5.8/18.2$). So, the weighted p for the CD player is 0.002 (0.006×0.319), and its weighted q is 0.210 (0.660×0.319). The sum of the weighted results for all three products provides the estimated parameters for satellite radio of 0.011 for p and 0.492 for q .

We can plug our estimates of m , p , and q into the Bass model to get a forecast of total demand over time (see Exhibit 18). Because the coefficient of innovation, p , is much lower than the coefficient of imitation, q , the model suggests a slow rate of adoption at first followed by a rapid rise once the industry realizes critical mass. After a few years, imitators overwhelmingly drive adoption (see Exhibit 19).

Exhibit 18: A Bass Model Forecast of Total Demand for Satellite Radio

Source: Elie Ofek, "Forecasting the Adoption of a New Product," Harvard Business School Case Study 9-505-062, December 12, 2013; Credit Suisse.

Exhibit 19: Adoptions of Satellite Radio by Innovators and Imitators

Source: Elie Ofek, "Forecasting the Adoption of a New Product," Harvard Business School Case Study 9-505-062, December 12, 2013; Credit Suisse.

We can compare this forecast to the actual results by combining the subscriber bases of the two U.S. satellite radio companies, Sirius Satellite Radio and XM Satellite Radio. We have 13 years of data, as XM launched its service in late 2001 and Sirius in early 2002. They were separate companies until they merged in 2008.

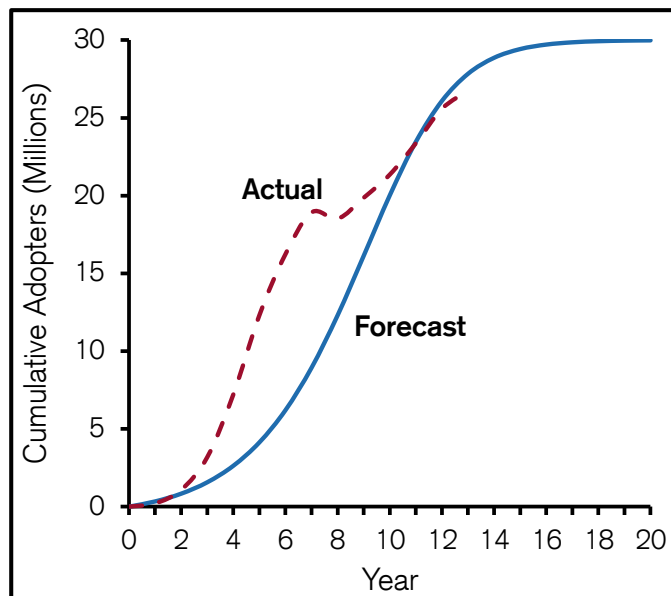
The Bass model forecast was off the mark for the initial trajectory of demand, but proved remarkably prescient in its long-term forecast of users. In the most recent year (through the third quarter of 2014), the forecast differed from the actual results by only 1.1 million users, or about 4 percent (see Exhibit 20).

The parameters also allow us to estimate the peak sales:

$$\text{Size of peak sales} = m \left[\frac{(p+q)^2}{4q} \right] = 30 \left[\frac{(0.011 + 0.492)^2}{4 \cdot 0.492} \right] = 3.9 \text{ million}$$

This forecast, too, was very accurate, predicting peak annual subscriber growth of 3.9 million, consistent with the actual outcome you can see in exhibit 19.

Exhibit 20: Demand for Satellite Radio—Bass Model Forecast versus Actual



Source: Company reports; Elie Ofek, "Forecasting the Adoption of a New Product," Harvard Business School Case Study 9-505-062, December 12, 2013; Credit Suisse.

Appendix C: Diffusion and the Replacement Cycle *

In this appendix, we demonstrate the significance of the replacement cycle in understanding demand for an industry. When forecasting demand for a product or service, analysts tend to focus primarily on the rate of new adopters, or penetration. But the rate of new adopters is not the only thing that determines unit volumes over time.

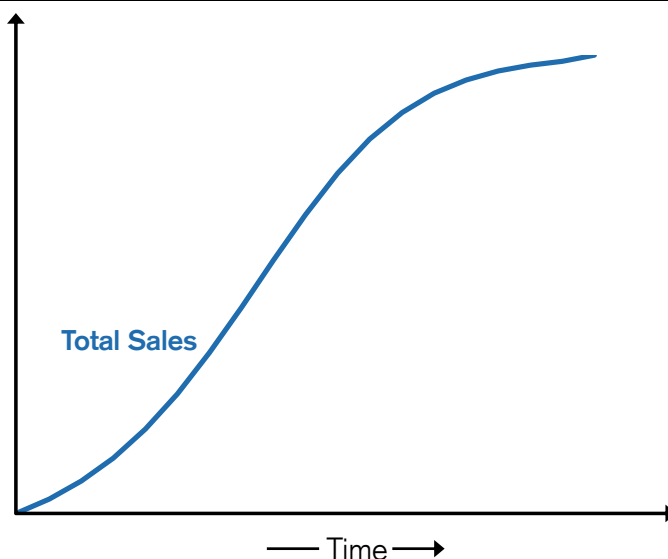
The rate at which customers replace their products, or the replacement cycle, can be just as meaningful as the rate of adoption. If the replacement cycle is shortening, customers are replacing their products faster. If it is lengthening, customers are taking more time between purchase and replacement. For most products, a time comes when replacement units are a majority of the total. And because products diffuse faster today, the replacement cycle quickly becomes an important consideration.

When replacements become a large portion of total demand, an interesting and counterintuitive thing can happen. If consumers expand the time between when they purchase and replace their products, total demand can decline even if there is continued growth in population and penetration. You still have plenty of customers making their first purchase, but this new demand is more than offset by a large existing base of users who are waiting longer between upgrades.

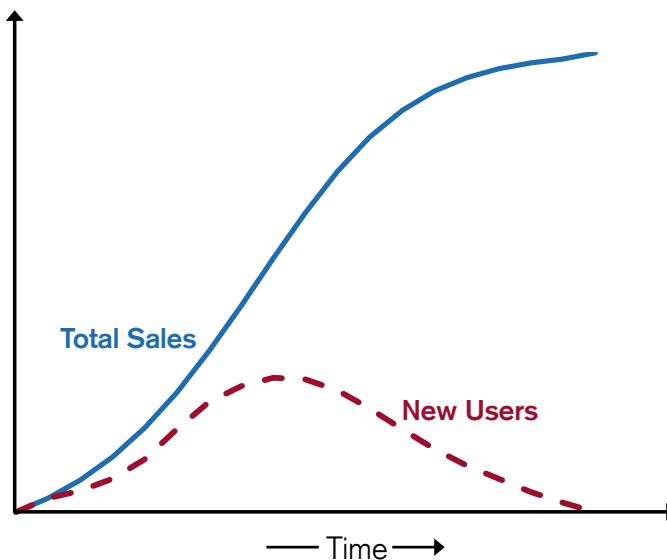
To understand when to prioritize new users and when to focus on the replacement cycle, it's useful to consider a simple three-stage model of the life of a product or service. The first stage is all about growth in new users. The second stage is transitional and marks when replacements exceed new users for the first time. Here the analysis requires a balance between new users and replacement demand. The length and change in the replacement cycle become essential inputs into a demand model. The third stage is maturity. The market is fully penetrated and the replacement cycle defines demand.

To set the stage for our analysis, we begin by illustrating the typical pattern of diffusion for an innovation. The pattern of cumulative users follows an S-curve (see Exhibit 21). While the S-curve shows cumulative product adoption, the plot of new adopters follows a normal distribution (see Exhibit 22).

Exhibit 21: Generic S-Curve

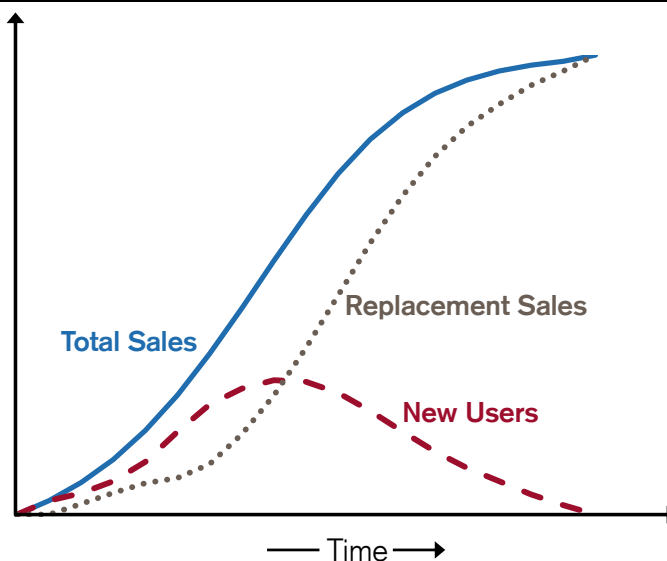


Source: Credit Suisse.

Exhibit 22: Cumulative and New Users

Source: Credit Suisse.

We now turn to replacement sales. It often doesn't take long for replacements to account for the majority of total unit sales (see Exhibit 23). Replacements become a majority of the total within five to seven years for many products and are the majority of demand for almost all industries within a dozen years. So, in a relatively short period of time, replacement cycles become the most important leading indicator of value.

Exhibit 23: Replacement Sales as a Percentage of Total Sales

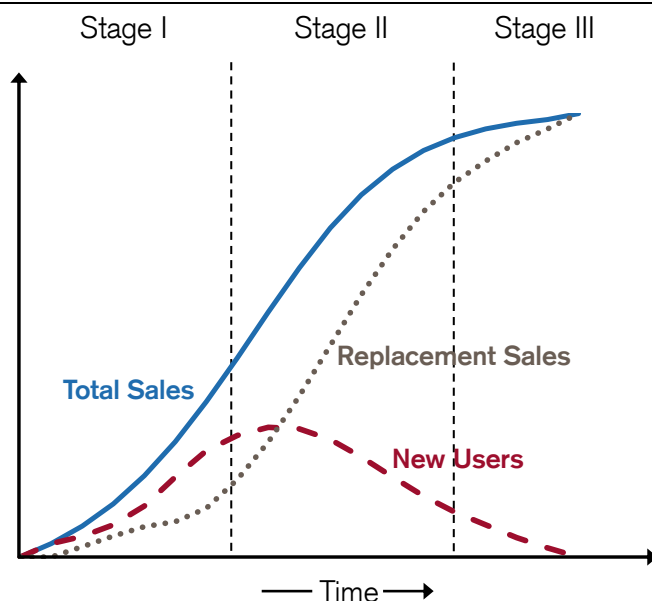
Source: Credit Suisse.

The Three Stages

Our next step is to break a product's life into three stages (see Exhibit 24):

- **Stage I—Penetration.** Here, the priority is to gain widespread acceptance and increase penetration of the new product or service. Replacement sales exist at this stage but their contribution is negligible. 3D printers are in this stage today.
- **Stage II—Transition.** In this stage, replacement demand exceeds demand from new users for the first time. Your analysis should shift from determining the rate of new user growth to assessing the length and potential change of the replacement cycle. Smartphones are in this stage today.
- **Stage III—Maturity.** With the market fully penetrated, unit sales are comprised nearly solely by replacement demand. Personal computers and laptops are in this stage today.

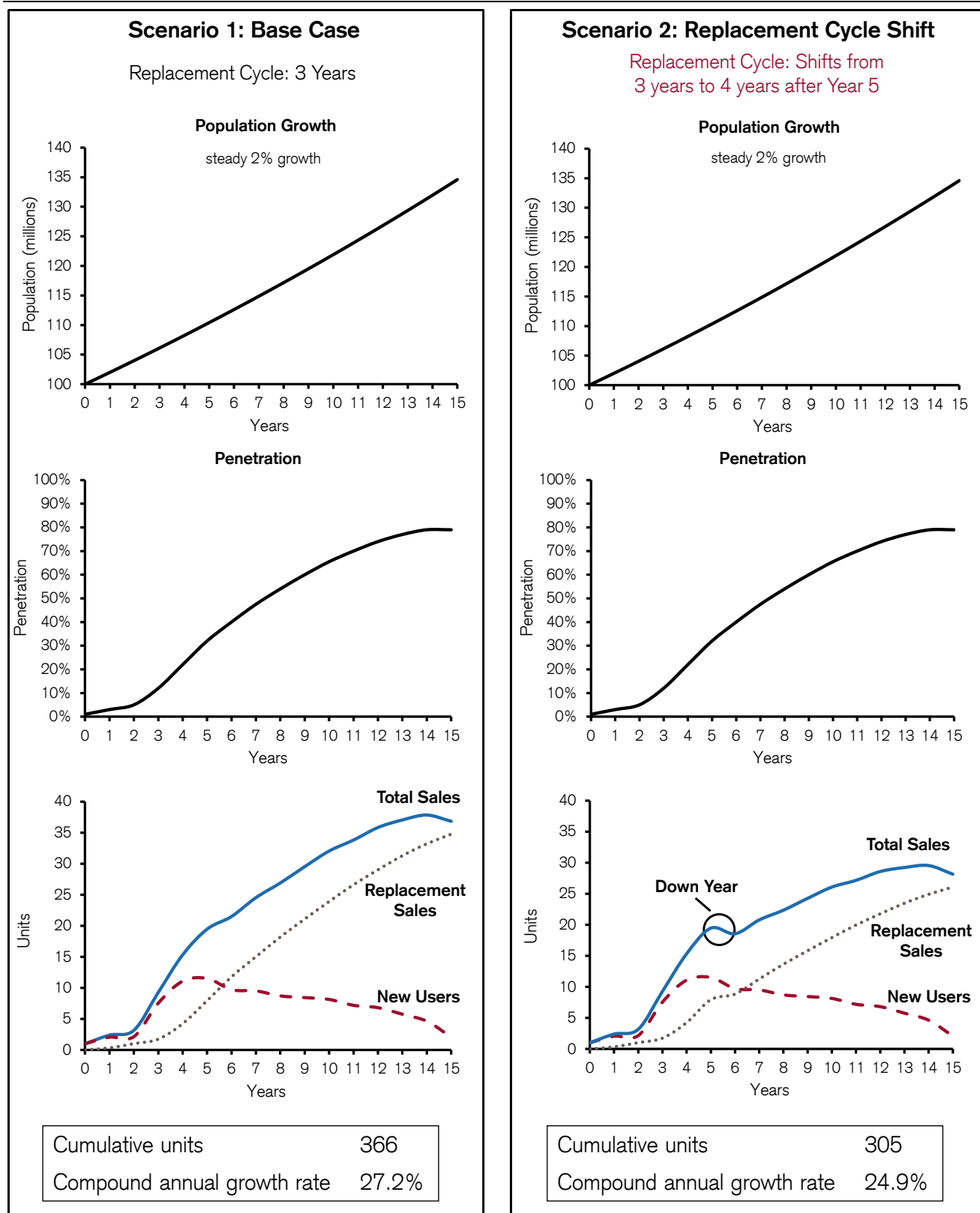
Exhibit 24: Three Stages of a Product's Life



Source: Credit Suisse.

This progression from Stage 1 to Stage 3 suggests three important considerations. The first is the drivers of the replacement cycle. The second is whether or not the needs of customers change as a product matures (they do). The final, and arguably most critical, issue is how a shift in the replacement cycle affects total demand. Here, it is possible for the decline in demand for replacement sales as the result of an expanding replacement cycle to exceed the contribution of sales from new users.

A simple example demonstrates the large impact of a change in the replacement cycle. Exhibit 25 shows two scenarios. They are exactly the same except that Scenario 1 assumes the replacement cycle remains at 3 years through all 15 years, while Scenario 2 assumes that the replacement cycle expands from 3 to 4 years following the fifth year.

Exhibit 25: The Impact of a Lengthening Replacement Cycle

Source: Credit Suisse.

The example provides two key lessons. First, in Scenario 2 we see that total unit sales decline in year 6 despite continued growth in population and penetration. (Exhibits 26 and 27 show the data behind these charts.) Second, the seemingly modest shift from a three- to a four-year replacement cycle results in a material drop in long-term demand. Cumulative total unit sales decline by 17 percent versus the steady 3-year replacement cycle case, and the 15-year compound annual growth rate is 230 basis points lower.

This analysis of replacement cycles shows that a product can experience negative unit growth even when penetration is rising. This conclusion, while counterintuitive, reflects the fact that as an industry matures it becomes increasingly dependent on repeat purchases by its existing user base.

(*) = The idea behind this analysis came from Jay Freedman, founder and managing partner of Crystal Rock Capital Management, LLC. This appendix borrows heavily from Michael J. Mauboussin, Jay Freedman, Alexander Schay, and Christian Pitt, "Diffusion Confusion: The Rising Role of the Replacement Cycle," *Credit Suisse First Boston Equity Research*, August 1, 2001.

Exhibit 26: Base Case: Replacement Cycle Remains at Three Years

Population Growth	2%															
Price Depreciation	7%															
Replacement Cycle (yrs.)	3	<i>First 5 years</i>														
Replacement Cycle (yrs.)	3	<i>After 5th year</i>														
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Population	100.0	102.0	104.0	106.1	108.2	110.4	112.6	114.9	117.2	119.5	121.9	124.3	126.8	129.4	131.9	134.6
Total Penetration	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cumulative penetration units	1.0	3.1	5.2	12.7	23.8	35.3	45.0	54.6	63.3	71.7	79.8	87.0	93.8	99.6	104.2	106.3
New Sales	1.0	2.1	2.1	7.5	11.1	11.5	9.7	9.5	8.7	8.4	8.1	7.2	6.8	5.8	4.6	2.1
Replacement sales		0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
			0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
				0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
					2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51	2.51
						3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69	3.69
							3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84	3.84
								3.24	3.24	3.24	3.24	3.24	3.24	3.24	3.24	3.24
									3.17	3.17	3.17	3.17	3.17	3.17	3.17	3.17
										2.90	2.90	2.90	2.90	2.90	2.90	2.90
											2.81	2.81	2.81	2.81	2.81	2.81
												2.71	2.71	2.71	2.71	2.71
													2.40	2.40	2.40	2.40
														2.27	2.27	2.27
															1.92	1.92
																1.54
Replacement sales	0.0	0.3	1.0	1.7	4.2	7.9	11.8	15.0	18.2	21.1	23.9	26.6	29.0	31.3	33.2	34.7
Percent from penetration	100%	86%	68%	81%	72%	59%	45%	39%	32%	29%	25%	21%	19%	16%	12%	6%
Percent from replacement	0%	14%	32%	19%	28%	41%	55%	61%	68%	71%	75%	79%	81%	84%	88%	94%
TOTAL UNIT VOLUME	1.0	2.4	3.2	9.3	15.3	19.5	21.5	24.5	26.9	29.5	32.0	33.8	35.8	37.0	37.8	36.8
PRICE	100.0	93.0	86.5	80.4	74.8	69.6	64.7	60.2	56.0	52.0	48.4	45.0	41.9	38.9	36.2	33.7
MARKET SIZE	1.0	2.2	2.7	7.5	11.5	13.5	13.9	14.8	15.0	15.4	15.5	15.2	15.0	14.4	13.7	12.4
Unit volume growth		139%	32%	193%	65%	27%	10%	14%	10%	10%	9%	6%	6%	3%	2%	-3%
Market size growth		123%	23%	173%	54%	18%	3%	6%	2%	2%	1%	-2%	-1%	-4%	-5%	-9%

Source: Credit Suisse.

Exhibit 27: Modified Case: Replacement Cycle Goes from Three to Four Years after Year 5

Population Growth	2%															
Price Depreciation	7%															
Replacement Cycle (yrs.)	3	<i>First 5 years</i>														
Replacement Cycle (yrs.)	4	<i>After 5th year</i>														
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Population	100.0	102.0	104.0	106.1	108.2	110.4	112.6	114.9	117.2	119.5	121.9	124.3	126.8	129.4	131.9	134.6
Total Penetration	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Cumulative penetration units	1%	3%	5%	12%	22%	32%	40%	48%	54%	60%	66%	70%	74%	77%	79%	79%
	1.0	3.1	5.2	12.7	23.8	35.3	45.0	54.6	63.3	71.7	79.8	87.0	93.8	99.6	104.2	106.3
New Sales	1.0	2.1	2.1	7.5	11.1	11.5	9.7	9.5	8.7	8.4	8.1	7.2	6.8	5.8	4.6	2.1
	<i>*SHIFT to 4 year replacement cycle</i>															
Replacement sales		0.33	0.33	0.33	0.33	0.33	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
			0.69	0.69	0.69	0.69	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
				0.71	0.71	0.71	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
					2.51	2.51	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88
						3.69	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77
							2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88	2.88
								2.43	2.43	2.43	2.43	2.43	2.43	2.43	2.43	2.43
									2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
										2.18	2.18	2.18	2.18	2.18	2.18	2.18
											2.11	2.11	2.11	2.11	2.11	2.11
												2.03	2.03	2.03	2.03	2.03
													1.80	1.80	1.80	1.80
														1.70	1.70	1.70
															1.44	1.44
																1.16
Replacement sales	0.0	0.3	1.0	1.7	4.2	7.9	8.8	11.3	13.6	15.8	17.9	20.0	21.8	23.5	24.9	26.1
Percent from penetration	100%	86%	68%	81%	72%	59%	52%	46%	39%	35%	31%	26%	24%	20%	16%	7%
Percent from replacement	0%	14%	32%	19%	28%	41%	48%	54%	61%	65%	69%	74%	76%	80%	84%	93%
TOTAL UNIT VOLUME	1.0	2.4	3.2	9.3	15.3	19.5	18.5	20.8	22.3	24.3	26.1	27.2	28.6	29.2	29.5	28.1
PRICE	100.0	93.0	86.5	80.4	74.8	69.6	64.7	60.2	56.0	52.0	48.4	45.0	41.9	38.9	36.2	33.7
MARKET SIZE	1.0	2.2	2.7	7.5	11.5	13.5	12.0	12.5	12.5	12.6	12.6	12.2	12.0	11.4	10.7	9.5
Unit volume growth		139%	32%	193%	65%	27%	-5%	12%	8%	9%	7%	4%	5%	2%	1%	-5%
Market size growth		123%	23%	173%	54%	18%	-11%	4%	0%	1%	0%	-3%	-2%	-5%	-6%	-11%

Source: Credit Suisse.

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Sharpening Your Forecasting Skills

Foresight Is a Measurable Skill That You Can Cultivate

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“Beliefs are hypotheses to be tested, not treasures to be protected.”

Philip E. Tetlock and Dan Gardner¹

- Philip Tetlock’s study of hundreds of experts making thousands of predictions over two decades found that the average prediction was “little better than guessing.” That’s the bad news.
- Tetlock, along with his colleagues, participated in a forecasting tournament sponsored by the U.S. intelligence community. That work identified “superforecasters,” people who consistently make superior predictions. That’s the good news.
- The key to superforecasters is how they think. They are actively open-minded, intellectually humble, numerate, thoughtful updaters, and hard working.
- Superforecasters achieve better results when they are part of a team. But since there are pros and cons to working in teams, training is essential.
- Instruction in methods to reduce bias in forecasts improves outcomes. There must be a close link between training and implementation.
- The best leaders recognize that proper, even bold, action requires good thinking.

Introduction: The Bad News and the Good News

What if you had the opportunity to learn how to improve the quality of your forecasts, measured as the distance between forecasts and outcomes, by 60 percent? Interested? *Superforecasting: The Art and Science of Prediction* by Philip Tetlock and Dan Gardner is a book that shows how a small number of “superforecasters” achieved that level of skill. If you are in the forecasting business—which is likely if you’re reading this—you should take a moment to buy it now. You’ll find that it’s a rare book that is both grounded in science and highly practical.

Phil Tetlock is a professor of psychology and political science at the University of Pennsylvania who has spent decades studying the predictions of experts. Specifically, he enticed 284 experts to make more than 27,000 predictions on political, social, and economic outcomes over a 21-year span ended in 2004. The period included six presidential elections and three wars. These forecasters had crack credentials, including more than a dozen years of relevant work experience and lots of advanced degrees—nearly all had postgraduate training and half had PhDs.

Tetlock then did something very unusual. He kept track of their predictions. The results, summarized in his book *Expert Political Judgment*, were not encouraging.² The predictions of the average expert were “little better than guessing,” which is a polite way to say that “they were roughly as accurate as a dart-throwing chimpanzee.” When confronted with the evidence of their futility, the experts did what the rest of us do: they put up their psychological defense shields. They noted that they almost called it right, or that their prediction carried so much weight that it affected the outcome, or that they were correct about the prediction but simply off on timing. Overall, Tetlock’s results provide lethal ammunition for those who debunk the value of experts.

Below the headline of expert ineffectiveness were some more subtle findings. One was an inverse correlation between fame and accuracy. While famous experts had among the worst records of prediction, they demonstrated “skill at telling a compelling story.” To gain fame it helps to tell “tight, simple, clear stories that grab and hold audiences.” These pundits are often wrong but never in doubt.

Another result, which is related to the first, was that what mattered in the quality of predictions was less *what* the expert thought and more *how* he or she thought. Tetlock categorized his experts as foxes or hedgehogs based on a famous essay on thinking styles by the philosopher Isaiah Berlin. Foxes know a little about a lot of things, and hedgehogs know one big thing. Foxes did better than the dart-throwing chimp, and hedgehogs did worse.

It’s not hard to see the link between these findings. Most topics of interest in the economic, social, and political realms defy tight, simple, and clear stories. But imagine you are the producer of a television show that covers politics. Who do you want to put on the air, the equivocal guest who constantly says “on the other hand,” or the one who confidently tells a crisp and controversial story? It’s not a hard decision, which is why many hedgehogs are both famous and poor predictors.

While the conclusions of *Expert Political Judgment* were nuanced, they were on balance bad news for pundits. Despite how some read his results, Tetlock never believed in the extreme point of view that forecasts are useless. That foxes were better forecasters than the average of all experts provided a strong clue that foresight might be a real skill that could be identified and cultivated. Tetlock marked himself as an “optimistic skeptic.”

Expert Political Judgment is excellent scholarly research but is written in, well, scholarly prose. In *Superforecasting*, Tetlock collaborates with Dan Gardner, a journalist and author of a book about the failure of prediction. The result is great research that is easy to read.

Naturally, Tetlock is not the only one interested in learning how to make effective forecasts. The United States intelligence community was also keen to improve the quality of predictions, especially in the wake of the failure to anticipate the terrorist acts on September 11, 2001 and the overestimation of the probability of the existence of weapons of mass destruction in Iraq in 2003. An agency within the community, Intelligence Advanced Research Projects Activity (IARPA), was assembled to pursue high-risk research into how to improve American intelligence. IARPA decided to create a forecasting tournament to see if there might be a way to sharpen forecasts.

Tetlock and some colleagues launched the Good Judgment Project (GJP), one of five scientific teams that would compete to answer questions accurately. The teams could use whatever approaches they wanted to generate the best possible answers. Starting in September 2011, IARPA asked nearly 500 questions about various political and economic outcomes. The tournament garnered more than one million individual forecasts in the following four years. It is important to note that the time frames for the questions in the IARPA tournament, generally one month to one year, were shorter than the three to five years that were common in Tetlock's study of experts.

Now the good news: the GJP results beat the control group by 60 percent in year one. Results in year two were even better, trouncing the control group by almost 80 percent. In fact, the GJP did so well that IARPA dropped the other teams.

Of the 2,800 GJP volunteers in the first year of the tournament, the top 2 percent were called "superforecasters." To give you some sense of their acuity, the superforecasters performed about 30 percent better than the average for the intelligence community—people who had access to classified data—according to an editor at the *Washington Post*.³

Encouraged by the GJP's results, Tetlock came to a couple conclusions. The first is that foresight is a real and measurable skill. One test of skill is persistence. High persistence means that you do consistently well over time and are not a one-hit wonder. About 70 percent of superforecasters remain in those elite ranks from one year to the next, vastly more than what chance would dictate.

The second is that foresight "is the product of particular ways of thinking, of gathering information, of updating beliefs." Importantly, the essential ingredients of being a superforecaster can be learned and cultivated. The beauty of the GJP is that it was carried out with scientific rigor, which allowed the researchers to distill the elements of success. We explore these elements in this report.

Even though most people can improve their thinking and forecasting, there has always been resistance to change based on what Tetlock and Gardner call "illusions of knowledge." Intuition is one example. Intuition is a form of pattern recognition that works in settings with lots of "valid cues."⁴ But intuition is notoriously unreliable in unstable or nonlinear environments. An overreliance on intuition leads to poor decisions.

Another case is insufficient self-reflection. This is in part prompted by a module in our brain that seeks to rapidly close cause-and-effect loops. We show you an outcome and your mind quickly comes up with an explanation for it. As Tetlock and Gardner write, "we move too fast from confusion and uncertainty to a clear and confident conclusion without spending any time in between." This is related to the concept that Daniel Kahneman, an eminent psychologist, calls thinking fast.⁵

Keeping track of forecasts and the outcomes may not serve an expert's interests. If you are paid well to be a pundit, introducing a scoring system offers little upside and lots of downside. In extreme cases, experts are so sure that they are correct that they see no need to measure outcomes at all.

Tetlock and Gardner share the words of Galen, the physician to Roman emperors, who practiced in the second century. Of a particular cure he wrote, "All who drink of this treatment recover in a short time, except those whom it does not help, who all die. It is obvious, therefore, that it fails only in incurable cases." Fortunately, medical researchers have applied the scientific method more rigorously in recent centuries, but it's still easy to spot an overconfident, and unchecked, expert.

So what is the source of good forecasting? Tetlock and his colleagues found four drivers behind the success of the superforecasters:⁶

- **Find the right people.** You get a 10-15 percent boost from screening forecasters on fluid intelligence and active open-mindedness.
- **Manage interaction.** You get a 10-20 percent enhancement by allowing the forecasters to work collaboratively in teams or competitively in prediction markets.
- **Train effectively.** Cognitive debiasing exercises lift results by 10 percent.
- **Overweight elite forecasters or extremize estimates.** Results improve by 15-30 percent if you give more weight to better forecasters and make forecasts more extreme to compensate for the conservatism of forecasts.

The scientists measure these improvements using a Brier score (the appendix provides more detail on the calculation). A Brier score reflects the difference between a forecast and the outcome. Like golf scores, lower is better. There are a couple of ways to calculate Brier scores, but a common scale runs from zero to 2.0. Zero means that the forecast is spot on, 0.50 is a random forecast, and 2.0 means that the forecast is completely wrong.

By this scoring, a person who predicts a 55 percent probability of an outcome that happens receives a Brier score of 0.405. A subsequent forecast of a 65 percent probability of an event that occurs gets a Brier score of 0.245, nearly a 40 percent improvement.

There are a lot of details in finding the right people, effectively building and managing teams, and proper training. But Tetlock and Gardner offer a simple formula that is at the core of the whole process: "Forecast, measure, and revise: it is the surest path to seeing better."

How can we all become more like superforecasters? To answer that question, we discuss the profile of a superforecaster, the tools you will need to think like a superforecaster, the lessons for leadership, and the valid doubts that remain.

Find the Right People

Throughout the book, Tetlock and Gardner provide the pieces that allow you to construct the profile of a superforecaster. Because the GJP researchers took the time to run the forecasters through a battery of psychological tests, they were able to examine the personalities of the superforecasters. Further, the data

allow the researchers to avoid the error of first observing success and then attempting to find common attributes after the fact.⁷ The portrait of a modal superforecaster has four elements:

Philosophical Outlook. Superforecasters tend to be comfortable with a sense of doubt. Scientists sometimes sense that they know the truth. Good thinkers can feel the same way. “But they know they must set that feeling aside and replace it with finely measured degrees of doubt,” write Tetlock and Gardner, “—doubt that can be reduced (although never to zero) by better evidence from better studies.”

Recall that our minds are keen to assign causality. We want the case to be closed. But as Daniel Kahneman says, “It is wise to take admissions of uncertainty seriously, but declarations of high confidence mainly tell you that an individual has constructed a coherent story in his mind, not necessarily that the story is true.”⁸

Superforecasters are also humble, but not in the sense of feeling unworthy. Rather, their humility comes from the recognition that reality is profoundly complex. Indeed, it is possible to think highly of yourself and to be intellectually humble at the same time. Tetlock and Gardner note that, “Intellectual humility compels the careful reflection necessary for good judgment; confidence in one’s abilities inspires determined action.”

It is common, and often soothing, to attribute outcomes to fate. Superforecasters aren’t big believers in fate. On a one to nine “fate score,” where one is a total rejection of fate and nine is complete belief in it, the average adult American falls near the middle. The mean score for a student at the University of Pennsylvania is a little lower, the regular forecasters are below that, and the superforecasters are the lowest of these groups. Superforecasters don’t think that what happened had to happen.

Ability and Thinking Style. The first point is that superforecasters are not geniuses. The researchers tested the fluid and crystallized intelligence of all the GJP volunteers. Fluid intelligence is the ability to think logically and to solve novel problems. It doesn’t rely on accumulated knowledge. Crystallized intelligence is exactly what it sounds like: your collection of skills, facts, and wisdom, and your ability to use them when you need to.

Those who participated in the GJP were not a valid sample of the population—these are people who raised their hand to make lots of forecasts in return for a \$250 gift certificate from Amazon.com. The regular forecasters scored higher than about 70 percent of the population on intelligence tests. That translates roughly into an average intelligence quotient (IQ) of 108-110 where the average of the population is 100. The superforecasters scored higher than about 80 percent of the population, or an average IQ range of 112-114. There is a much bigger gap between the overall population and regular forecasters than there is between those forecasters and the superforecasters.

Keith Stanovich, professor emeritus of applied psychology and human development at the University of Toronto, distinguishes between IQ and what he calls “RQ,” or rationality quotient.⁹ The correlation coefficient between the two is a relatively low .20 to .35. Those with high RQ’s exhibit adaptive behavioral acts, efficient behavioral regulation, sensible goal prioritization, reflectivity, and the proper treatment of evidence. These qualities are very consistent with those of the superforecasters.

Jonathan Baron, a professor of psychology at the University of Pennsylvania and a colleague of Tetlock’s, coined the term “active open-mindedness.”¹⁰ Those who are actively open-minded seek views that are different than their own and consider them carefully. Tetlock and Gardner suggest that if they had to reduce superforecasting to a bumper sticker, it would read, “Beliefs are hypotheses to be tested, not treasures to be guarded.”

The Big Five is one of the most widely-accepted personality tests. Subjects are tested for five personality traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism. The tests revealed that superforecasters score high in openness to experience, which suggests a preference for cognitive variety and intellectual curiosity. Superforecasters are interested in the world and are willing explorers.

Superforecasters also spend time thinking about their own process and constantly seek to improve. When collaborating, the superforecasters often leave lots of comments in their online discussions, which allow them to recreate their thought processes and improve them when possible. Timely and accurate feedback is an essential element of improvement. Superforecasters embrace feedback.

The superforecasters rarely use sophisticated mathematical models to make their forecasts, but they are uniformly highly numerate. Comfort with numbers is a prerequisite for making good forecasts but fancy quantitative models are not.

Methods of Forecasting. Superforecasters, similar to the foxes in Tetlock's study of expert political judgment, tend to be pragmatic in their methods. Rather than looking at all aspects of the world through a single lens, good forecasting requires considering multiple points of view. Charles Munger, vice chairman of Berkshire Hathaway, captures this concept well with the mental models approach. Says Munger, "Well, the first rule is that you've got to have *multiple* models—because if you just have one or two that you're using, the nature of human psychology is such that you'll *torture* reality so that it fits your models, or at least you'll think it does."¹¹

Kahneman has popularized the notion of two systems of the mind. System 1 is fast, automatic, and difficult to train. System 2 is slow, deliberate, and purposeful. One of the important conclusions from this research is that we commonly rely on our fast system when we should recruit our slow system.¹² Tetlock and Gardner call the fast system the "tip-of-your-nose perspective," because it is unique to each of us. Superforecasters have a firm sense of when they need to engage System 2.

There is good evidence that the aggregation of diverse points of view, done correctly, improves the accuracy of forecasts. James Surowiecki provides ample illustrations of this idea in his bestselling book, *The Wisdom of Crowds*.¹³ You can gain from diversity by capturing the views of different individuals, for example, investors in a stock market, or by aggregating multiple views in your head.

Tetlock and Gardner use the metaphor of a dragonfly's eye. Each eye has up to 30,000 individual lenses aimed in slightly different directions that provide the dragonfly's brain with massive input. The result is extraordinary visual acuity, allowing the dragonfly to nab small, fast-moving insects.

The authors find that superforecasters, similar to the dragonfly, are able to consider and synthesize multiple points of view. They also emphasize that "aggregation doesn't come to us naturally." We are generally content with our own beliefs and see no reason to entertain alternative thoughts. Sometimes the answer is to survey the views of others and ask them to criticize your view. Other times you can simply think about the same topic at different times and create a crowd within your head. No matter how you get there, taking in the views of others is valuable.

Good forecasters think in probabilities, but there's nothing easy about that. Tetlock and Gardner propose that we come out of the factory with three settings on our dial of probability: it's going to happen; it's not going to happen; and maybe. They suggest this worked fine for our ancestors. "Is that a lion? YES = run! MAYBE = stay alert! NO = relax."

Forecasters commonly use 50 percent to represent “maybe,” and sure enough the forecasters who used 50 percent the most frequently were less accurate than the average.

Superforecasters provide more finely detailed forecasts than the other forecasters. Instead of 60, 70, 80 percent they are more likely to use 70, 75, 80 percent, or even 70, 71, 72 percent. This precision was not for show: the more granular forecasts were more accurate than the less granular ones.

Philosophers suggest a distinction between cases where you don’t know the outcome but the possibilities are knowable—the roll of a die for instance—and cases where you don’t know and the alternatives are unknowable.¹⁴ Superforecasters recognize that the cloudier the outlook for the answer, the more it benefits them to stay in the zone of “maybe.”

We will come back to probability when we discuss tools, but it is again worth underscoring the value of feedback. One of the surest ways to improve calibration, the alignment of subjective and objective probabilities, is through timely and accurate feedback. Part of the reason that weather forecasters are better than financial forecasters is that they quickly see whether their predictions are accurate.¹⁵

We live in a dynamic world, so new information that should change our assessments of probabilities arrives all the time. Superforecasters have more accurate initial predictions on average than the regular forecasters do, but they also update their views more often. Such updating requires an open mind, but also comes with the risk of under- or overreacting.

Tetlock and Gardner offer three reasons that forecasters underreact to new information. To start, sometimes we are so busy that novel information merely slips our attention. We also may take our eye off of the original question and dwell on a simpler or slightly different one. So the new information may not appear relevant to the question in our minds even though it is relevant to the question at hand. Finally, and probably most likely, is belief perseverance. This is typically accompanied by confirmation bias—actively seeking information that supports our view and dismissing views counter to it.¹⁶

But it’s also possible to overreact to new information. One reason is that we take into account irrelevant information. People may base their initial estimate on solid reasoning, but subsequently place weight on additional information that has no bearing on the issue at hand. A second reason for overreaction is a lack of commitment. Say you buy a mutual fund after having done research convincing yourself that the portfolio manager is skillful and that her strategy will do well over time. If you sell at the first bump in performance, you are showing a lack of commitment.

Use of Bayes’s Theorem is a formal way to update probabilities, but it turns out that the superforecasters generally don’t use it. This is true even for those steeped in the math of the theorem. There is no easy way to correctly update views, but we know that superforecasters spend a lot of time thinking about how to do it well.

We think intuitively most of the time. Our intuitive system tends to use rules of thumb, or heuristics. For example, the availability heuristic suggests that we deem events that are easy to remember, because of vividness or recency, to be more numerous than events of equal frequency that are not as simple to recall. Other heuristics include representativeness and anchoring.¹⁷

Heuristics are wonderful because they save us a great deal of time. But they also come with biases that can undermine the quality of our judgments. For example, people are unjustifiably more fearful of flying after having heard of an aviation accident.

Superforecasters have an above-average awareness of these biases and try to manage them. Both the thinking styles and forecasting methods of superforecasters help address bias. The melding of humans and computers is another path to improved decisions. Done correctly, the output of man plus machine can exceed man or machine in certain domains.

David Ferrucci is an artificial intelligence expert who was in charge of creating Watson, the computer that beat champions Ken Jennings and Brad Rutter in the game show *Jeopardy!* He sees a role for human judgment even with the rise of the robots. But he also believes that computers can help overcome human bias. “So what I want is that human expert paired with a computer,” said Ferrucci, “to overcome the human cognitive limitations and biases.”

Work Ethic. Carol Dweck, a professor of psychology at Stanford University, is best known for her work on mindset, or a way of thinking. She suggests individuals can be placed on a continuum, with a “fixed mindset” at one extreme and a “growth mindset” at the other, based on their implicit belief about the source of ability. People with a fixed mindset believe that ability is innate and therefore can’t be budged. People who say, “I’m just bad at math,” have a fixed mindset. Those with a growth mindset believe that ability is the result of hard work and effort and therefore can improve over time.

Superforecasters fall on the growth mindset side of the continuum. They believe that there is always room for improvement and seek ways to get better. In discussing the results of one of her experiments, Dweck noted, “Only people with a growth mindset paid close attention to information that could stretch their knowledge. Only for them was learning a priority.”¹⁸

Another quality that the superforecasters have is grit, a term popularized by Angela Duckworth, another one of Tetlock’s colleagues at the University of Pennsylvania.¹⁹ Grit is perseverance in the service of long-term goals. It entails the ability to overcome failure and obstacles along the way of achieving an objective.

Combine a growth mindset and grit and you have an outstanding formula for personal development and improvement. Tetlock and Gardner call the combination “perpetual beta.” A product in beta is nearly complete but has room for improvement. Perpetual beta suggests a desire for ongoing improvement. Exhibit 1 summarizes the composite portrait of a superforecaster.

Exhibit 1: Composite Portrait of the Modal Superforecaster

■ Philosophic Outlook

- **Cautious:** Nothing is certain
- **Humble:** Reality is infinitely complex
- **Nondeterministic:** What happens is not meant to be and does not have to happen

■ Abilities and Thinking Styles

- **Actively open-minded:** Beliefs are hypotheses to be tested, not treasures to be protected
- **Intelligent and knowledgeable, with a “need for cognition”:** Intellectually curious, enjoy puzzles and mental challenges
- **Reflective:** Introspective and self-critical
- **Numerate:** Comfortable with numbers

■ Methods of Forecasting

- **Pragmatic:** Not wedded to any idea or agenda
- **Analytical:** Capable of stepping back from the tip-of-your-nose perspective and considering other views
- **Dragonfly-eyed:** Value diverse views and synthesize them into your own
- **Probabilistic:** Judge using many grades of maybe
- **Thoughtful updaters:** When facts change, they change their minds
- **Good intuitive psychologists:** Aware of the value of checking thinking for cognitive and emotional biases

■ Work Ethic

- **A growth mindset:** Believe it's possible to get better
- **Grit:** Determined to keep at it however long it takes

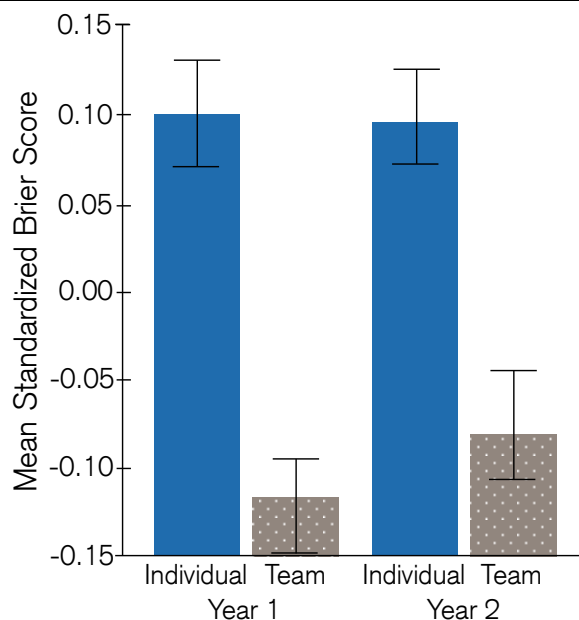
Source: Philip E. Tetlock and Dan Gardner, Superforecasting: The Art and Science of Prediction (New York: Crown Publishers, 2015), 191-192. Used by permission.

These elements of a superforecaster may be valuable for adding structure to hiring processes and performance evaluation. Further, leaders of organizations in the forecasting business should give careful consideration to creating an environment conducive to good judgment.

Manage Interaction

The objective of the IARPA tournament was to make accurate forecasts, and the GJP had already proven that it could do that. The next question was whether working in teams would improve accuracy. To find out, in year one the GJP researchers randomly assigned some forecasters to work in teams and provided them with tips on how to work together effectively. Others were to work alone. This was before the scientists had identified the superforecasters.

The results were clear: teams were on average 23 percent more accurate than individuals. Exhibit 2 shows the statistical results for the first two years. Recall that a lower Brier score is better than a higher one.

Exhibit 2: Forecasting Teams Outperformed Individuals

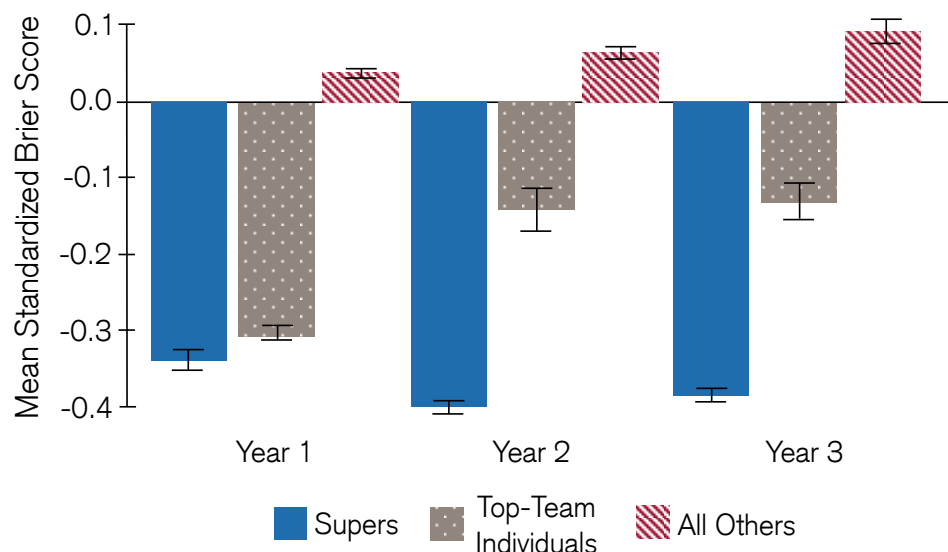
Source: Based on Barbara Mellers, Lyle Ungar, Jonathan Baron, Jaime Ramos, Burcu Gurcay, Katrina Fincher, Sydney E. Scott, Don Moore, Pavel Atanasov, Samuel A. Swift, Terry Murray, Eric Stone, and Philip E. Tetlock, "Psychological Strategies for Winning a Geopolitical Forecasting Tournament," *Psychological Science*, Vol. 25, No. 5, May 2014, 1106-1115.

Note: Error bars represent plus and minus two standard errors.

Most organizations use teams to get their work done. In some sectors, including investment management, the trend shows an increasing use of teams.²⁰ But the research also reveals that there are pros and cons to working in teams. The pros are that individuals can share information, and aggregation tends to lead to more accurate forecasts. The cons are that team members may be tempted to loaf, and the team may fall into groupthink, failing to capture the value of cognitive diversity.

In year two, the researchers created teams of superforecasters. Each team had a dozen members, but about five or six individuals did most of the work. Once again, the teams were trained on how to work together, and because the members did not meet face-to-face the project coordinators created forums for them to communicate.

The outcome was remarkable. Those who were good enough to achieve superforecaster status in year 1 were 50 percent more accurate, on average, in year 2 as part of a team. Year three was more of the same. (See Exhibit 3.) Indeed, these superteams were 15 to 30 percent better than prediction markets, a high standard to exceed.

Exhibit 3: Superforecasters Are Even Better in Teams

Source: Based on Barbara Mellers, Eric Stone, Terry Murray, Angela Minster, Nick Rohrbaugh, Michael Bishop, Eva Chen, Joshua Baker, Yuan Hou, Michael Horowitz, Lyle Ungar, and Philip Tetlock, "Identifying and Cultivating Superforecasters as a Method of Improving Probabilistic Predictions," *Perspectives on Psychological Science*, Vol. 10, No. 3, May 2015, 267–281.

Note: Error bars represent plus and minus one standard error.

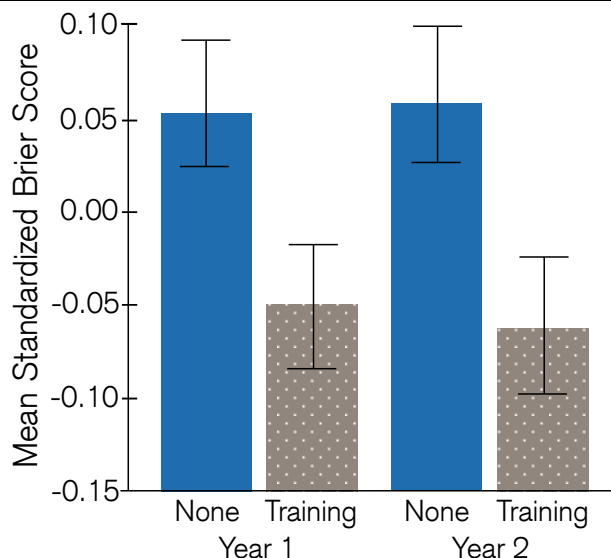
This is not to say that all went smoothly. Initially, the superforecasters were cautious, restraining comments that would be perceived to be too critical of the assessments of others. And not all of the superforecasters had great social skills. In most cases, however, the teammates figured out ways to engage one another in constructive confrontation that allowed the groups to improve performance. The superforecasters were invited to get together in person after years two and three, and many of them reported that the added human dimension and sense of commitment were helpful.

Notwithstanding the success of the superteams, the GJP researchers have reservations about how well the formula would apply in a corporate setting. Identifying individuals as "super," getting employees from different parts of the firm to work together, and interpersonal dynamics might all create friction.

The main lesson is that interaction among a diverse group, especially those with the profile of a superforecaster, can be very effective if managed properly. Companies that seek diversity should also be prepared to train employees in how to manage diversity.²¹

Train Effectively

One remarkable finding from the GJP is that relatively little training, about an hour, can improve results by 10 percent. (See Exhibit 4.) For individuals, the training focused on sharpening probabilistic reasoning and removing cognitive biases. One example is how we tend to use the "inside" versus the "outside" view. With the inside view, we tend to rely on our own information and perception. The outside view considers a problem as an instance of a larger reference class and appeals to the base rate of past occurrence. While both are important in good judgment, psychologists have shown that we commonly rely too much on the inside view. Making individuals aware of the outside view can help reduce this bias.

Exhibit 4: Forecasters Benefit from Debiasing Training

Source: Based on Barbara Mellers, Lyle Ungar, Jonathan Baron, Jaime Ramos, Burcu Gurcay, Katrina Fincher, Sydney E. Scott, Don Moore, Pavel Atanasov, Samuel A. Swift, Terry Murray, Eric Stone, and Philip E. Tetlock, "Psychological Strategies for Winning a Geopolitical Forecasting Tournament," *Psychological Science*, Vol. 25, No. 5, May 2014, 1106-1115.

Note: Error bars represent plus and minus two standard errors.

For groups, the training addressed how to work together. The goal is to strike a balance between conflict and harmony. Too much conflict and the group dynamics break down. No one wants to interact. Too much harmony leads to a false consensus, or even groupthink. The right balance is an atmosphere of constructive criticism.

Overweight Elite Forecasters or Extremize Estimates

The simplest way to capture the wisdom of crowds is to aggregate the estimates of a large number of people with diverse views. For example, you can let lots of people examine a jar filled with jelly beans and ask each of them to provide an estimate of the total. The collective prediction will beat the average individual predictions and will generally be very close to the actual number of jelly beans.

The statisticians working on the GJP figured out two ways to improve the quality of forecasts.²² The first is to place more weight on what the superforecasters say. The intuition behind this is straightforward; give those who predict more accurately a greater voice.

The second is the application of an algorithm to "extremize" answers. Imagine five individuals with different points of view who all estimate the probability of an outcome to be 75 percent. The extremizing algorithm would push that probability closer to 100 percent. Likewise, a group estimate with a low probability would be adjusted closer to zero percent. How far the algorithm pushes the aggregate forecast toward 0 or 100 is a function of the diversity and sophistication of the pool of forecasters.

The idea is to capture unshared information.²³ Here's one way to think about it. Each of our diverse forecasters who come up with a probability of 75 percent uses some information that's common to all of them and some that's unique to them. What would happen if each of them knew all of the information? It would strengthen their confidence, moving their collective estimate toward 100 percent. So the extremizing algorithm captures what would happen if diverse individuals could share all of their information with the group.

A Superforecaster's Tools

We have covered what makes for a superforecaster and the elements of an accurate prediction. But we have glossed over some of the essential tools necessary to come up with good forecasts. We now cover those tools, including defining a good question, keeping score, and approaches to forecasts.

Good Questions. The first step in coming to useful answers is to ask good questions. A good question has a clear outcome within a specified period of time and addresses an issue that is relevant to the world. Let's look at each of these components.

Because keeping score is essential to developing the skill of foresight, questions must have clear answers. Consider the simple example of weather. Weather forecasters predict temperature, precipitation, and winds. They can measure each of these and compare the prediction to the outcome. Likewise, questions in the GJP and those from the intelligence community should have clear answers.

Questions must also have a set time frame. One key difference between Tetlock's prior research on expert judgment, which showed poor results, and the latest results from the forecasting tournament, which paint a more optimistic picture, is the time frame. In the prior research, the questions went out three to five years whereas in the IARPA tournament they average about a few months to a year. Predicting outcomes in the political, economic, and social realms over three to five years is very hard for anyone. Predictions in shorter time frames are more feasible and yet still relevant for business and policy decisions.

Open-ended predictions are of limited value. Tetlock and Gardner discuss a letter sent in November 2010 to Ben Bernanke, then chairman of the Federal Reserve. Signed by nearly two dozen economists, investors, and commentators, the letter suggested that quantitative easing should be "reconsidered and discontinued" and noted the risk of "currency debasement and inflation." In the fall of 2014, reporters at *Bloomberg* contacted some of the signees and found that "all of those who commented stood by the letter's contents." With no time frame or objective way to score the prediction, the letter provides no way to keep score.

Finally, good questions are also relevant. Some questions may be a subset of a group of questions that allow you to assess a larger, but more difficult, issue. Tetlock and Gardner suggest a useful question should pass the smack -the-forehead test: "when you read the question after time has passed, you smack your forehead and say, 'If only I had thought of that before!'"

Here's an example of a question from the forecasting tournament. Note that it has a clear outcome, specified time period, and relevance:²⁴

"Will Italy's Silvio Berlusconi resign, lose reelection/confidence vote, or otherwise vacate office before 1 January 2012?"

Tetlock and Gardner make an additional point on questions. They suggest that the skills in asking good questions may be different than the skills in answering them. The superquestioners might not be the same as the superforecasters. Thoughtful organizations should seek to cultivate skills in both capacities.

Keeping Score. We have already mentioned the Brier score, the main method that psychologists use to measure results. If you have a prediction with a specific probability and an outcome, you are in a position to grade the predictions. Since Brier scores reflect the distance from a forecast to the outcome, lower figures are better. Superforecasters were those in the tournament who earned the lowest Brier scores.

Keeping score is crucial because it provides feedback and therefore an opportunity to learn. Forecasters want to improve in two ways. One way is called “calibration,” which means that your forecasts line up with the outcomes. For example, you are well calibrated if you say that certain events will occur with a 40 percent probability and they actually happen 40 percent of the time.

Another way to improve is what the authors call “resolution.” Resolution means that when you are sure something is not going to happen, it doesn't happen, or when you're sure it will happen, it does. It's a measure of conviction. Good calibration and resolution are correlated, but they are distinct. You want to sharpen your skills in both ways.

Tetlock is fond of the phrase “vague verbiage slows learning cycles.”²⁶ In our day-to-day conversations we use lots of phrases—maybe, possible, probable, might happen—that are ambiguous. In one famous illustration, in 1951 the U.S. intelligence community produced a report saying that the Soviet Union's invasion of Yugoslavia was a “serious possibility.” Sherman Kent, a professor of history at Yale who was then serving at the Central Intelligence Agency, asked some members of his team what “serious possibility” meant. Even though they all agreed to use the term in their report, one analyst said it meant an 80 percent probability and another said 20 percent.

The lesson from this story is to use specific probabilities and time horizons whenever possible and to keep track of those forecasts. Numerical probabilities dismiss the risk of misinterpretation or misunderstanding that Kent faced and provide forecasters with the feedback they need to improve.

Approaches to Forecasts. In studying how superforecasters approach their task, Tetlock and his colleagues noticed a few methods that may be useful beyond the tidy confines of the forecasting tournament.

The first is the idea of question triage. In times of medical emergency such as war, doctors and nurses sort casualties based on their injuries. This process is called triage. Patients who require immediate care receive priority over those who are expected to live and those who have no chance of survival. Similarly, you can sort questions. Some are too easy and others too hard. The priority should go to questions that are between those extremes where “effort pays off the most.”

Superforecasters also use specific techniques to answer some bigger, but answerable, questions. One is associated with Enrico Fermi, a professor at the University of Chicago who worked on the Manhattan Project and won the Nobel Prize in physics. It is effectively a back-of-the-envelope calculation. Fermi used the approach to estimate the strength of an atomic bomb test, but you can use the technique for any question for which there is an answer.

In *Superforecasting*, Tetlock and Gardner use a popular example of a Fermi problem: How many piano tuners are there in Chicago? The tactic is to break the big question into a series of smaller, and easier, questions. You might estimate the population of Chicago, assess the number of households, judge how many pianos there are per household, consider the number of schools and places of worship, determine how often pianos need to be tuned, and contemplate how long it takes to tune a piano and how many hours a piano tuner might work. It turns out there are about 250-300 piano tuners in Chicago.²⁷

Another technique is called question clustering. The idea is that the big question we want to answer—“Will North Korea initiate a war?”—is too big, and the small questions—“Will North Korea launch a multistage rocket by some date?”—are too small. Tetlock and Gardner suggest that a cluster of small questions, each of which you can update, provide insight into answering the bigger question. They use the metaphor of the

painting technique, pointillism, which consists of adding dots to the canvas. No dot by itself means much, but together they paint an evocative picture.

To gauge the likelihood of North Korean aggression, they propose that you might ask questions about missile launches, nuclear tests, cyber-attacks, and artillery shelling. The patterns of probabilities provide a path to tackling some of the big questions. Here again, it's good to remember that those who come up with the questions and those who answer need not be the same.

Leadership

Tetlock and Gardner suggest that if you ask people to list the qualities of a strong leader, you will hear adjectives such as confident, decisive, and visionary. But as we have seen, those descriptions don't fit the superforecasters very well. Leaders are supposed to be in perpetual action mode, while superforecasters seem to be in perpetual learning mode.

The authors refer to the wisdom of Helmuth von Moltke, the chief of staff of the Prussian Army for three decades and considered by many to be the inventor of the modern method of directing troops in the field. "In war, everything is uncertain," said Moltke, recognizing the limits of knowledge. And acknowledging the necessity of flexibility, he observed, "No plan of operations extends with certainty beyond the first encounter with the enemy's main strength."

Moltke's point, which was eventually embraced by the German army, is that leaders must think and change their course of action as necessary. Orders could be questioned, even criticized, if there was a better way. The message was to be actively open-minded. A German military manual notes, "The art of leadership consists of the timely recognition of circumstances and of the moment when a new decision is required."

David Petraeus, a retired four-star U.S. Army general, embraced many of Moltke's themes in a contemporary context. He supported sending his officers to top universities to pursue graduate studies in order to hear points of view that were different from their own. This creates vital mental flexibility and sounds a lot like what superforecasters do.

But Petraeus also recognized that leading requires thinking and doing. He said that a leader "needs to figure out what's the right move and then execute it boldly." Humility should make a leader think carefully about what he or she is doing, and confidence should give an individual the strength to act.

Ultimately, we want our leaders to be confident, decisive, and visionary. But the lesson of *Superforecasting* is that thinking is an important precursor to action. Further, circumstances change and it is vital to update views and change strategic course appropriately.

Doubts

Phil Tetlock is highly respected in his field and, like the superforecasters he studies, is in constant search of improvement. Two of his friends and colleagues, Daniel Kahneman and Nassim Taleb, offer some challenges to the skill Tetlock has identified in forecasting.

Kahneman's challenge relates to "scope insensitivity." The idea is that the questions we face often evoke a feeling of emotion. Scientists can measure that affect with money.

For example, researchers might ask you how much money you would be willing to pay to save 2,000 migratory birds from dying from hazards, including oil spills, wetlands destruction, or residue from herbicides and pesticides. Subjects say about \$80. You feel bad about the situation and are willing to pay some amount of money to help.

Here's the issue: When researchers asked subjects how much they would be willing to pay to save 20,000 birds, the answer was \$78. And for 200,000 birds the response was \$88.²⁸ The dollar sum reflects how people feel about the scenario, not how much they would be willing to pay to save each bird. There is no cost-benefit analysis. Subjects think using System 1 and as a result are insensitive to the scope.

Kahneman thought that a similar type of scope insensitivity might affect the GJP forecasters. Specifically, he thought scope insensitivity would have to do with the time frame. For example, if you are asked how likely it is that a particular dictatorial regime will fall you will focus on the probability and fail to properly consider the time frame.

Running the numbers, the GJP scientists found that indeed many of the forecasters were scope insensitive. When asked the probability that the regime of Syrian President Bashar al-Assad would fall, regular forecasters assigned a 40 percent probability that it would happen within 3 months and a 41 percent chance within 6 months. They assigned essentially the same probability to a period twice as long as the first.

But the superforecasters did much better. Their probabilities were 15 percent for 3 months and 24 percent for 6 months. That's not perfect sensitivity, but it is a lot closer than the regular forecasters. Tetlock and Gardner interpret this result as the ability of superforecasters to engage System 2 thinking more readily than the majority of forecasters. Indeed, they argue that superforecasters have internalized this way of thinking to the point that it has become automatic.

Nassim Taleb has popularized the concept of a black swan event, which comes as a surprise, is consequential, and is explained after the fact. Tetlock and Gardner say that "Taleb insists that black swans, and black swans alone, determine the course of history." If so, IARPA's forecasting tournament is of little value.

Tetlock and Gardner offer some thoughts to counter this view. The first has to do with the definition of a black swan. If we know what a distribution of outcomes looks like, even those with extreme events, then we are dealing with "gray swans," not black swans. Scientists have done a lot of work classifying the distributions of certain phenomena, including earthquakes, terrorist acts, and power-grid failures. While predicting a specific outcome is very difficult, scientists have a general understanding of how these systems behave. Taleb calls these "modelable extreme events" and they capture much of what is of interest to us.²⁹

Black swans and gray swans are highly improbable outcomes. As a result, there are simply not enough data from the forecasting tournament to conclude that superforecasters are either good or bad at spotting them. In

fact, even if the tournament ran for decades it would be hard to know. So those seeking accurate forecasts of black or gray swan events will have to look elsewhere.

But the fact is that the forecasting tournament does address a lot of issues that are relevant for executives, investors, and policymakers. While black swans have a large impact on the world, so do the accumulation of lots of small events. Thinking about the future is not black swan or nothing; there is plenty of room to consider outcomes that have smaller impact.

One point on which Tetlock, Kahneman, and Taleb agree is that forecasting many years into the future is very difficult. There are severe limits on predictability beyond a certain period of time. The essential issue is whether there is value in sharp forecasts for horizons less than a year. Most professionals would answer with a resounding yes.

Summary

Humans have a deep-seated desire to anticipate the future. The demand for forecasts is met by a supply of seers, pundits, and experts expounding on what will happen next. But we generally don't measure the quality of predictions, and when it has been done the results are unimpressive.

Superforecasting shows that prediction may not be so futile after all. The Good Judgment Project, part of a forecasting tournament sponsored by the U.S. intelligence community, revealed that some forecasters are not only good but consistently good. Using the best ideas from psychology and careful measurement, the GJP team has been able to provide essential lessons for anyone in the prediction business. Here are some of the main conclusions:

- **Forecasting skill exists.** The researchers found that a small percentage of the forecasting population were much more accurate than average and consistently so. They were able to find the superforecasters because they welcomed a large sample of forecasters, asked questions with time frames of a year or less, and kept track of the responses.
- **Way of thinking is vital.** Closer analysis of the superforecasters shows that they are bright, but not extraordinarily so. What distinguishes them from regular forecasters is the way they think. Superforecasters are actively open-minded, nondeterministic, intellectually humble, numerate, thoughtful updaters, and hard working.
- **Teams.** When superforecasters interact with one another, their predictions improve. But there are pros and cons to working in teams. The pros include more information and the ability to harness the power of aggregation. The cons are social loafing and the risk of groupthink. Teams that do the best have members who have been given instruction and training on how to work together.
- **Training.** Training in methods to de-bias forecasts and to collaborate effectively improves outcomes. Proper training has content that is valuable and processes that can be implemented immediately. Training without implementation is a waste.
- **Leadership.** At first blush, the qualities associated with leadership appear antithetical to those of the superforecasters. The way to reconcile the two is to acknowledge that proper, even bold, action requires good thinking. And the best leaders recognize that even the best laid plans need to be constantly revised based on the conditions.

Appendix: Keeping Score with Brier

Psychologists commonly use the Brier score as a method for gauging the accuracy of probabilistic forecasts. Glenn Brier, a meteorologist, developed the score in the 1950s.³⁰ In its simplest form, the Brier score measures the square of the forecast error, or $(\text{forecast} - \text{outcome})^2$. For binary events, the value of the outcome is 1 if the event occurs and 0 if it does not. As in golf, a lower score is better.

You can express a Brier score either on a scale of 0 to 1, or 0 to 2, depending on the calculation. We follow Brier's original approach and place our results on a scale of 0 to 2. When calculating the Brier score this way, you consider the squared forecast error for both the event and the non-event.

Exhibit 5 shows a meteorologist's probabilistic forecasts for whether it will rain over the next four days. For example, on Day 2, she forecasts an 80 percent probability that it will rain. Likewise, we can say she forecasts a 20 percent probability that it will *not* rain. Because it did rain, we place a 1 in the outcome column below "Rain" and a 0 in the "No Rain" column. Her Brier score for that day was 0.08. For multiple forecasts, the overall Brier score is the mean of the scores for each forecast. The meteorologist's overall Brier score comes to 0.25.

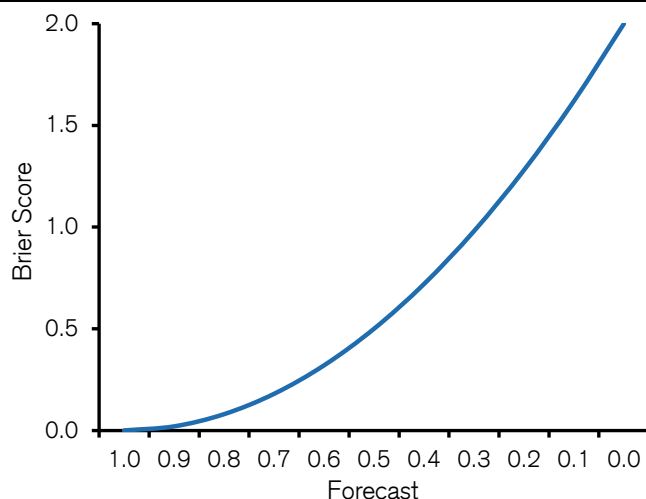
Exhibit 5: Calculation of Brier Score

Day	Rain		No Rain		Brier Score	
	Forecast	Outcome	Forecast	Outcome	Calculation	Result
1	30%	0	70%	1	$= (0.3-0)^2 + (0.7-1)^2$	0.18
2	80%	1	20%	0	$= (0.8-1)^2 + (0.2-0)^2$	0.08
3	60%	0	40%	1	$= (0.6-0)^2 + (0.4-1)^2$	0.72
4	100%	1	0%	0	$= (1.0-1)^2 + (0.0-0)^2$	0.00
Mean						0.25

Source: Credit Suisse.

The scale from 0 to 2 has a nice feature. Random guesses have a Brier score of exactly 0.50. Exhibit 6 shows the Brier scores for an event that occurs ("Rain") for subjective probabilities from 0 to 100 percent. Superforecasters have Brier scores of around 0.20 – 0.25 and in some exceptional cases can achieve scores in the teens.

Exhibit 6: Brier Scores of Event That Occurs for Various Subjective Probabilities



Source: Credit Suisse.

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What's Going On in Your Brain?

Common Investor Biases and Where They Come From

October 20, 2015

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- Humans are social and generally want to be part of the crowd. Studies of social conformity suggest that the group's view may shape how we perceive a situation. Those individuals who remain independent show activity in a part of the brain associated with fear.
- We are natural pattern seekers and see them even where none exist. Our brains are keen to make causal inferences, which can lead to faulty conclusions.
- Standard economic theory assumes that one discount rate allows us to translate value in the future to value in the present, and vice versa. Yet humans often use a high discount rate in the short term and a low one in the long term. This may be because different parts of the brain mediate short- and long-term decisions.
- We suffer losses more than we enjoy gains of comparable size. But the magnitude of loss aversion varies across the population and even for each individual based on recent experience. As a result, we sometimes forgo attractive opportunities because the fear of loss looms too large.

Introduction

In recent decades, psychologists and economists have cataloged the ways in which human behavior deviates from economic theory.¹ They have done this mostly through experiments and observation. Daniel Kahneman and Amos Tversky, psychologists who formalized this research, showed that individuals use heuristics, or rules of thumb, to make their judgments. These heuristics lead to biases when compared to normative economic behavior.² For example, people generally place too much weight on information that is available to their minds, often associated with an event that is vivid or recent, and overestimate the probability of a similar event occurring again.

Neuroscientists have joined psychologists and economists to create the field of neuroeconomics. One of the goals of neuroeconomics is to understand how certain behaviors are linked to specific brain activity. The theory of modularity says that particular cognitive functions are associated with different parts of the brain. Neuroeconomics allows researchers to connect behaviors to specific regions, providing insight into how the brain handles certain cognitive challenges.

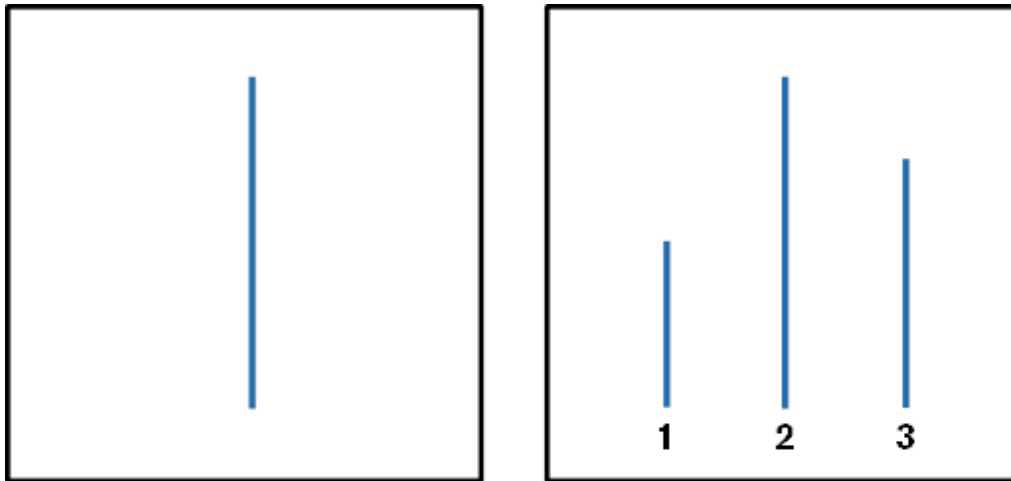
In this report, we examine four situations where individuals make poor choices and review the research to show where the brain makes those decisions. In each case, we present some ideas about how to overcome the potentially suboptimal choice.

Mental Mistake #1: Social Conformity

In the summer of 2015, the CFA Institute surveyed 724 investors about which behavioral biases affect decision making the most.³ More than one-third of the investors voted for herding, or “being influenced by peers to follow trends.” Herding is problematic because an investor can’t beat his or her peers by doing the exact same thing that they are doing. Further, herding can lead to inefficient market prices.⁴

Humans are social beings, and conformity makes sense in a wide range of contexts. For example, you are well served to do what others are doing when they know more than you do. Conformity also encourages others to like you, which can confer loyalty and safety. Problems arise, however, when the group is wrong.

Solomon Asch conducted the most famous experiment of social conformity in the 1940s and 1950s.⁵ The researcher showed two cards to the subjects, who were in groups of seven to nine. One card had a single line on it and the other had three lines of varying lengths, including one of the same length as that on the first card (see Exhibit 1). The task was to choose the line of the same length. Going around the room, the participants answered one after the other. The experiment opened uneventfully as the group selected with near perfect accuracy.

Exhibit 1: Example of Line Matching from Solomon Asch's Experiments

Source: Solomon E. Asch, "Opinions and Social Pressure," *Scientific American*, Vol. 193, No. 5, November 1955, 31-35.

The experiment then started for real. Asch had arranged for all of the members except one to be in with him on the experiment, making that individual the true subject. The researchers instructed the confederates, who answered publicly before the true subject, to give the wrong response in two-thirds of the trials. In a set of 123 experiments, the subjects conformed to the majority's wrong answer 36.8 percent of the time. While about one-quarter of the subjects remained completely independent throughout the experiment, one-third aligned with the majority most of the time.

Asch was fascinated by this degree of social conformity and interviewed the subjects immediately following the experiment. Based on their responses, he surmised that three "distortions" could explain the behavior of the conformers.⁶

Distortion of judgment is a case when the subject concludes that the group knows more than he does and hence conforms. "These subjects," wrote Asch, "suffer from primary doubt."

Distortion of action captures instances when the subject knows the right answer but feels more comfortable being part of the crowd but wrong. According to Asch, "They yield because of an overmastering need not to appear different."

Distortion of perception occurs when the subjects are unaware "that their estimates have been displaced or distorted by the majority." In other words, the majority's answer changes how they perceive the answer. He added that perception is the least popular explanation for conformity.

While Asch's curiosity was laudable, interviews are not a rigorous way to determine the source of social conformity. In the mid-2000s, neuroscientists picked up where Asch left off. They were able to use functional magnetic resonance imaging (fMRI) technology to pinpoint the mechanisms of social conformity within the brain.

First, scientists have been able to replicate Asch's results consistently.⁷ Subjects conform not only for perceptual tasks, such as identifying line lengths, but also for subjective evaluations including judging the quality of paintings. There is even some evidence another species, chimpanzees, conforms.

One of the earliest studies of social conformity using fMRI provided a startling result.⁸ Dr. Greg Berns and his colleagues, using a perceptual task, showed that social conformity is consistent with activity in the occipital and parietal lobes—visual processing regions associated with perception. More directly, the research suggests that the social setting alters what the subjects perceive. This is consistent with Asch's distortion of perception.

Further, those subjects who remained independent showed increased activity in the amygdala. This is a part of the brain that decodes emotion and is especially attuned to threats. Various stimuli trigger activity in the amygdala, but fear is the most effective. Staying independent creates an emotional burden and requires overcoming a wave of fear.

Additional research supports the finding of Dr. Berns and his collaborators but overall the evidence remains tantalizing but tenuous.⁹ Multiple studies show that social conformity is associated with activity in the posterior medial frontal cortex. This is the part of your brain that detects errors and interacts with other parts of the brain to correct the error.¹⁰ Your brain notices when the group provides an answer that is different from yours, and that disparity is unpleasant. For many, aligning with the group is more rewarding for the brain than being independent and correct.

This research also provides some hints about how to avoid inappropriate conformity. The studies, starting with Asch, show that having someone in the group with the same view as you substantially reduces the pull of conformity. Seek others who are like-minded if you feel as if everyone has a point of view that is both different from yours and wrong.

Perhaps the best advice comes from the father of security analysis, Benjamin Graham. He said, "Have the courage of your knowledge and experience. If you have formed a conclusion from the facts and if you know your judgment is sound, act on it—even though others may hesitate or differ. (You are neither right nor wrong because the crowd disagrees with you. You are right because your data and reasoning are right.)"¹¹

Mental Mistake #2: Pattern Seeking

Humans are natural pattern seekers. This ability has conferred an advantage to *Homo sapiens* throughout our history. But problems arise when we perceive patterns where none exist, more formally what statisticians call Type I error.

Research shows that our desire to discern patterns, even when they are an incorrect assessment of cause and effect, has contributed to our evolutionary success. Essentially, evolution forgives lots of Type I errors as long as the occasional correct assessment carries a sufficiently large benefit.¹²

The use of a chart to divine a stock's next move is a good example of pattern seeking.¹³ While there may be value in technical analysis, there is not much in the way that most investors use past prices to understand the future. We are naturally drawn to imposing order, even to cases where the underlying processes are random.

Neuroscientists have created some ingenious experiments to figure out what part of our brain is determined to see patterns. But before we get to humans, let's start with pigeons.

Scientists set up a box with two keys that a pigeon can peck with payoffs that are random. They then make one key much more attractive than the other—for example, the red key provides food with an 80 percent probability and the white key with a 20 percent probability (1 - .80). How will the pigeons choose?

Once the pigeons figure out the relative probabilities, they maximize their payoff by hitting the red key almost every time. Rats do this as well, as do children under the age of four.¹⁴ If the total possible payoff is 100, this strategy yields 80 ($[1.0 * 80] + [0.0 * 20]$), and there is no strategy that can yield more.

Humans, on the other hand, tend to follow a strategy called “frequency matching.” After ascertaining the probabilities, humans alternate between the red and white keys in an attempt to anticipate what will happen next. They seek a pattern. They do guess red 80 percent of the time, matching the frequency of the payoffs, but still try to anticipate the rewards even when they know the occurrences are random. This strategy has a total payoff of just 68 ($[0.8 * 80] + [0.2 * 20]$).

From kindergarten on, humans are frequency matchers. In recent decades, neuroscientists have been able to figure out where this process happens in the brain through the study of split-brain patients. These are people who have surgery to sever the bundle of nerves between the two hemispheres of the brain to treat epilepsy. The surgery alleviates the symptoms of the disease and also allows scientists to determine which part of the brain handles various tasks. Specifically, experiments with the split-brain patients allowed researchers to discern where the tendency to search for patterns resides.

The right hemisphere is good at some tasks, including facial recognition, but is poor at making inferences. It tends to be literal. The left hemisphere, where language largely resides, is also good at inventing stories to fit facts—indeed, it may be too good at it.

When the scientists presented a version of the probability guessing experiment to the right hemisphere, they found that it maximized just as the pigeons, rats, and little kids did. But when they did the same experiment with the left hemisphere, they found it attempted to match frequency.¹⁵ The left hemisphere is the part of your brain responsible for finding patterns. The scientists conclude “that the left hemisphere does this even when it can be nonadaptive.”¹⁶

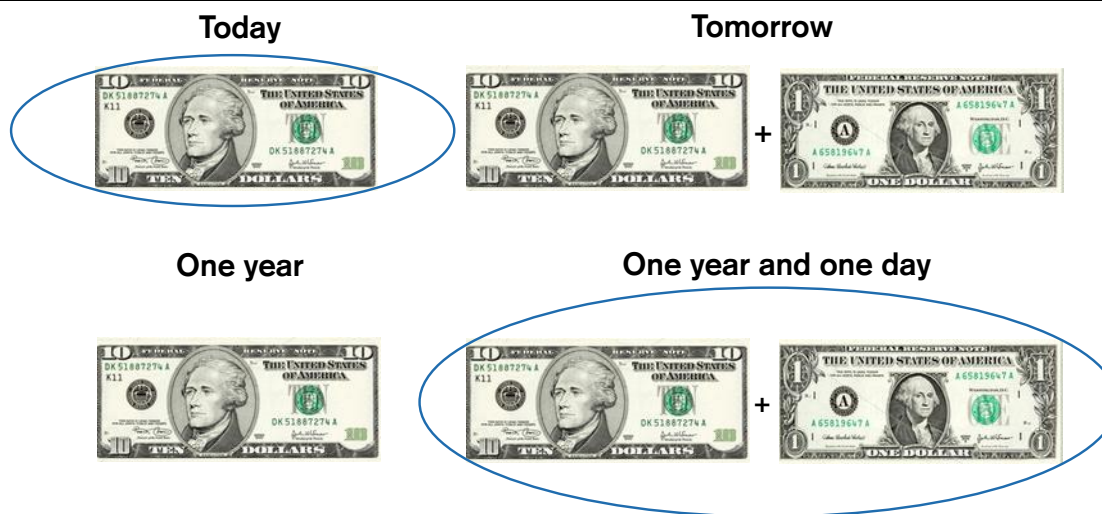
One investor behavior that appears consistent with pattern seeking is called the “dumb money effect,” where investors “tend to transfer money from funds with low recent returns to funds with high recent returns.”¹⁷ On average, investors in mutual funds earn 1.5 percentage points less per year than a buy-and-hold strategy as a result of the dumb money effect. The effect is even larger, 3 to 7 percentage points, in hedge funds.¹⁸

So it's crucial to be aware that part of your brain is seeking patterns and will see them even when they don't exist. Distinguish between realms where patterns are likely to be useful and where they are generally illusory. The behavior of investors and executives suggests that they believe they see dependable patterns even in cases when those patterns don't exist.

Mental Mistake #3: Hyperbolic Discounting — Preferring a Small Gain Today to a Larger Gain Tomorrow

Here's a quiz for you: Which would you prefer, \$10 today or \$11 tomorrow? How about a choice between \$10 one year from now and \$11 in one year and a day? When researchers ask these questions, subjects generally prefer the lower amount now (“I'll take the \$10 today”) and the higher amount in the future (“I'll pick the \$11 in a year and a day”). Exhibit 2 shows this reversal in preference.

Exhibit 2: Subjects Opt for a Smaller Reward Today and a Larger Reward in the Future

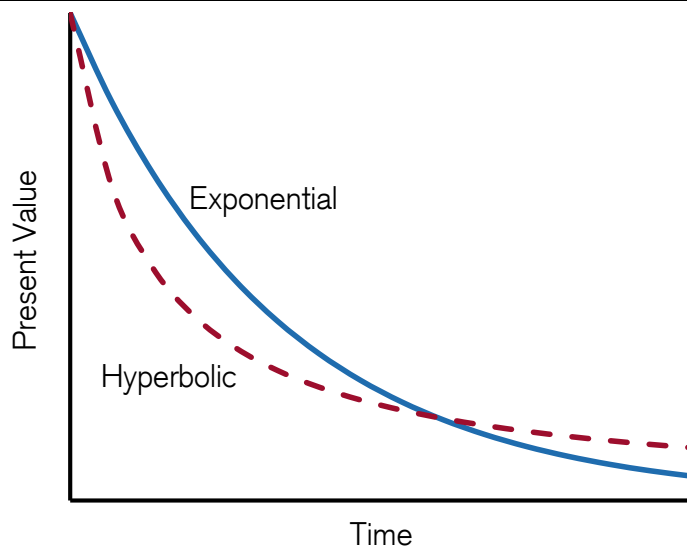


Source: Shane Frederick, George Loewenstein, and Ted O'Donoghue, "Time Discounting and Time Preference: A Critical Review," *Journal of Economic Literature*, Vol. 40, No. 2, June 2002, 351-401.

This pattern of preference runs counter to the discounted utility model, which says we can translate choices from the present to the future, and back again, using a single discount rate. For example, if your annual discount rate is 8 percent you are equally happy to receive \$100 today or \$108 one year from now. While economists have known all along that people don't behave this way, it has become the standard in economic theory. This is called exponential discounting.¹⁹

Economists and psychologists can use the answers of their subjects to impute the discount rates that are consistent with their choices. If you prefer \$10 today to \$11 in one week, your implied annual discount rate is really high. If you prefer \$11 in a year and a day to \$10 in a year, your discount rate is much lower. The pattern of high implied discount rates in the short term and low discount rates in the long term is called hyperbolic discounting.²⁰ Exhibit 3 shows how the present values differ for the same stream of cash.

Exhibit 3: Hyperbolic versus Exponential Discounting



Source: Discount rates based on Leonard Green and Joel Myerson, "Exponential Versus Hyperbolic Discounting of Delayed Outcomes: Risk and Waiting Time," *American Zoologist*, Vol. 36, No. 4, September 1996, 496-505.

The distinction between exponential and hyperbolic discounting may appear to be the purview of nerdy professors, but it actually has some important practical implications. We can start with a commonplace example: a diet. Most of us decide at some point that it would be healthy to shed some weight. And most of us choose to eat a delicious dessert today and resolve to start the diet tomorrow. If this sounds familiar, you are not alone.

Here's a case in point. Researchers were interested in the choices people make for their snacks. The subjects have a healthy choice, a piece of fruit, and an unhealthy choice, either a chocolate bar or a salty snack. A consistent pattern emerges. When the scientists ask the subjects what they want now, they pick the unhealthy snack 70 percent of the time. But when the subjects are asked about a snack for next week, they select the healthy one 74 percent of the time. We insist that our future selves will be good even as our present selves enjoy some candy.²¹

Considering which discount rate to apply also has major implications for policy decisions. For instance, economists have come to very different conclusions about the cost of climate change, and hence the immediate action necessary, based on the discount rate they assume. A low discount rate implies a high cost and a higher discount rate suggests a lower cost. Two economists who agree on the costs and risks of climate change might come to very different conclusions about necessary policy based solely on the interest rate assumption.²²

Finally, many individuals make financial decisions that are not optimal. One illustration is the age at which U.S. citizens should claim Social Security benefits. Full retirement age is 66 or 67 years old, but the age for early eligibility is 62 years old. Those who claim early receive a smaller monthly sum than those who wait until the full retirement age. For example, someone who is set to receive \$1,000 per month at the full retirement age collects \$750 if they start payments at age 62 and \$1,320 if they delay until age 70.²³

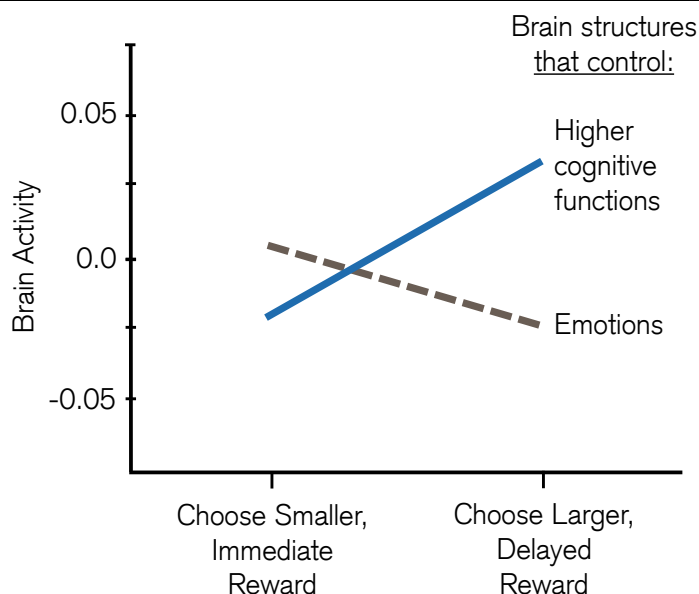
While the payment structures are designed to give comparable payoffs based on life expectancies, economists advise that it is in almost everyone's interest to delay claims as long as possible. Indeed, waiting until age 70 is the best strategy for many.²⁴ But this is not what Americans do. About 40 percent claim benefits at the early eligibility age, and the vast majority claim at or before the full retirement age.

Similar behavior appears when people are offered lump sums versus annuities. As part of the downsizing of the U.S. military in the early 1990s, the Department of Defense offered severance packages to 65,000 military personnel. They could choose between a lump sum and an annuity that was worth considerably more. A small majority of the officers selected the lump sum and virtually all of the enlisted personnel did. For both groups, the value of the annuity was approximately 80 percent higher than the lump sum.²⁵

Researchers set out to figure out what was going on as the brain decided between an immediate and a distant payoff. It turns out that different parts of the brain mediate each decision (see Exhibit 4). When the choice was for a smaller but immediate reward (\$10 today versus \$11 tomorrow) the limbic structures were in control. This part of the brain is associated with impulsive behavior and dysfunctions, including drug addiction.

When larger but delayed rewards are involved (\$10 in a year versus \$11 in a year and a day) areas of the prefrontal and parietal cortex are active. These areas are associated with deliberative processes and cognitive control.²⁶ So it appears that based on the type of problem, distinct neural systems handle the solution.

Exhibit 4: Different Parts of the Brain Mediate Short- and Long-Term Decisions



Source: Samuel M. McClure, David I. Laibson, George Loewenstein, and Jonathan D. Cohen, "Separate Neural Systems Value Immediate and Delayed Monetary Rewards," *Science*, Vol. 306, No. 5695, October 15, 2004, 503-507.

This discussion is relevant for a host of issues, including drug addiction, dieting, and saving enough for retirement. For investors, there are a few ways to deal with the preference for payoffs in the present. One way is to create default decisions, so the issue does not even come up. For instance, you may elect to dedicate all pay raises to savings, so you will never be tempted to spend the money today. This method doesn't allow your brain to deal with the problem at all and goes directly to a beneficial solution.

Scientists have also played with means to make our future selves concrete in our minds.²⁷ One way to do this is to use software to create an avatar. This allows a 25-year-old to see, virtually, a 65-year-old version of herself. A glimpse of the future can encourage activity in the planning part of the brain, avoiding the limbic system, and can therefore lead to better outcomes.

Mental Mistake #4: Loss Aversion and Financial Decisions

One of the main ideas from prospect theory is loss aversion, the idea that people suffer more from losses than they enjoy comparable gains. Prospect theory was developed by Kahneman and Tversky to explain how individuals actually behave when faced with risky choices.²⁸

The loss aversion coefficient is about two, which means that the unhappiness of a \$1 loss is twice as large as the happiness of a \$1 gain. So if you offer a proposition where a correct call of a coin toss pays \$300 and an incorrect call costs \$200, most people will turn it down. Although the expected value is \$50 ($[\.50 \times \$300] + [\.50 \times -\$200]$) the ratio of gain to loss, 1.5, is too low for most people to play. The average coefficient of two, however, belies that there is a wide distribution across the population. Some people are highly loss averse, others less so.

Women tend to be somewhat more loss averse than men, and the old are more loss averse than the young.²⁹ But perhaps the most important issue is that our loss aversion coefficient changes based on experience. For example, seasoned market participants have lower loss aversion coefficients because they ultimately have to make money. But if you have been stung with losses recently, you will tend to avoid risk.

One of the puzzles in finance is why the equity risk premium has historically been so high. The equity risk premium is the extra return that investors in equities earn to compensate them for owning risky stocks versus less-risky bonds. Researchers found that equity returns were higher than they should have been given the actual amount of risk.³⁰

Two behavioral economists, Shlomo Benartzi and Richard Thaler, offer a solution to the puzzle through what they call “myopic loss aversion.”³¹ Look at the stock market over rolling 10- or 20-year periods and you almost always see gains. But in the short run, there are lots of ups and downs. So how frequently you check your stock portfolio determines the probability that you will see gains or losses.

The basic idea of myopic loss aversion is that if you examine your portfolio often, you are more likely to see losses. Being loss averse, you will insist on higher returns to compensate for your suffering. However, if you check your portfolio infrequently, you are more likely to see gains and hence will not require returns as high. They found that the evaluation period consistent with the equity risk premium to that time was about one year.

Benartzi and Thaler’s answer to the puzzle is that since people check their portfolios pretty often (myopic) they suffer (loss aversion) and hence demand a high premium. But in markets, it is often the case that expected returns go up as prices go down and expected returns go down when markets are up. So we end up being conservative when we should be aggressive and aggressive when we should be conservative.

All of this raises an obvious question: How would we invest if we were immune to loss aversion? Researchers created a clever experiment to test the proposition.

The subjects in the experiment were endowed with \$20 and told that they would play several rounds of an investment game. In each round, the subject could either invest, or not invest, one dollar. If they invested, they handed their dollar to the researcher who then flipped a fair coin in full view of the subject. If it landed on heads, the subject lost their money. If it landed on tails, they won \$2.50. If they did not invest, they kept their dollar for that round and went on to the next one. The experiment lasted for 20 rounds, and the subjects were paid the money based on the results.

Participants included normal people recruited from the local community and patients with brain damage stemming from stroke, surgery, or disease. The patients had ordinary intelligence, but the brain damage had affected their ability to process emotion. So these people could do basic math but do not feel emotion the way most people do.

It is easy to see that the best strategy in this investing game is to hand your dollar to the researcher every time, as the expected value for each round is \$1.25 ($[(.50 \times \$2.50) + (.50 \times \$0)]$). In fact, if you played every round there is only about a 1-in-8 chance of having less money than you started with, and the expected value is \$25. However, keeping your dollar does prevent you from losing in any particular round.

The brain-damaged patients finished with \$25.70 on average, 13 percent more than the \$22.80 the normal people earned. They ended with more money because they played 45 percent more rounds than the normal people did, including twice as many rounds after having suffered a loss.³²

It is hard to know exactly what the normal people were thinking, but one plausible explanation is that when they lost, they preferred the sure dollar in the next round to the risk of another loss. In other words, their loss aversion caused them to willfully give up a positive net present value proposition.

The main lesson from this experiment is to try to keep in check the effect of loss aversion. Some traders deal with loss aversion by quickly selling losers.³³ Others focus on finding investments with attractive risk and reward characteristics and don't let past outcomes shape present decisions. This is easier said than done. A final strategy picks up on Benartzi and Thaler's work on myopic loss aversion and suggests that you lengthen the evaluation period you use for your investments, thus mostly sidestepping loss aversion.

Conclusion

In recent decades, psychologists, economists, and neuroscientists have worked together to understand how our behaviors depart from the standards of normative economic theory and why exactly we have a proclivity to do so.

Scientists now have technology to observe brains of individuals as they decide and have crafted experiments to compare behaviors of people with normally functioning brains with those who had their brains altered through stroke, surgery, or disease. This research has lifted the veil on the mental processes behind our choices. Some of the findings include the following:

- Humans are social and generally want to be part of the crowd. Studies of social conformity suggest that the group's view may shape how we perceive a situation. Those individuals who remain independent show activity in a part of the brain associated with fear.
- We are natural pattern seekers and we see them even where none exist. Our brains are keen to make causal inferences, which can lead to faulty conclusions.
- Standard economic theory assumes that one discount rate allows us to translate value in the future to value in the present, and vice versa. Yet humans often use a high discount rate in the short term and a low one in the long term. This may be because different parts of the brain mediate short- and long-term decisions.
- We suffer losses more than we enjoy gains of comparable size. But the magnitude of loss aversion varies across the population and even for each individual based on recent experience. As a result, we sometimes forgo attractive opportunities because the fear of loss looms too large.

The challenge now is to create processes and procedures that manage or mitigate the biases that arise from these tendencies.

* * *

We offer special thanks to our summer intern, Brett Roston, who is now a junior at the Wharton School of the University of Pennsylvania. Brett made a substantial contribution to this document, including reviewing research papers, linking the findings back to the practical implications, and creating a presentation. We appreciate your work, Brett.

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How Corporate
Governance
Matters

Corporate governance and capital allocation

The governing objective, corporate governance and the two camps.

Michael Mauboussin and Dan Callahan

Properly conceived, corporate governance is a system of checks and balances that a company designs in order to serve its governing objective. A governing objective is a clear statement of what a company is trying to achieve, which ultimately shapes the firm's culture, communications and choices about how it allocates capital (Mauboussin and Rappaport, 2015). In this section, we examine the link between corporate governance and capital allocation.

Since the world of business is dynamic, companies must constantly assess trade-offs and make difficult decisions. A clear governing objective provides executives with a basis to mediate trade-offs in the firm. It also provides the stakeholders, including employees, customers, suppliers, debtors, and shareholders, with information they need to assess a company's prospects and to evaluate its performance.

Few companies explicitly state a governing objective, but we can broadly define two camps: maximizing shareholder value and balancing the interests of stakeholders. As a general rule, countries that operate under common law have the strongest protection of shareholders and hence lean towards the shareholder value camp. These countries include the United States, the United Kingdom, and most of the countries that were formerly part of the British Empire (e.g. Australia, Canada and India). Markets for capital and labor play a central role for companies in the shareholder value camp.

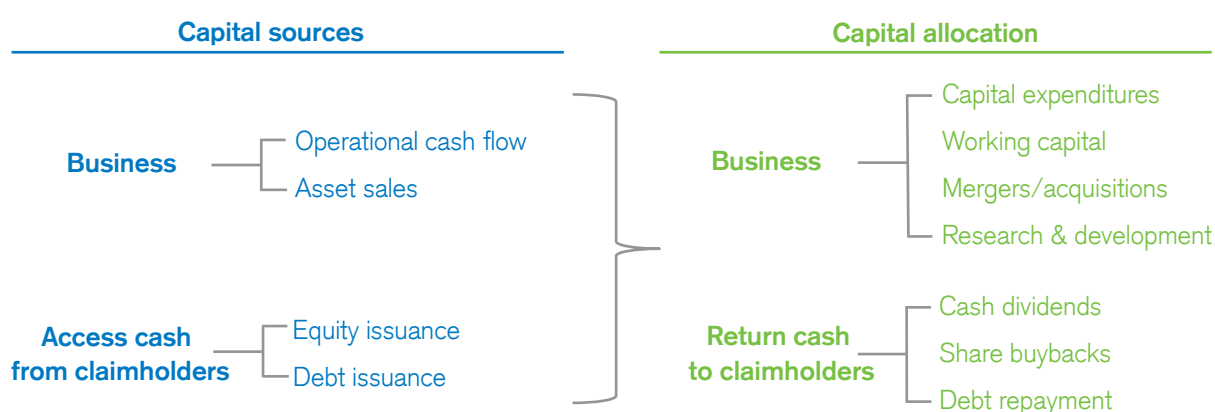
Countries that operate under civil law have weaker protection for shareholders and stronger protection for creditors. They tend towards the camp that seeks to balance the interests of stakeholders. These countries include France, Germany and Japan as well as most Scandinavian countries (La Porta and Lopez-de-Silanes, Shleifer, Vishny, 2001). Formal and informal rules about the interaction between constituencies are vital for stakeholder-centered companies.

Naturally, the mindsets of these camps lead to different structures of corporate governance and choices about how a company invests and finances itself. For example, academics who study shareholder and stakeholder-oriented governing objectives have found that firms that are shareholder-centric have a higher proportion of incentive pay for executives in the form of equity, more externally verifiable control mechanisms, more debt as a percentage of total capital, and higher rates of labor turnover than firms that are stakeholder-centric (García-Castro, Ariño, Rodríguez, and Ayuso, 2008).

Some scholars charge that balancing stakeholder interests cannot serve as a company's singular governing objective because it is impossible to simultaneously maximize the interests of all stakeholders (Jensen, 2002). As a result, executives have discretion to make decisions as they see fit. The problem is that investors and other stakeholders have no reliable basis to evaluate a company's strategy as well as the operating and financing choices its managers make.

Figure 31

Sources and uses of financial capital



Source: Credit Suisse

The fundamental role of capital allocation

Capital allocation is the most fundamental responsibility of a public corporation's senior management team. Successful capital allocation means converting inputs, including money, ideas and people, into something more valuable than they would be otherwise. The net present value test is a simple, appropriate and classic way to determine whether management is living up to this responsibility. A company passes the test when the present value of the long-term cash flow from an investment exceeds the initial cost.

There are two reasons value should determine whether a management team is living up to its responsibility. The first is that companies must compete. A company that is allocating its resources wisely will ultimately prevail over a competitor that is allocating its resources foolishly. This reason is particularly important for firms that compete in global markets. The second is that inputs have an opportunity cost, or the value of the next best alternative. Unless an input is going to its best and highest use, it is underperforming relative to its opportunity cost.

Figure 31 (and in more depth, Figures 32 to 39) shows the sources of capital and the ways that a company can allocate capital. The primary source of capital is cash flow from operations. Companies can also access capital by selling businesses or raising funds through the issuance of debt or equity. Companies can invest in the business through capital expenditures, increases in working capital, research and development, and mergers. Firms can also return capital to claimholders by repaying debt, issuing dividends and repurchasing shares. While a comprehensive consideration of capital allocation also takes into account human capital, we restrict our discussion here to financial capital.

Over time, a company's results will reflect a combination of the opportunities it has and how the executives allocate capital. Industries and companies generally have a lifecycle where a start-up period is followed by a phase of growth, a fade in return on investment, and ultimately a state of maturity (Madden, 1999). Investment in the business is strongest in the early part of the lifecycle and the proclivity to return capital to claimholders is higher towards the end.

Capital allocation is a dynamic process, so the correct answer to most questions is: "It depends." Sometimes acquiring makes sense and other times divesting is the better alternative. There are times to issue equity and times to retire it. As the components that determine price and value are changing constantly, so too must the assessments that a chief executive officer (CEO) makes. As Warren Buffett, CEO of Berkshire Hathaway says: "The first law of capital allocation — whether the money is slated for acquisitions or share repurchases — is that what is smart at one price is dumb at another" (Buffett, 2011).

A basic equation in finance says that a company's sustainable earnings growth rate is a function of its return on investment and the amount it pays out to shareholders. Companies with high returns on investment can sustain more rapid growth than companies with low returns, holding constant the payout ratio.

As a result, companies in a country with a high return on investment can generally fund a greater percentage of their investments with internally-generated cash than companies in a country with a low return. Figure 40 shows this correlation, using cash flow return on investment (CFROI) as a measure of return on investment. The data reflect the average of the ten years up to 2014.

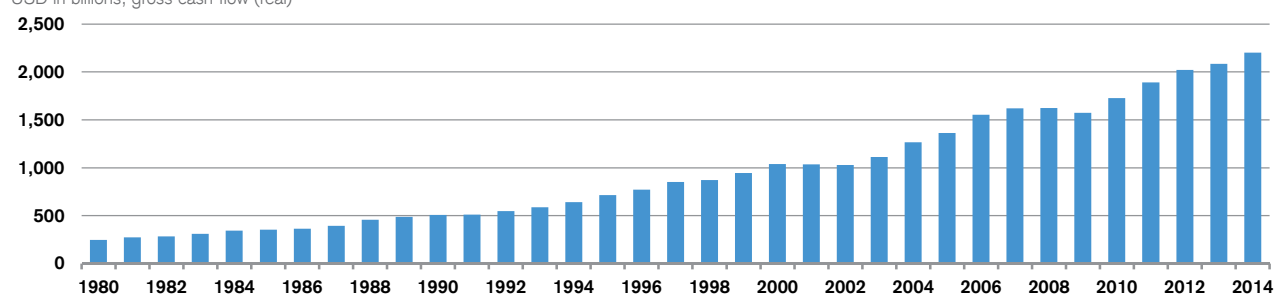
Tying this idea back to corporate governance, countries with a bias towards shareholder value also generate higher CFROI than those that lean towards the balanced stakeholder approach. Specifically, the five largest markets under common law (USA, UK, Hong Kong, Australia, and Canada) have realized an average CFROI of 8.0% since 1994, while representative countries under civil law (Japan, Germany, France, Switzerland, and Sweden) had an average of 6.4%. So for the same rate of growth, common-law countries can afford a higher payout ratio than civil-law countries.

Maximizing long-term value creation per share is the result of making investments that earn in excess of the cost of capital, including the repurchase of shares. A company's governing objective and the corporate governance structures that support it have a profound influence on how the firm allocates capital. We now examine how capital has been allocated across different regions of the globe.

Figure 32

Capital sources: Business operational cash flow

USD in billions, gross cash flow (real)



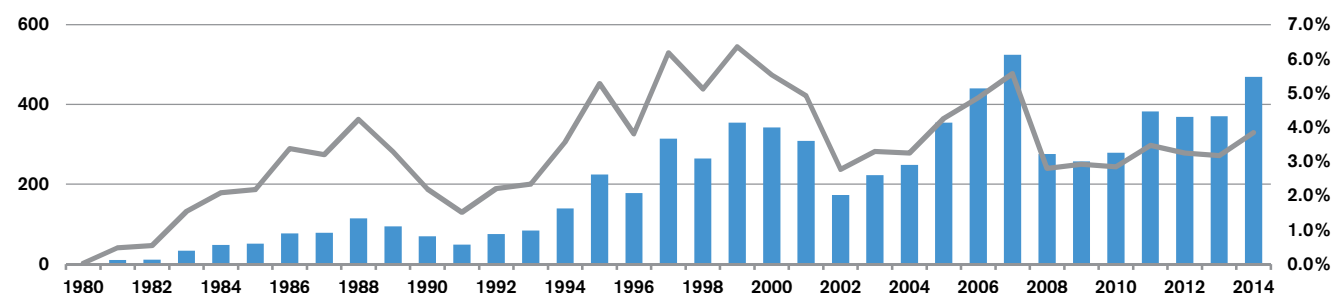
Source: Thomson Reuters DataStream, Credit Suisse HOLT, Credit Suisse

Note: dollar amounts are not inflated. Data includes top 1,500 US industrial firms, excludes financial companies and regulated utilities.

Figure 33

Capital sources: Business asset sales (divestitures)

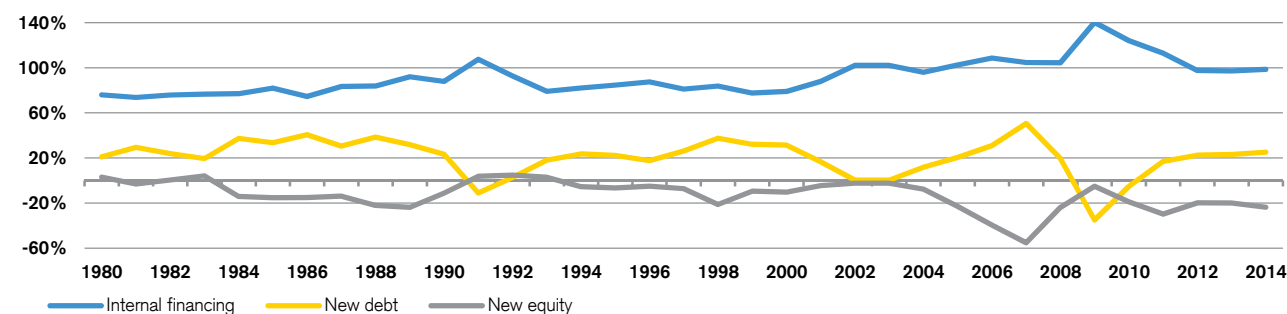
USD in billions, line (right axis) represents percentage of net sales



Source: Thomson Reuters DataStream, Credit Suisse HOLT, Credit Suisse

Note: dollar amounts are not inflated. Data includes all industries; excludes debt tender offers, equity carve-outs, exchange offers, loan modifications, and open market repurchases.

Figure 34

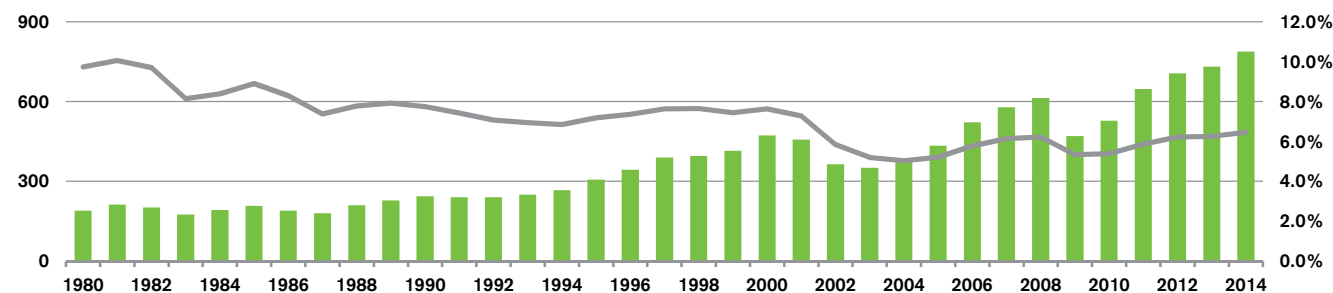
Capital sources: Equity and debt issuance

Source: Board of Governors of the Federal Reserve System, Division of Research and Statistics, Flow of Funds Accounts Table F.103.

Figure 35

Capital allocation: Business capital expenditures

USD in billions, line (right axis) represents percentage of net sales



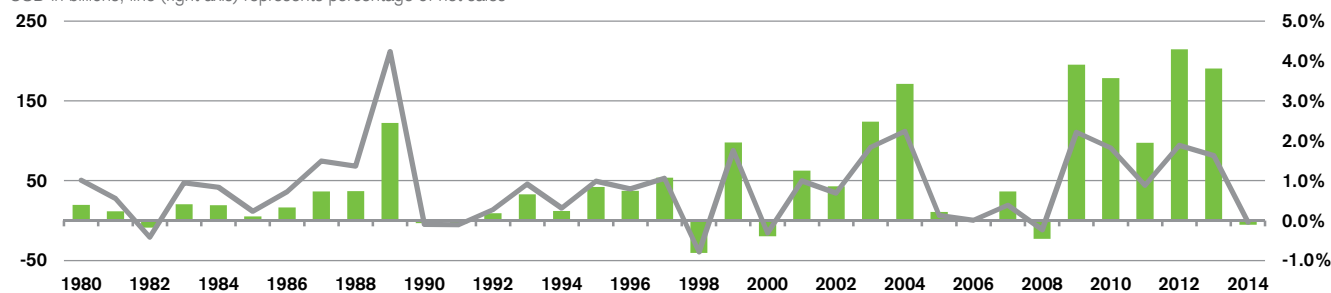
Source: Thomson Reuters DataStream, Credit Suisse HOLT, Credit Suisse

Note: dollar amounts are not inflated. Data includes top 1,500 US industrial firms, excludes financial companies and regulated utilities.

Figure 36

Capital allocation: Change in net working capital

USD in billions, line (right axis) represents percentage of net sales



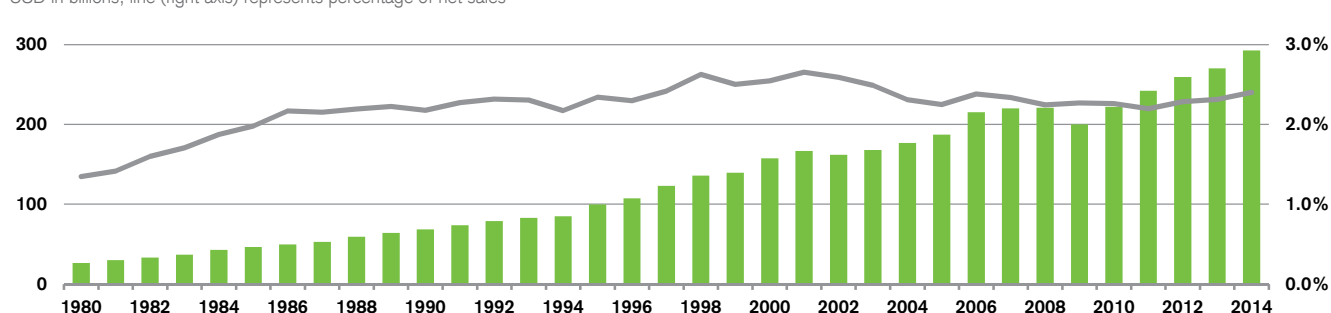
Source: Thomson Reuters DataStream, Credit Suisse HOLT, Credit Suisse

Note: dollar amounts are not inflated. Data includes top 1,500 US industrial firms, excludes financial companies and regulated utilities.

Figure 37

Capital allocation: Business research & development

USD in billions, line (right axis) represents percentage of net sales



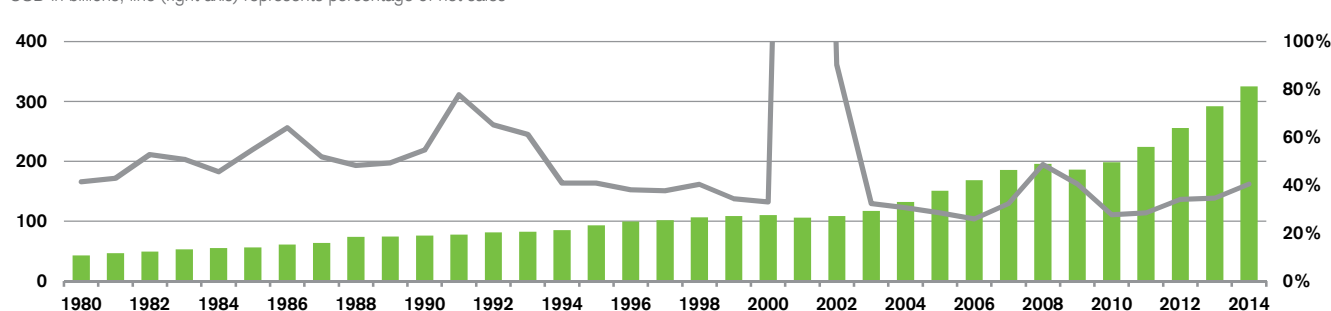
Source: Thomson Reuters DataStream, Credit Suisse HOLT, Credit Suisse

Note: dollar amounts are not inflated. Data includes top 1,500 US industrial firms, excludes financial companies and regulated utilities.

Figure 38

Capital allocation: Cash dividends

USD in billions, line (right axis) represents percentage of net sales



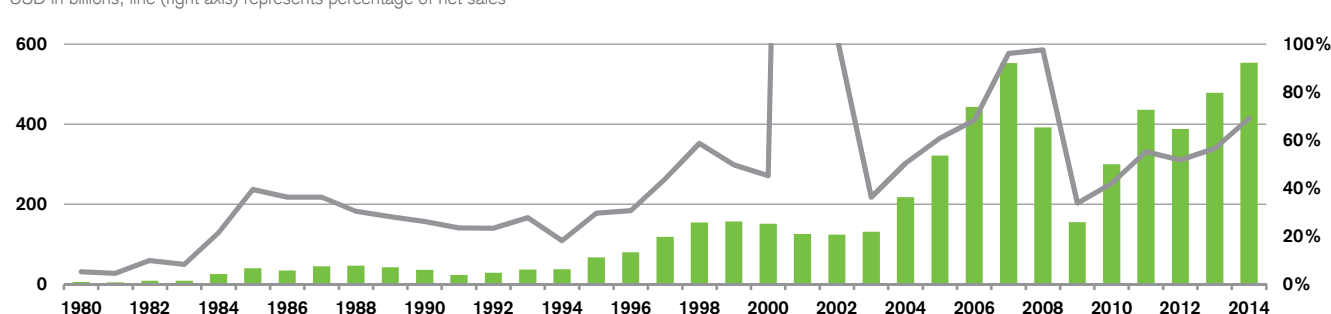
Source: Credit Suisse HOLT

Note: Dollar amounts are not inflated. Data includes top 1,500 US industrial firms, excludes financial companies and regulated utilities.

Figure 39

Capital allocation: Gross share buybacks

USD in billions, line (right axis) represents percentage of net sales



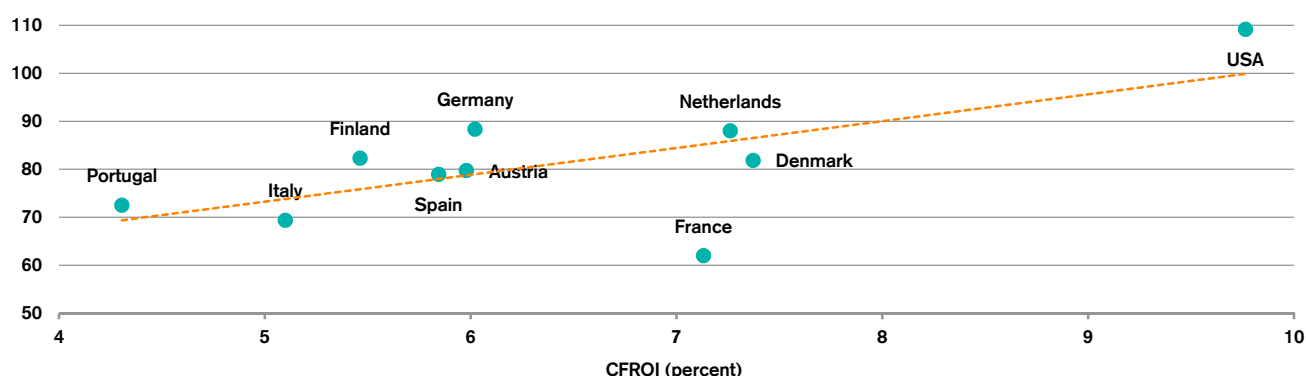
Source: Credit Suisse HOLT

Note: dollar amounts are not inflated. Data includes top 1,500 US industrial firms, excludes financial companies and regulated utilities.

Figure 40

Relationship between CFROI and internal financing capability (2005-2014 average)

Internal financing (percentage of total)



Source: Europe: Eurostat European Sector accounts; U.S.: Board of Governors of the Federal Reserve System, Division of Research and Statistics, Flow of Funds Accounts Table F.102; Credit Suisse.

Table 3

Capital deployment by region

Historical averages for USA, Japan, Europe, APEJ, and GEM

	Uses of capital (as a percentage of sales)							Economic returns and growth	
	M&A	Capex	R&D expense	Net working capital	Gross buybacks	Divestitures	Dividends	CFROI	Real asset growth rate
USA	10.4%	7.1%	2.2%	0.8%	2.1%	3.3%	2.2%	8.5%	5.6%
Japan	1.2%	4.6%	2.1%	1.2%	0.2%	0.4%	0.6%	3.0%	3.3%
Europe	9.7%	7.0%	2.0%	1.5%	0.6%	5.1%	2.2%	6.7%	3.9%
APEJ	10.2%	10.5%	0.8%	2.8%	0.4%	5.1%	2.6%	6.4%	9.8%
GEM	15.8%	12.1%	0.3%	3.7%	0.5%	6.5%	3.2%	6.3%	9.3%

Source: Credit Suisse HOLT.

Note: for uses of capital, historical averages are based on the following years: USA (1980-2013), Japan (1985-2013), Europe (1985-2013), APEJ (1992-2013), GEM (1992-2013). For CFROI® and real asset growth rates, historical averages are based on the years 1993-2013 for all regions.

The history of capital deployment

Table 3 shows capital allocation in recent decades by region, including the United States, Japan, Europe, Asia Pacific ex-Japan (APEJ) and global emerging markets (GEM). The exhibit also shows CFROI and asset growth, adjusted for inflation, over the last 20 years.

The main observations on spending in recent decades include the following:

- M&A is the largest use of capital in the USA, Europe and GEM, the second largest use in APEJ, and the fourth largest use in Japan. The rarity of M&A in Japan is of particular note.
- Capital expenditures are the largest use of capital in Japan and APEJ and the second largest use in the USA, Europe and GEM.
- R&D is the second largest use of capital in Japan, the third largest in the USA and Europe, and the fourth largest in APEJ and GEM. Developed markets spend substantially more on R&D than developing markets.

- Divestitures play a significant role in each of the regions, constituting roughly one-third to one-half the level of total M&A. They are also larger than dividends and share buybacks in all regions but Japan.
- Dividends substantially exceed share buybacks in all regions except the USA, where they have been roughly equivalent on average. Buybacks are modest in Europe and fairly insignificant in Japan, APEJ and GEM.
- Share buybacks have been meaningful in common-law countries and inconsequential in nearly all other regions. This pattern reflects cultural and regulatory constraints.

A country's legal tradition appears to lead to implicit assumptions about what the governing objective should be as well as the society's rules and regulations.



Incentives and capital allocation

One of the enduring lessons of economics is that incentives matter. It is also the case that incentives designed to achieve one objective can lead to unintended consequences. The goal of this section is to consider whether the incentives a company has in place encourage judicious capital allocation. Most of these incentives address compensation.

Agency theory is the classic way to explain why the managers of a company may not act in the interests of the shareholders (Jensen and Meckling, 1976). The idea is that conflicts can arise when there is a separation between a firm's ownership (principal) and control (agent). There are three areas where these conflicts tend to arise (Lambert and Larcker, 1991).

The first is that while it is clear that shareholders want management to maximize the value of their holdings, management may derive benefits from controlling resources that don't enrich shareholders. For example, if remuneration is roughly correlated with the size of the firm, management may seek value-destroying M&A deals to grow.

The second area of conflict is with risk tolerance. Since shareholders tend to hold stocks as part of a diversified portfolio, whereas managers are disproportionately exposed to their own company, managers may seek less risk than shareholders would deem appropriate.

The final conflict is with time horizon. To the degree that compensation plans have a shorter time horizon than the period shareholders use to assess the merit of an investment, there can be a mismatch. So managers may dwell on short-term boosts in

earnings. Indeed, research shows that a large majority of managers are willing to forego value-creating investments to deliver near-term earnings (Graham, Harvey and Rajgopal, 2006).

The principal-agent problem arises in capital allocation choices. For example, some companies repurchase stock to offset the dilution of equity issuance to employees (Kahle, 2002) or boost earnings per share (Hribar, Jenkins, Johnson, 2006) without consideration of the economic merits of such repurchases. Further, research shows that companies with strong anti-takeover provisions, which are less subject to market pressures, are more likely to pursue acquisitions that build an empire and destroy shareholder value than companies with fewer such provisions (Masulis, Wang and Xie, 2007).

There is also a link between compensation and capital allocation. Recent research suggests that overall CEO compensation and the use of compensation based on equity have a positive correlation to institutional ownership and board independence, variables that academics commonly use as proxies for quality and governance. Further, convergence in ownership structure and the globalization of capital markets have led to a narrowing of the dispersion between US and non-US CEO pay (Murphy, 2013).

The main point is that compensation practices should be consistent with a firm's governing objective. The goal is to encourage executives to allocate capital so as to maximize their long-term remuneration. While the structure of incentives depends on the governing objective a firm selects, the main task is to ensure that remuneration is congruent with those objectives.

Five principles of capital allocation

Here are five principles that investors can use as a sound benchmark to measure management's mindset regarding capital allocation (McTaggart, Kontes and Mankins, 1994).

1. **Zero-based capital allocation:** Companies generally think about capital allocation on an incremental basis. For example, a study of more than 1,600 US companies by McKinsey found that there was a 0.92 correlation between how much capital a business unit received in one year and the next. For one-third of the companies, that correlation was 0.99. In other words, inertia appears to play a large role in capital allocation (Hall, Lovallo, Musters, 2012).

The proper approach is zero-based, which simply asks: "What is the right amount of capital (and the right number of people) to have in this business to support the strategy that will create the most wealth?" There is no reference to how much the company has already invested in the business, only how much should be invested. Research by McKinsey suggests that those companies that showed a zero-based allocation mindset, and hence were the most proactive in reallocating resources, delivered higher total shareholder returns than the companies that took more of an incremental approach.

2. **Fund strategies, not projects:** The idea here is that capital allocation is not about assessing and approving projects, but rather assessing and approving strategies and determining the projects that support the strategies. Practitioners and academics sometimes fail to make this vital distinction. The key to this principle is recognizing that a business strategy is a bundle of projects and that the value of the bundle is what matters. The CEO and board must evaluate alternative strategies and consider the financial prospects of each.
3. **No capital rationing:** The attitude at many companies, which the results of surveys support, is that capital is scarce but free. The sense is that the business generates a limited amount of capital, which makes it scarce, but since it comes from within it is free.

A better mindset is that capital is plentiful but expensive. There are two sources of capital that companies can tap beyond the cash generated internally. The first is redeploying capital from businesses that do not earn sufficient returns. Management can execute this inside the company or sell the underperforming businesses and redeploy the proceeds. The second is the capital markets. When executives have value-creating strategies that need capital, the markets are there to fund them in all but the most challenging environments.

4. **Zero tolerance for bad growth:** Companies that wish to grow will inevitably make investments that do not pay off. The failure rate of new businesses and new products is high. Seeing an investment flop is no sin; indeed it is essential to the process of creating value. What is a sin is remaining committed to a strategy that has no prospect of creating value, hence draining human and financial resources.

5. **Know the value of assets, and be ready to take action to create value:** Intelligent capital allocation is similar to managing a portfolio of stocks in that it is very useful to have a sense of the difference, if any, between the value and price of each asset. This includes the value of the company and its stock price. Naturally, such analysis must incorporate considerations including taxes.

With a ready sense of value and price, management should be prepared to take action to create value. Sometimes that means acquiring, other times that means divesting, and frequently there are no clear gaps between value and price. As we have seen, managers tend to prefer to buy than to sell, even though the empirical record shows quite clearly that sellers fare better than buyers on average.

Summary

A governing objective is what a company says, capital allocation is what a company does, and corporate governance is the mechanism to make sure companies do what they say. Most companies around the world don't articulate a clear governing objective, but countries under common law tend to favor shareholders, and those under civil law tend to favor other stakeholders.

Over time, capital allocation determines a company's growth, cash flows, and viability. It is the most important responsibility of management. Thoughtful investors need to understand the history of a company's capital allocation and critically assess its actions in light of its goals (Mauboussin and Callahan, 2015).

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Celebrating the Summit

Making an Informed Decision After a Large Price Gain

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"It is part of the natural cycle of human emotion to let down your guard once you feel you've reached a goal."

Laurence Gonzales¹

- A key to successful investing is the ability to keep emotions in check in the face of emotional highs and lows.
- One challenging situation is when a stock in your portfolio rises sharply relative to the market. You don't want to celebrate too much, as you need to make a reasoned buy, hold, or sell decision.
- This report provides analytical guidance if one of your stocks increases 10 percent or more in one day relative to the S&P 500 Index. Such gains generally evoke strong emotional reactions and make sound decision making difficult.
- We provide the base rates for roughly 6,800 such events in the past quarter century. We refine the base rates by separating earnings and non-earnings announcements and by introducing quantitative factors including momentum, valuation, and quality.
- We provide a checklist to guide you as you decide whether to buy, hold, or sell the stock.

Introduction

A key to investing successfully is the ability to manage emotions in the face of highs and lows. The focus of this report is when one of the stocks in your portfolio rises sharply relative to the market and is not an acquisition target. As a portfolio manager you are likely to be pleased about the boost to investment returns and flush with a sense of success. As the analyst you might feel proud and self-assured. Enjoying achievement is fine to a point. But high emotional arousal is not conducive to good decision making.

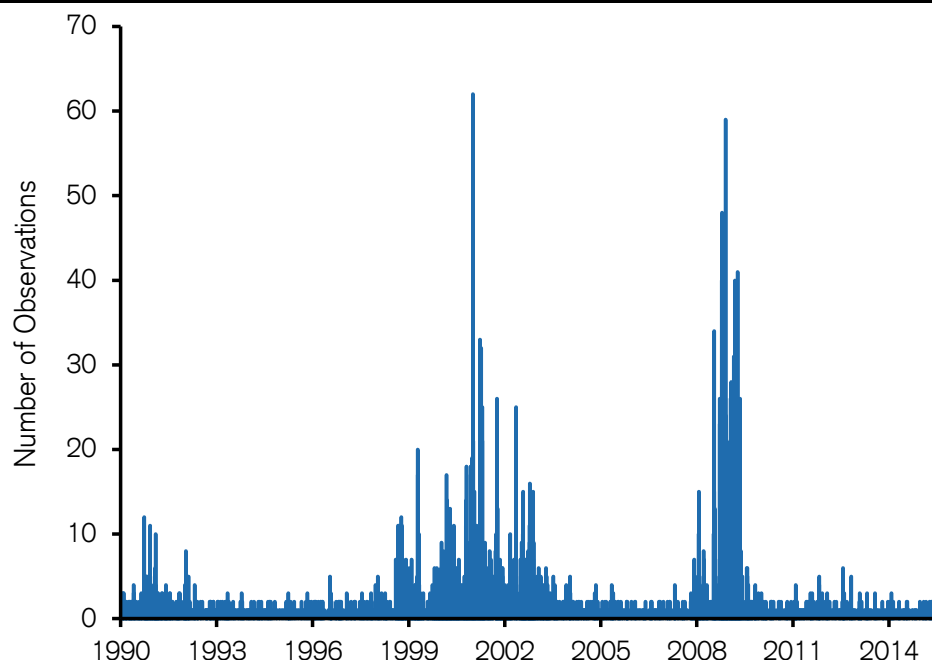
A big winner can create what we call a “celebrating the summit” moment.² The idea comes from Laurence Gonzales, an author and expert on survival in extreme situations, who warns against excessive congratulation after reaching a goal. He points out that mountain climbers commonly celebrate too much at the peak. This causes them to let their guard down just as they are approaching the part of the expedition that may be the most challenging. Gonzales points out that descent is technically more difficult than ascent and that most mountaineering accidents occur on the way down. Likewise, selling can be harder than buying.

You can use a checklist to help make good decisions when emotions are running high. Atul Gawande describes two types of checklists in his book, *The Checklist Manifesto*.³ The first is called DO-CONFIRM. Here you do your job from memory but pause periodically to make sure that you have done everything you are supposed to do. The second is called READ-DO. Here, you simply read the checklist and do what it says. READ-DO checklists are particularly helpful when you are in the state of high emotional arousal because they prevent you from being overcome by emotion as you decide how to act.

You can think of your emotional state and the ability to make good decisions as sitting on opposite sides of a seesaw. If your state of emotional arousal is high, your capacity to decide well is low. A checklist helps take out the emotion and moves you toward a proper choice. It also keeps you from succumbing to decision paralysis. A psychologist studying emergency checklists in aviation said the goal is to “minimize the need for a lot of effortful analysis when time may be limited and workload is high.”⁴

This report provides you with analytical guidance if one of your stocks rises 10 percent or more in one day relative to the S&P 500. We limit the analysis to stock price rises unrelated to announced mergers and acquisitions (M&A). More directly, we want to answer the question of whether you should buy, hold, or sell the stock following one of these big moves to the upside.

Exhibit 1 shows the number of such observations for the S&P 500 from January 1990 through mid-2015. There were roughly 6,800 occurrences, with noteworthy clusters around the dot-com bubble and the financial crisis in 2008-2009. The bubble periods contain 36 percent of the observations. These sharp gains happen frequently enough that they deserve a thoughtful process to deal with them but infrequently enough that few investment firms have developed such a process. Assuming an average number of stock holdings in a mutual fund that is benchmarked against the S&P 500, a portfolio manager of a typical mutual fund would encounter 5-15 “celebrating the summit” moments per year in low volatility years (e.g., 1994-1997 and 2012-2015) and more than 100 such moments in high volatility years (2000-2002 and 2008-2009).

Exhibit 1: Number of Observations of 10%+ Relative Stock Price Increases, January 1990-July 2015

Source: Credit Suisse HOLT.

Structure of the Analysis

There are two broad approaches to making a decision. You can rely on the specific circumstances of a particular situation as well as your own experience. This is known as the inside view. Or you can examine a larger reference class to understand the base rates. This is known as the outside view.⁵

For example, if you are forecasting the returns for the stock market in the next year you can use the inside view to come up with an estimate based on current valuation, sentiment, and your own gut feel. Or you can use the outside view and examine how the stock market has done over the years. Both approaches are useful, and there is a specific way to combine the two to allow for an effective forecast.⁶ But research in decision making suggests that we naturally rely more on the inside view than we should.⁷ In fact, it is common for investors to be unaware of the base rates that are relevant in their decisions.

We use base rates to show how stocks perform after they have risen sharply. To do this, we calculate the “cumulative abnormal return” for the 30, 60, and 90 trading days after the time of the increase. An abnormal return is the difference between the total shareholder return and the expected return. A stock’s expected return reflects the change in a broader stock market index, the S&P 500 in our case, adjusted for risk. The cumulative abnormal return, then, is simply the sum of the abnormal returns during the period that we measure.

Exhibit 2 shows the results for the full sample. The first thing to note is that weak relative stock price results generally precede the large positive moves. The stocks in the sample rose nearly 14 percentage points versus the S&P 500 on the event date, but fell almost 6 percentage points relative to the market in the 30 days prior to the event. Second, the excess returns following a large price gain are on average strongly positive.

Exhibit 2: Full Sample – Cumulative Abnormal Returns

	Days			Days				Days			Days		
	-30	Event	N =	+30	+60	+90		-30	Event	N =	+30	+60	+90
Full Sample	-5.9%	13.8%	6,797	3.5%	6.1%	7.0%	Earnings	-3.3%	14.5%	1,505	2.7%	3.7%	4.1%
							Non-Earnings	-6.6%	13.6%	5,292	3.8%	6.8%	7.9%

Source: Credit Suisse HOLT.

We refine the large sample into relevant categories in an effort to increase the usefulness of the base rates.⁸ The first refinement, which exhibit 2 shows, is segregation between earnings and non-earnings announcements. Earnings releases constitute about one-fifth of our sample. Non-earnings announcements include releases of information that are scheduled, such as same-store sales updates, as well as unanticipated announcements, including a change in management or an earnings update. On balance, returns subsequent to non-earnings announcements are greater than those following earnings releases.

There is strong evidence in the U.S. markets for “post-earnings-announcement drift.”⁹ This is a positive relationship between announced earnings surprises and subsequent stock price changes. For companies that report an upside earnings surprise, cumulative abnormal returns tend to continue to drift up.

The second refinement is the application of three factors—momentum, valuation, and quality—that consider corporate fundamentals and stock market measures. All companies receive a score for each factor. The scores are relative to a company’s peers in the same sector. You can find a detailed definition of the factors in Appendix A, but here’s a quick summary:

- **Momentum** predominantly considers two drivers, change in cash flow return on investment (CFROI®*) forecasts and stock price momentum. Good momentum is associated with rising CFROI forecasts and strong relative stock price appreciation.
- **Valuation** reflects the gap between the current stock price and the warranted value in the HOLT® valuation model. Valuation also incorporates adjusted measures of price-to-earnings and price-to-book ratios. Together, these metrics help assess whether a stock is relatively cheap or expensive.
- **Quality** captures the company’s level of achieved CFROI and whether the company has been able to consistently make investments that create value. Firms with high CFROIs and strong value creation score well on quality.

The upside of adding refinements is that you can find a base rate that closely matches the case you are considering. The downside is that the sample size (N) shrinks with each refinement. We have tried to maintain healthy sample sizes even in the end branches, and we display the Ns along the way so that you can assess the trade-off between fit and prior occurrences.

* CFROI® is a registered trademark in the United States and other countries (excluding the United Kingdom) of Credit Suisse Group AG or its affiliates.

We are almost ready to turn to the checklist and numbers, but we need to cover one additional item. All of our summary exhibits show the average, or mean, abnormal shareholder return. That average represents a full distribution of results. For most of the distributions, the median return, the return that separates the top half from the bottom half of the sample, is less than the mean, which tells you that the distributions are skewed to the right.

Further, the standard deviations of most of the distributions are in the range of 30-45 percent. While our summary figures show a tidy average, recognize that the figure belies a rich distribution. Appendix B shows the distributions for a handful of events. The base rate data can be extremely helpful in making a sound decision even if the outcome is probabilistic.

We're now ready to turn to the checklist and the base rates.

The Checklist

You come into the office and one of the stocks in your portfolio is up 10 percent or more relative to the S&P 500. The move is unrelated to announced M&A. Here's what you do:

- ☐ **Earnings or non-earnings.** Determine whether the precipitating announcement is an earnings release or a non-earnings disclosure and go to the appropriate exhibit;
- ☐ **Momentum.** Check the appropriate HOLT Lens™ page to determine if the stock had strong, weak, or neutral momentum going into the announcement. You can either go to the momentum section of the exhibit or continue;
- ☐ **Valuation.** Check to see if the valuation is cheap, expensive, or neutral. You can either go to the section in the exhibit that combines momentum and valuation or continue;
- ☐ **Quality.** Check to see if the quality is high, low, or neutral. Go to section in the exhibit that incorporates all of the factors.

We have two detailed case studies that we'll present in a moment, but let's run through an example to see how this works. The first item is to determine whether the announcement was a scheduled earnings release or not. Let's say it was an earnings event. That means we would refer to the data in exhibit 3.

Step two is to assess the momentum. We'll assume that momentum is weak. If you look at the left side of the exhibit you'll see the section that reflects momentum. If you focus on the results of the companies with weak momentum, you'll see a few figures. You'll notice that the 665 stocks in that reference class increased 15.2 percent, on average, the day of the event. You will also see that those stocks greatly underperformed the market, with a cumulative abnormal return of -5.7 percent in the prior 30 trading days.

You'll also see that the stocks in that class did well in the subsequent period, with cumulative abnormal returns of 4.1 percent in the next 30 trading days, 4.7 percent in 60 trading days, and 5.2 percent in 90 trading days. We selected 90 trading days as the extent of this analysis because we felt it is a sufficient amount of time for an investment team to thoroughly reassess the stock's merit. We designed the READ-DO checklist to provide immediate guidance.

We now turn to valuation, which you can find in the middle of the exhibit, to see if we can sharpen the analysis. Let's assume the valuation was expensive. If we look 60 days out, we see that the 164 instances in this group have an average cumulative abnormal return of 5.7 percent.

As a final check, we consider quality, which you can find on the right of the exhibit. Let's say quality is low. We've now shrunk our sample size to 72, and see that the 60-day cumulative abnormal return is 12.6 percent.

Exhibit 3: Earnings Event – Cumulative Abnormal Returns

Momentum							Valuation							Quality						

Exhibit 4: Non-Earnings Event – Cumulative Abnormal Returns

Momentum							Valuation							Quality							
Days							Days							Days							
<u>-30</u> <u>Event</u> N = <u>+30</u> <u>+60</u> <u>+90</u>							<u>-30</u> <u>Event</u> N = <u>+30</u> <u>+60</u> <u>+90</u>							<u>-30</u> <u>Event</u> N = <u>+30</u> <u>+60</u> <u>+90</u>							
Strong	-7.5%	12.7%	1,137	1.2%	1.5%	1.7%	Cheap	-9.8%	12.6%	347	3.4%	6.7%	8.6%	High	-15.2%	12.8%	122	7.3%	10.9%	10.2%	
							Neutral	-5.7%	12.8%	334	0.5%	4.4%	5.5%	Neutral	-8.1%	12.6%	98	-3.2%	1.6%	4.5%	
							Expensive	-7.0%	12.8%	456	0.0%	-4.5%	-6.2%	Low	-6.0%	12.5%	127	4.7%	6.6%	10.3%	
							Cheap	-13.0%	14.1%	543	4.7%	10.0%	10.4%	High	-9.7%	12.4%	105	-0.5%	1.7%	1.4%	
	Neutral	-7.5%	13.5%	1,383	2.8%	6.2%	7.1%	Neutral	-4.6%	12.8%	373	2.3%	4.3%	3.8%	Neutral	-4.2%	12.9%	94	-0.7%	3.3%	1.3%
								Expensive	-3.2%	13.6%	467	1.1%	3.5%	5.8%	Low	-3.6%	13.1%	135	2.1%	7.3%	11.5%
													High	-10.7%	12.9%	209	0.0%	-7.0%	-7.9%		
													Neutral	-2.3%	13.0%	116	-0.6%	-4.7%	-9.4%		
													Low	-5.5%	12.4%	131	0.5%	-0.4%	-0.7%		
Days							Days							Days							
<u>-30</u> <u>Event</u> N = <u>+30</u> <u>+60</u> <u>+90</u>							<u>-30</u> <u>Event</u> N = <u>+30</u> <u>+60</u> <u>+90</u>							<u>-30</u> <u>Event</u> N = <u>+30</u> <u>+60</u> <u>+90</u>							
Neutral	-7.5%	13.5%	1,383	2.8%	6.2%	7.1%	Cheap	-13.0%	14.1%	543	4.7%	10.0%	10.4%	High	-13.9%	13.9%	187	4.0%	9.3%	7.9%	
							Neutral	-4.6%	12.8%	373	2.3%	4.3%	3.8%	Neutral	-19.7%	14.3%	183	6.3%	15.0%	19.5%	
							Expensive	-3.2%	13.6%	467	1.1%	3.5%	5.8%	Low	-5.1%	14.0%	173	3.8%	5.3%	3.6%	
													High	-5.9%	12.5%	128	2.7%	4.7%	6.1%		
													Neutral	-1.6%	12.3%	103	-1.1%	1.3%	0.0%		
													Low	-5.6%	13.3%	142	4.4%	6.1%	4.4%		
													High	-3.8%	13.1%	120	-0.3%	4.2%	4.3%		
													Neutral	1.8%	13.2%	147	1.1%	7.4%	11.0%		
													Low	-6.7%	14.2%	200	1.9%	0.1%	3.0%		
Days							Days							Days							
<u>-30</u> <u>Event</u> N = <u>+30</u> <u>+60</u> <u>+90</u>							<u>-30</u> <u>Event</u> N = <u>+30</u> <u>+60</u> <u>+90</u>							<u>-30</u> <u>Event</u> N = <u>+30</u> <u>+60</u> <u>+90</u>							
Weak	-5.8%	14.0%	2,772	5.3%	9.1%	10.8%	Cheap	-10.5%	14.4%	1,270	7.6%	11.4%	13.5%	High	-12.4%	14.4%	370	5.9%	9.4%	13.1%	
							Neutral	-3.8%	13.9%	810	4.5%	8.9%	10.9%	Neutral	-7.7%	14.4%	445	9.0%	13.3%	15.4%	
							Expensive	0.5%	13.2%	692	2.1%	5.4%	5.5%	Low	-11.6%	14.3%	455	7.6%	11.0%	12.0%	
													High	-7.7%	13.1%	217	5.6%	11.7%	11.9%		
													Neutral	1.9%	14.1%	232	5.1%	8.9%	12.5%		
													Low	-5.1%	14.4%	361	3.6%	7.3%	9.3%		
													High	0.1%	12.6%	149	0.3%	4.4%	3.1%		
													Neutral	4.9%	13.7%	175	4.7%	9.3%	12.6%		
													Low	-1.5%	13.1%	368	1.6%	3.9%	3.0%		

Source: Credit Suisse HOLT.

Note: The abnormal return for the event reflects only the day of the event.

Case Studies

We now turn to two case studies that provide detail about the analysis.

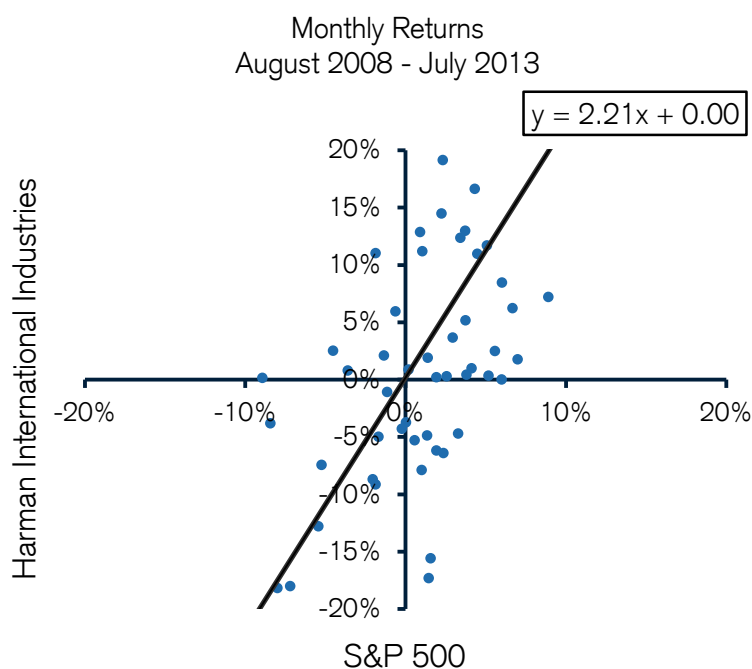
Harman International Industries, Incorporated

At an investors' day on August 8, 2013, Harman International Industries, Inc. provided guidance for sales, earnings before interest, taxes, depreciation, and amortization (EBITDA), and earnings per share for the 2014 and 2016 fiscal years (ended June 30). The stock rose 10.7 percent that day, from \$58.62 to \$64.90. The S&P 500 was down 0.4 percent. This was a non-earnings event.

Since we use cumulative abnormal return (CAR) for all of the stock performance data, it is worth taking a moment to explain how we do the calculation. We determine daily abnormal return using a simplified market model, which compares the actual return of a stock to its expected return. The expected return equals the total shareholder return of the benchmark, the S&P 500, times the stock's beta. The abnormal return is the difference between the actual return and the expected return.

We calculate beta by doing a regression analysis with the S&P 500's total returns as the independent variable (x-axis) and Harman's total returns as the dependent variable (y-axis). We use monthly total returns for the prior 60 months. Beta is the slope of the best-fit line. Exhibit 5 shows that the beta for Harman for the 60 months ended July 2013 was 2.2. This is the beta we use for our calculations of daily abnormal returns during the month of August 2013. Similarly, the beta for September 2013 would use returns for the 60 months ended August 2013.

Exhibit 5: Beta Calculation for Harman



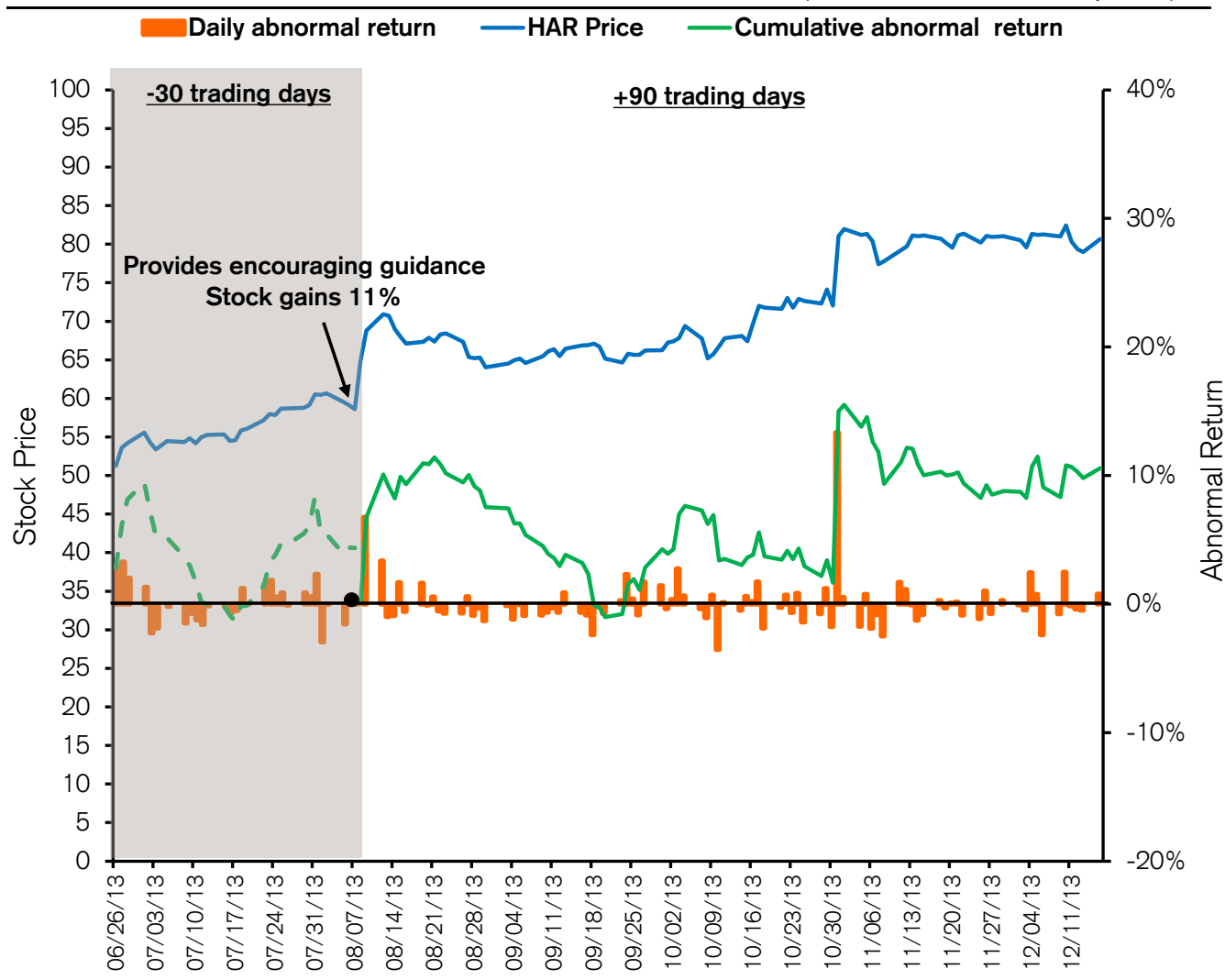
Source: Credit Suisse.

Using the 90 trading days following the event, we calculate a CAR of 11.8 percent as follows:

$$\begin{aligned}\text{CAR} &= \text{Actual return} - \text{expected return} \\ &= 25.3\% - (\text{Beta} * \text{Market Return}) \\ &= 25.3\% - (2.2 * 6.1\%) \\ \text{CAR} &= 25.3\% - 13.5\% = 11.8\%\end{aligned}$$

Exhibit 6 shows the chart of the stock's performance for the 30 trading days prior to the event through 90 trading days following the event. The top line shows the stock price itself. The middle line is the cumulative abnormal return. We reset the cumulative abnormal return to zero on the event date. The bars are the daily abnormal returns. It's evident that buying Harman on the day after this event would have yielded good returns in the subsequent 90 days. Let's go through the checklist to see how we would have assessed the situation in real time.

Exhibit 6: Harman Stock Price and Cumulative Abnormal Returns (June 26 – December 16, 2013)

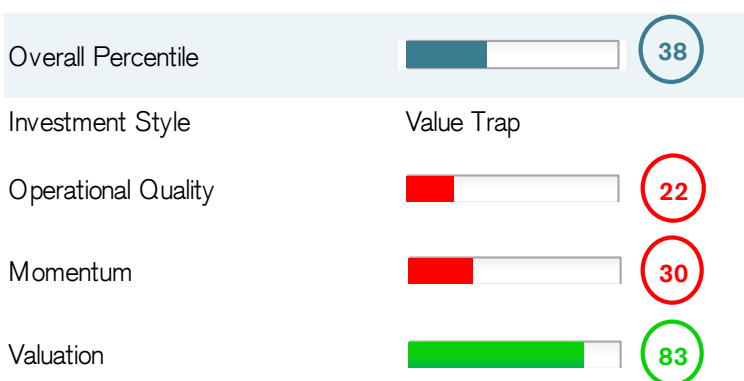


Source: Credit Suisse.

The next step is determining how the stock scores with regard to momentum, valuation, and quality through HOLT Lens. (Please contact your HOLT or Credit Suisse representative if you do not have access to Lens and would like to use it.) At the welcome page, search for the company of the stock under consideration. This takes you to the summary page for that company, which includes a Relative Wealth Chart (see [here](#) for Harman's latest summary page). Toward the top of the page you will find a link called "Scorecard Percentile." If you click on it, you will see numerical scores, from 0 to 100, for momentum, valuation, and operational quality, among other items.

To best align with the base rates, which reflect factor scores from before the price gain, it is appropriate to use the Scorecard on the day of the event as opposed to the days afterwards. On the day of the event, the factors do not yet incorporate the price gain—HOLT makes those adjustments overnight. For the purposes of this analysis, a score of 67 or more reflects strong momentum, cheap valuation, and high quality. A score of 33 or less means weak momentum, expensive valuation, and low quality. Numbers from 34 to 66 are neutral for the factors. Exhibit 7 shows you this screen for Harman on the date of the event.

Exhibit 7: Harman's Factor Scores



Source: HOLT Lens.

We see that momentum is weak (30), valuation is cheap (83), and quality is low (22). This allows us to follow the relevant branches in exhibit 4. Exhibit 8 extracts the branches that are relevant for Harman.

Exhibit 8: The Branches That Lead to Harman's Reference Class

Momentum							Valuation							Quality						
Days	-30	Event	N =	+30	+60	+90	Days	-30	Event	N =	+30	+60	+90	Days	-30	Event	N =	+30	+60	+90
Weak	-5.8%	14.0%	2,772	5.3%	9.1%	10.8%	Cheap	-10.5%	14.4%	1,270	7.6%	11.4%	13.5%	Low	-11.6%	14.3%	455	7.6%	11.0%	12.0%

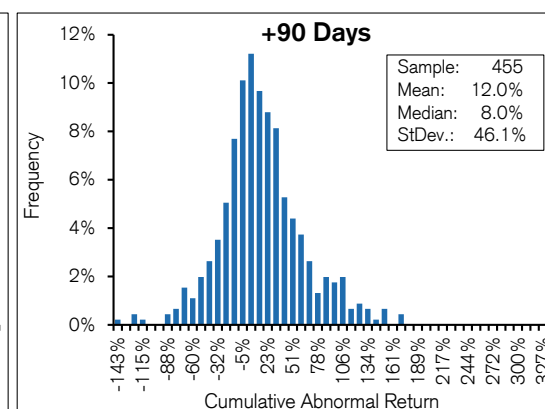
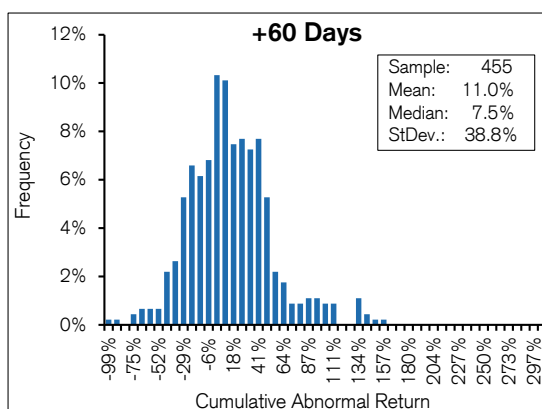
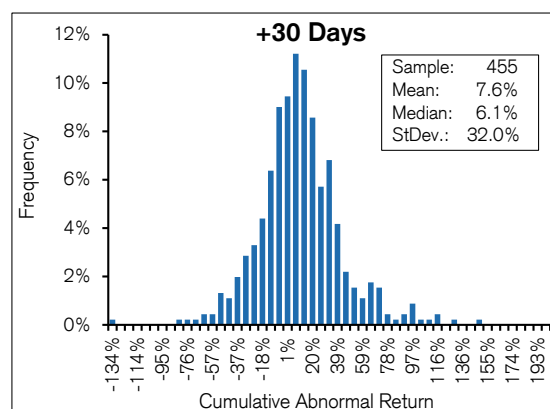
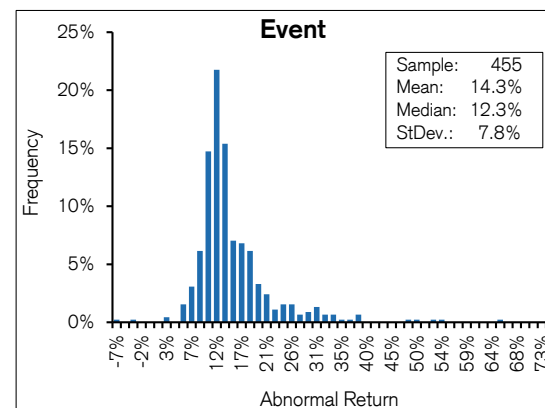
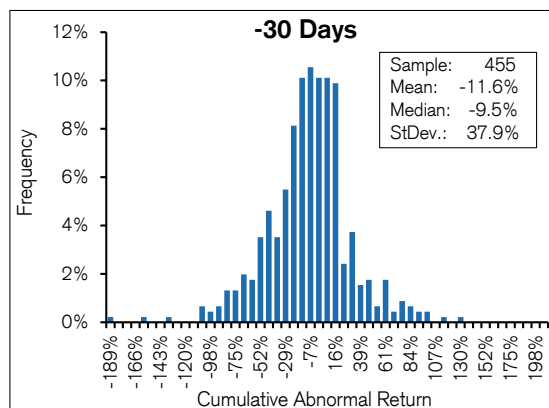
Source: Credit Suisse HOLT.

The cumulative abnormal returns are consistently positive for each branch of the tree for all of the time periods we measure. The final branch, with a sample size of 455 events, shows a 7.6 percent CAR for 30 days, 11.0 percent for 60 days, and 12.0 percent for 90 days. In this case, the base rates would suggest buying the stock on the day following the increase.

We can compare those base rates with what actually happened. The CAR for Harman shares was -1.0 percent in the 30 trading days following the event, 15.5 percent for 60 days, and 10.5 percent for 90 days. The line for CAR in exhibit 6 also shows these returns.

While the results are consistent with the base rate, we must reiterate that the averages belie a more complex distribution. Exhibit 9 shows the distribution of stock price returns for the 455 companies in Harman's reference class. For each of the return distributions that follow the event (+30, +60, and +90 days), the mean, or average, was greater than the median. The standard deviations are high at about 30 percent for 30 days, 40 percent for 60 days, and 45 percent for 90 days.

Exhibit 9: Distributions for Non-Earnings Events That Have Weak Momentum, Cheap Valuation, Low Quality



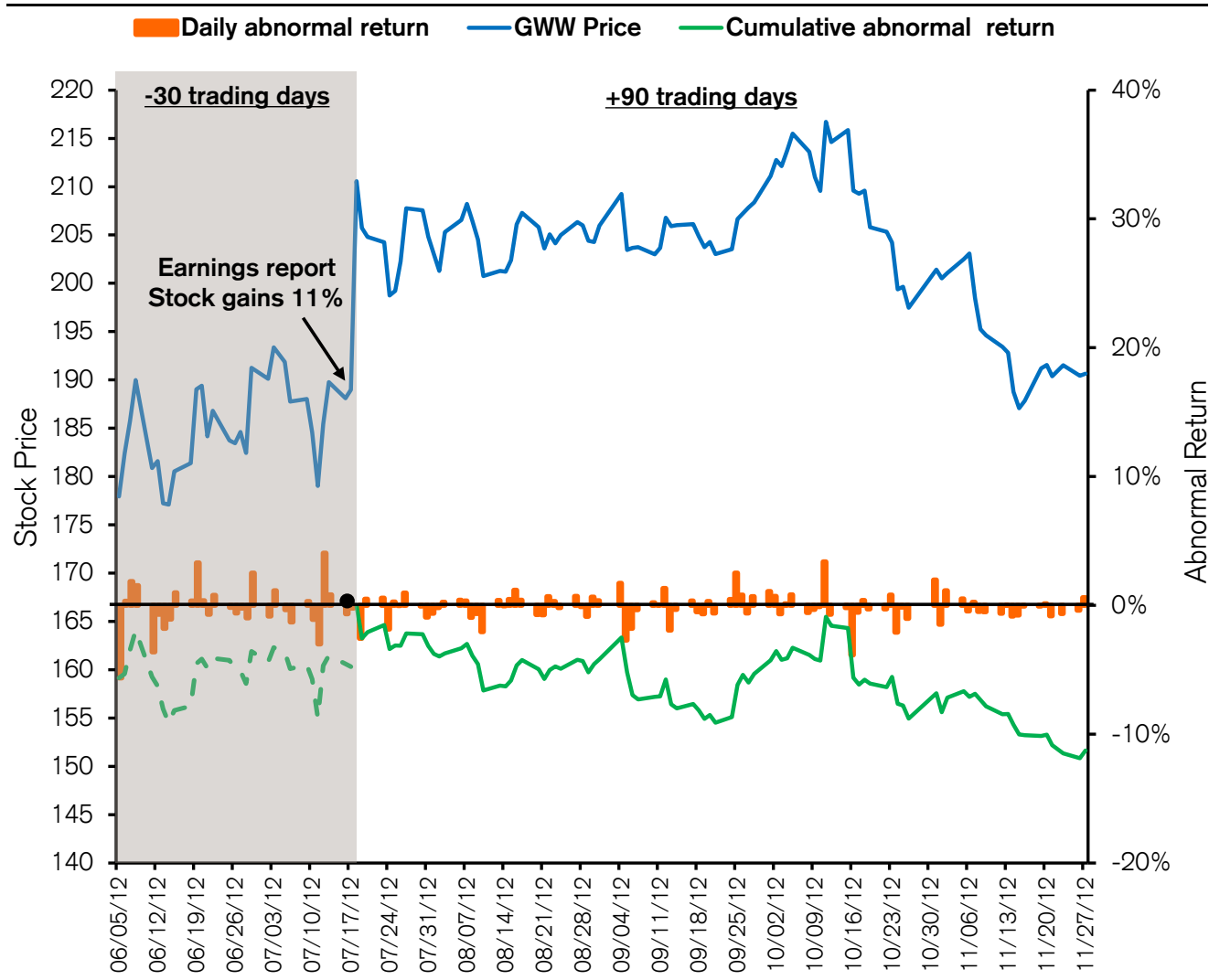
Source: Credit Suisse HOLT.

W.W. Grainger

On the morning of July 18, 2012, W.W. Grainger reported strong earnings. This was a scheduled earnings event and the stock increased 11.4 percent. The S&P 500 was up 0.7 percent.

Exhibit 10 shows the chart of W.W. Grainger's stock performance for the 30 trading days prior to the event through 90 trading days following the event. The top line starting on the left shows the stock price, which spikes on the day of the earnings release, then stays in a holding pattern for the next 60 trading days, and then eventually declines sharply over the full 90 days. The bars in the middle of the exhibit are the daily abnormal return, and the line at the bottom is the cumulative abnormal return. This is a case where selling W.W. Grainger stock would have made sense. Let's go through the checklist to see how we would have assessed the situation as it occurred.

Exhibit 10: W.W. Grainger's Stock Price and CAR (June 5, 2012 – November 27, 2012)



Source: Credit Suisse.

The first item on the checklist is the determination of whether the event was an earnings release. We know that it was scheduled, so we refer to exhibit 3.

The next step is to determine the scores with regard to momentum, valuation, and operational quality. To do so, we go to the link, "Scorecard Percentile," on HOLT Lens. Exhibit 11 shows the scores. See [here](#) for W.W. Grainger's latest summary page.

Exhibit 11: W.W. Grainger's Factor Scores

GRAINGER (W W) INC Scorecard Analysis



Source: HOLT Lens.

For W.W. Grainger, we see that momentum is strong (80), valuation is expensive (19), and quality is high (68). Exhibit 12 shows the branches in exhibit 3 that are relevant for W.W. Grainger.

Exhibit 12: The Branches That Lead to W.W. Grainger's Reference Class

Momentum							Valuation							Quality																								
														Days																								
														-30																								
														Event																								
														N =																								
														+30																								
														+60																								
														+90																								
Days							Days							Days																								
-30							-30							-30																								
Event							Event							Event																								
N =							N =							N =																								
+30							+30							+30																								
+60							+60							+60																								
+90							+90							+90																								
Strong							-1.3%	13.9%	411	1.1%	1.9%	2.3%	Expensive							0.0%	13.7%	153	-0.6%	-1.4%	-2.8%	High							-0.6%	13.8%	65	-2.3%	-1.7%	-6.0%

Source: Credit Suisse HOLT.

The cumulative abnormal returns are consistently negative for each branch of the tree for all of the time periods we consider. The final branch, with a sample size of 65 events, shows a -2.3 percent CAR for 30 days, -1.7 percent for 60 days, and -6.0 percent for 90 days. In this case, the base rates would suggest selling the stock on the day following the decline.

We can compare these base rates with what actually happened. The CAR for W.W. Grainger's shares was -5.2 percent in the 30 trading days following the event, -0.9 percent for 60 days, and -11.3 percent for 90 days. Exhibit 10 reflects these returns. Once again, note that there is a distribution of returns for this reference class, and the best we can do is make a probabilistic assessment.

Summary

The goal of this analysis is to provide you with useful base rates in the case that you see a sharp gain in one of the stocks in your portfolio. Mountain climbers run a risk of “celebrating the summit,” enjoying the pleasure without considering the rest of the journey. Likewise, investors should not bask in their success but rather consider their next action.

The base rates in this report offer guidance in determining whether you should buy, sell, or do nothing in the days following the event. You should keep this report handy, and when an event occurs you can pull it out and follow the steps in the checklist. The results contained here are a useful complement to fundamental analysis.

Because these events tend to be infrequent, most investors don't have a systematic approach, or data, to make a sound judgment. Further, large price increases almost always evoke a strong emotional reaction, which complicates the process of decision making even more.

Our examination of exhibits 3 and 4 suggests that the following characteristics are consistent with buy and sell signals:

Buy. For earnings releases, there is a clear and convincing buy signal for stocks with weak or neutral momentum prior to the event. This buy signal is strengthened if the stock has a cheap or neutral valuation.

The buy signal for stocks with weak momentum is even more pronounced for non-earnings events than it is for earnings releases. This signal is stronger for stocks that have a cheap valuation, and is further amplified if the companies are of high or neutral quality, although the returns for low quality are still very high. Harman, the subject of our first case study, was a non-earnings event with weak momentum, cheap valuation, and low quality, and hence the data suggested a buy.

Sell. For earnings releases, momentum alone does not indicate a strong buy or sell pattern. But there is a fairly strong sell signal for stocks that have the combination of strong momentum and expensive valuation. The sell signal holds for stocks with strong momentum, expensive valuation, and high or neutral quality. W.W. Grainger, our second case, had strong momentum, expensive valuation, and high quality—factors that suggested selling the shares.

For non-earnings events, the cumulative abnormal returns following an event are largely positive. But we must note that these stocks as a group performed poorly prior to the event, down nearly seven percentage points relative to the market. There are a couple of combinations that suggest selling the stock. The strongest sell signal is for companies that combine strong momentum and expensive valuation. That signal is further amplified if the companies are of high or neutral quality.

Making decisions in the face of uncertainty is always a challenge, but it is inherent to investing. Deciding what to do with a stock following a sharp increase is particularly difficult because emotions tend to run high after these events. This report provides grounding in the form of base rates in an effort to better inform decision making.

Appendix A: Definition of the Factors

Below we explain how HOLT calculates factor scores. For those interested in learning more about HOLT, see [here](#) for the “What Is HOLT?” fact sheet.

Momentum: Momentum is a gauge of market sentiment. Stocks that score well have rising levels of expected CFROI as the result of upward earnings revisions; positive stock price momentum; and good liquidity.

- **CFROI Key Momentum, 13-week (60%)** - CFROI Key Momentum measures change in the level of expected CFROI following revisions in consensus earnings per share estimates.
- **Price Momentum (52-week) (30%)** - Price Momentum is based on the percentage change in market value over the past 52 weeks.
- **Daily Liquidity Average (10%)** - Daily Liquidity Average reflects the number of shares traded in the last quarter, divided by 63 trading days, multiplied by the stock price at the end of the most recent week, divided by market capitalization.

Valuation: Valuation assesses the difference between the stock’s warranted value, based on the HOLT framework®, and the stock’s current market price. Stocks with the most upside are cheap, and those with the least upside, or downside, are expensive.

- **Percentage Change to Best Price (50%)** - Percentage Change to Best Price measures the difference between HOLT’s warranted value and the current stock price. By using a discounted cash flow approach that standardizes financial figures, the HOLT model generates values that allow for the comparison of firms across regions, sectors, and accounting standards.
- **Economic P/E (30%)** – Economic P/E is HOLT’s version of a price-to-earnings ratio. You can compare Economic P/E across companies and industries because the value-to-cost ratio is divided by CFROI, normalizing results. Specifically, $\text{Economic P/E} = (\text{Enterprise Value} / \text{Inflation Adjusted Net Assets}) / \text{CFROI}$
- **Value-to-Cost Ratio (10%)** – Value-to-Cost Ratio is analogous to price/book value, but reflects a number of adjustments that reduce volatility and better reflect firm value. These include inflation adjustments for old plant and inventory in gross investment, capitalized research and development (R&D), capitalized operating leases, the reflection of the contingent claim for stock options in debt, pension debt, preferred stock, and liabilities related to capitalized operating leases. $\text{Value-to-Cost Ratio} = (\text{Market Value of Equity} + \text{Minority Interest} + \text{HOLT Debt}) / \text{Inflation Adjusted Net Assets}$
- **Dividend Yield (10%)** – Dividend Yield is the dividends paid in the last 12 months divided by the most recent share price.

Quality: Quality measures a company’s record of generating cash and managing growth, independent of expectations about the future. Firms that score well have high CFROIs and have shown the ability to grow profitable businesses or the willingness to shrink unprofitable ones.

- **CFROI Last Fiscal Year (50%)** - CFROI Last Fiscal Year is the ratio of gross cash flow to gross investment and is expressed as an internal rate of return. We use the CFROI for the last reported fiscal year.
- **Managing for Value (30%)** - Managing for Value equals the spread between CFROI and the Discount Rate, multiplied by the inflation-adjusted gross investment. This allows us to determine whether the company’s growth creates value and is sustainable. Growth in businesses that earn a

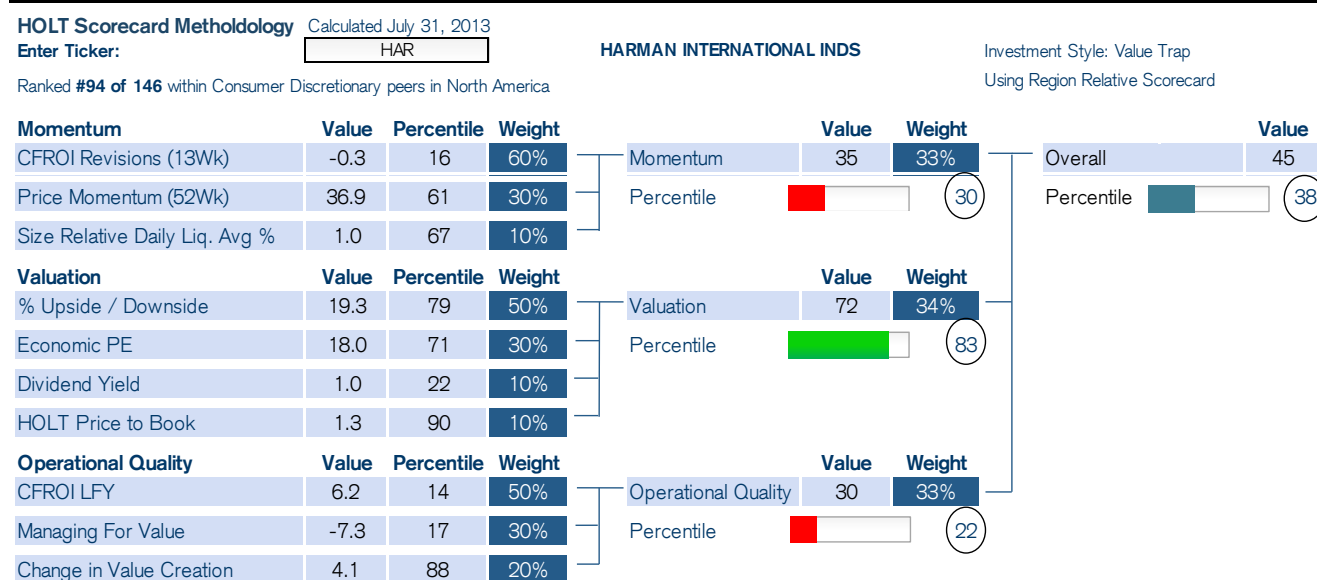
CFROI in excess of the cost of capital is value creating, while growth in businesses with a negative spread destroys value.

- **Change in Value Creation (20%)** - Change in Value Creation measures the improvement in “economic profit” in the most recent fiscal year. A positive value indicates that the company either increased the spread between CFROI and the discount rate, or grew in a business with a positive spread. Change in Value Creation = (CFROI – Discount Rate * Growth Rate) – Prior Fiscal Year Spread.

Once on HOLT Lens, you can find the scores on the homepage of each company by clicking on “Scorecard Percentile.” To best align with the base rates, which reflect factor scores from before the event, it is appropriate to use the Scorecard on the day of the gain as opposed to the days afterwards. On the day of the jump, the factors do not yet incorporate that price movement—HOLT makes those adjustments overnight.

You can also see the company’s factor scores from prior to the event by selecting “More Information” from within the “Scorecard Percentile” page. You will see a screen similar to exhibit 13. This screen shows the factor scores from the end of the most recent month prior to the event. For instance, the date of the event for Harman was August 8, 2013, so here we show the factor scores for Harman as of July 31, 2013.

Exhibit 13: Detailed Breakdown of Harman’s Factor Scores



Source: HOLT Lens.

Appendix B: Distributions of Stock Price Changes

This appendix reviews the distributions that apply to Harman, one of our case studies. These distributions reflect non-earnings announcements and contain all events, including the bubble periods. We also provide some statistical properties for each distribution, including the sample size, mean, median, and standard deviation.

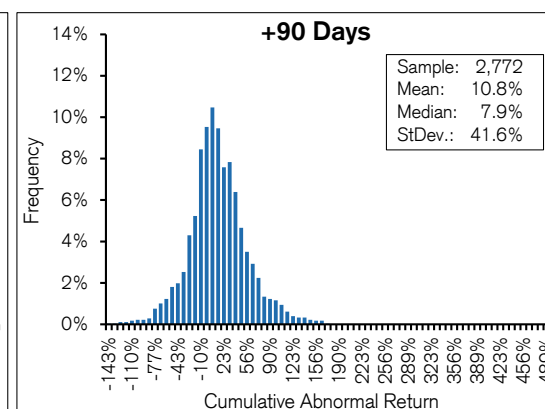
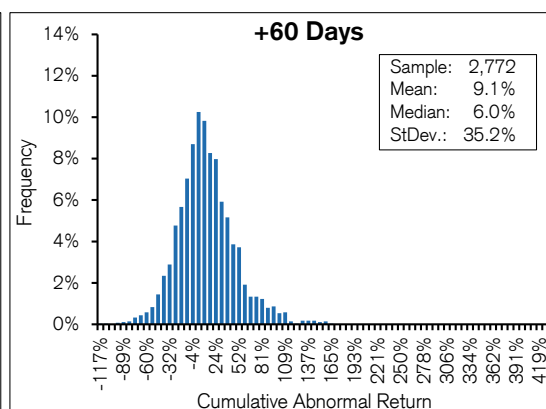
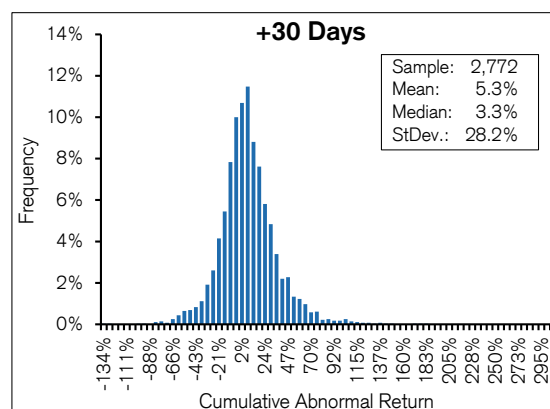
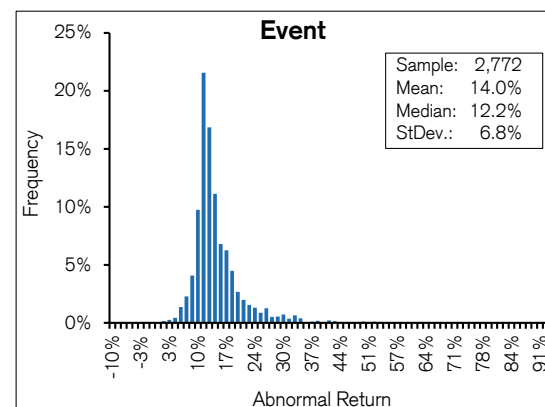
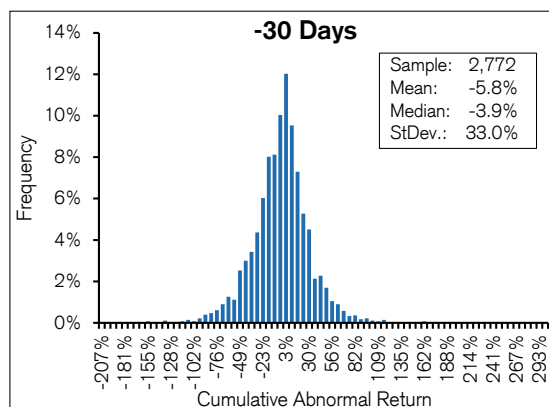
Exhibit 14 shows all the cases with weak momentum and displays five distributions of cumulative abnormal returns, including the 30 trading days prior to the event, the day of the event itself, and the 30, 60, and 90 trading days subsequent to the event. This is the first branch of the Harman case study.

Exhibit 15 shows weak momentum and cheap valuation, which trims the sample size by more than one-half. Here again we include the 30 trading days prior to the event, the day of the event itself, and the 30, 60, and 90 trading days after the event. This is the second branch of the Harman case study.

Exhibit 16 shows the final branch in the Harman case study: weak momentum, cheap valuation, and low quality. The sample size is just over one-third of the prior branch. You can see the 30 trading days prior to the event, the day of the event itself, and the 30, 60, and 90 trading days after the event.

Exhibit 14: Distributions for the First Branch of the Harman Case Study

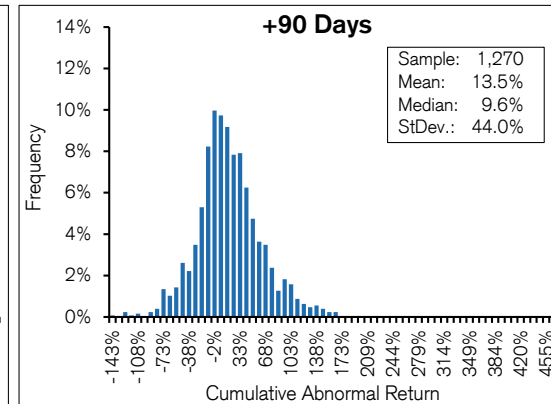
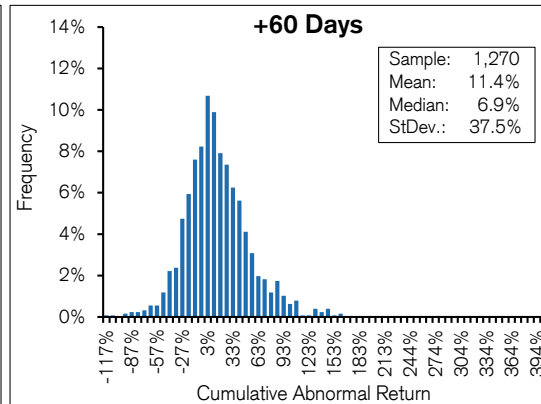
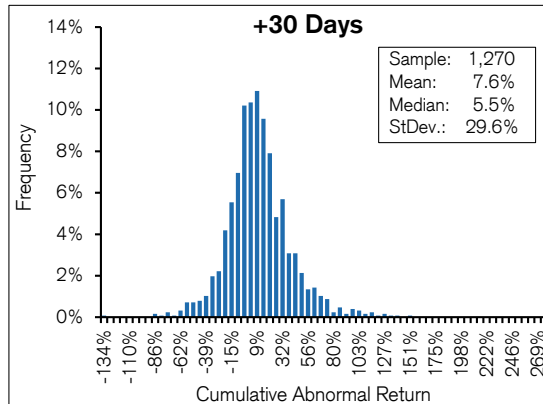
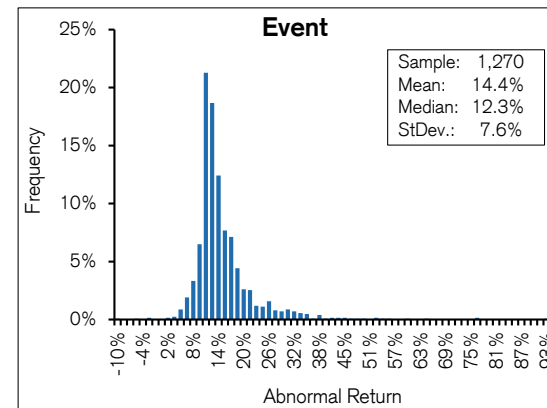
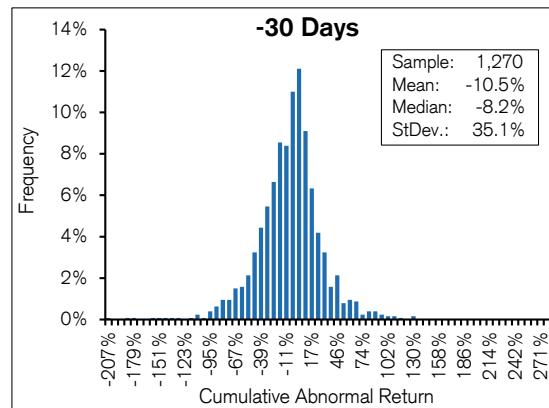
Weak Momentum



Source: Credit Suisse HOLT.

Exhibit 15: Distributions for the Second Branch of the Harman Case Study

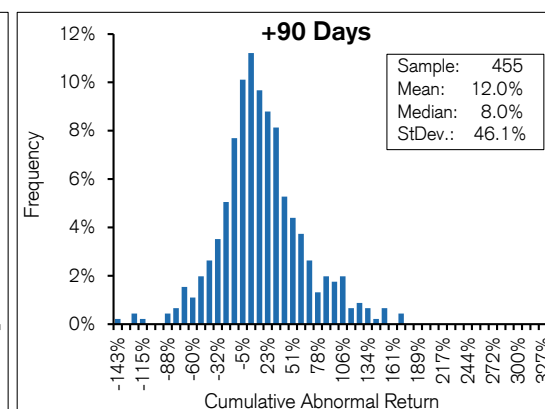
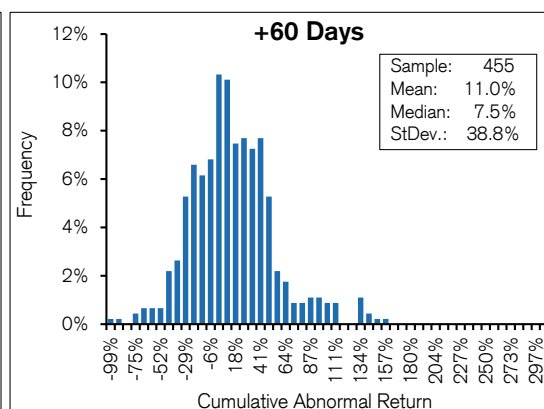
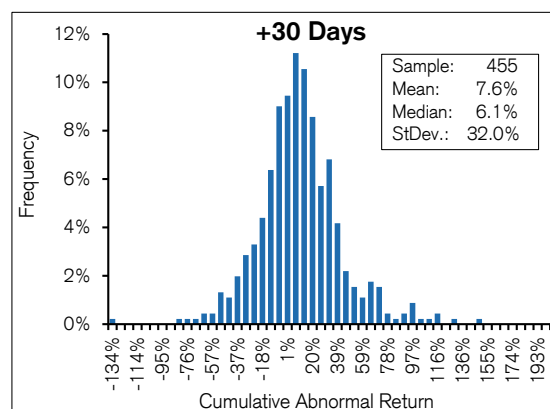
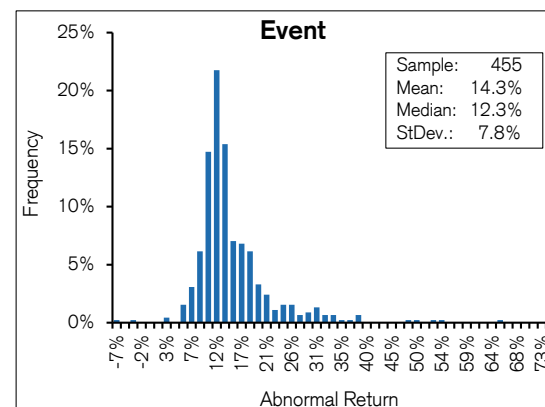
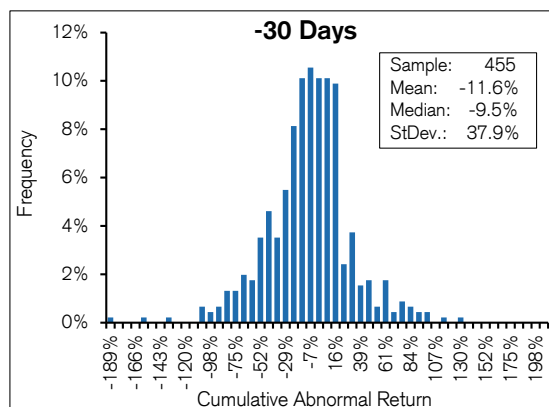
Weak Momentum, Cheap Valuation



Source: Credit Suisse HOLT.

Exhibit 16: Distributions for the Third Branch of the Harman Case Study

Weak Momentum, Cheap Valuation, Low Quality



Source: Credit Suisse HOLT.

Appendix C: A Quick Survey of the Academic Literature

There is a rich literature on abnormal price changes following large stock price moves. Much of this academic work was done in the mid-1980s through the mid-1990s. We found no papers that trace the steps we follow:

1. Observe relative price increases of 10 percent or more;
2. Sort based on scheduled earnings and non-earnings events;
3. Introduce factors to refine the reference classes;
4. Observe cumulative abnormal returns by reference class.

The papers we consulted include the following:

Amini Shima, Bartosz Gebka, Robert Hudson, Kevin Keasey, "A review of the international literature on the short term predictability of stock prices conditional on large prior price changes: Microstructure, behavioral and risk related explanations," *International Review of Financial Analysis*, Vol. 26, January 2013, 1-17.

Atkins, Allen B., and Edward A. Dyl, "Price Reversals, Bid-Ask Spreads, and Market Efficiency," *Journal of Financial and Quantitative Analysis*, Vol. 25, No. 4, December 1990, 535-547.

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Jegadeesh, Narasimhan, "Evidence of Predictable Behavior of Security Returns," *Journal of Finance*, Vol. 49, No. 1, March 1994, 255-267.

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Endnotes

¹ Laurence Gonzales, *Deep Survival: Who Lives, Who Dies, and Why* (New York: W.W. Norton & Company, 2003), 119.

² Laurence Gonzales, "How to Survive (Almost) Anything: 14 Survival Skills," *National Geographic Adventure*, August 2008.

³ Atul Gawande, *The Checklist Manifesto: How to Get Things Right* (New York: Metropolitan Books, 2009), 122-128. For checklists related to investing, see Mohnish Pabrai, Guy Spier, and Michael Shearn, "Keynote Q&A Session on Investment Checklists," *Best Ideas 2014, Hosted by John and Oliver Mihaljevic*, January 7, 2014. See <http://www.valueconferences.com/wp-content/uploads/2014/12/ideas14-pabrai-spier-shearn-transcript.pdf>.

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What Makes for a Useful Statistic

Not All Numbers Are Created Equal

April 5, 2016

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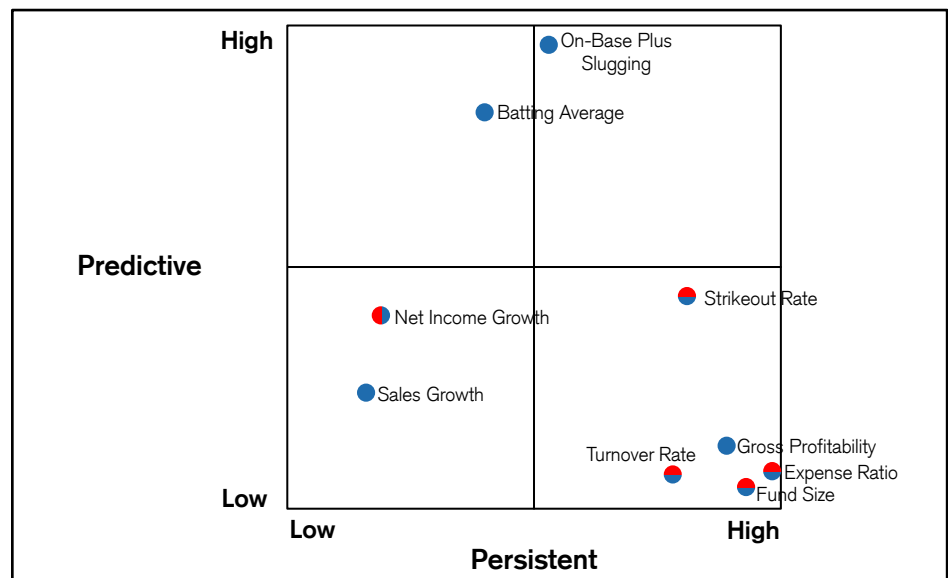
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Source: Credit Suisse.

“To our surprise, we discovered that most companies have made little attempt to identify areas of nonfinancial performance that might advance their chosen strategy. Nor have they demonstrated a cause-and-effect link between improvements in those nonfinancial areas and in cash flow, profit, or stock price.”

Christopher D. Ittner and David F. Larcker¹

- The worlds of business, investing, and sports are awash in numbers, yet we rarely pause to consider what makes for a suitable statistic.
- We provide a way to think about the numbers you use and put them in a format that allows you to compare across domains.
- The first quality to seek in a statistic is persistence, which means what happens in the present is similar to what happened in the past.
- The second quality is that the statistic is predictive, or highly correlated with the outcome you are trying to achieve.
- The goal is to find a statistic that offers a robust combination of persistence and predictive value.

Introduction

In 2009, Robert Jones, a delivery driver, was on the job in the town of Todmorden in West Yorkshire, England. He relied on his BMW's navigation feature, guided by the Global Positioning System (GPS), to lead him to his destination safely. The system led him up a steep and narrow footpath, "insisting the path was a road." The car finally came to a stop at a fence, inches from a cliff with a 100-foot drop. Jones was whisked to safety, but the lesson is clear: slavishly submitting to false signals can lead you astray.²

The worlds of business, investing, and sports are awash in numbers. We all know that the numbers are not equally informative, yet we rarely pause to consider what makes for a suitable statistic. Here, we provide a way to think about the numbers you use and put them in a format that allows you to compare across domains.³

Persistent and Predictive

The first quality to seek in a statistic is persistence, which means what happens in the present is similar to what happened in the past. For activities that are largely a matter of skill, persistence tends to be high. For activities that have a lot of luck, persistence is low. Statisticians use the word "reliable" to capture this idea.

True score theory is one of the best ways to think about persistence.⁴ It says:

Observed score = true ability (skill) + random error (luck)

When the ratio of true ability to observed score is high, we know the statistic will be persistent. We can measure persistence using the correlation coefficient, a measure of the degree of linear relationship between two variables in a pair of distributions.

The correlation coefficient, r , takes a value that ranges from 1.00 to -1.00. When r is 1.00, a plot of each point from both distributions falls on a straight line. Values from each distribution need not be the same, but the differences are identical. If $r = -1.00$, there is a perfect inverse correlation: an increase in one variable leads to a decrease in the other. When $r = 0$, results are random.

The SAT, a standardized test for admission into U.S. colleges, provides a good example.⁵ About half of the students who sit for the SAT take it more than once.⁶ The correlation between the score on the first and second test is about 0.90.⁷ SAT scores are very persistent, which means the exam accurately captures the skills it tests for.

The second quality you want in a statistic is predictive value, or that it is highly correlated with the outcome you are trying to achieve. Statisticians say a statistic is "valid" if it effectively measures what it is supposed to measure. For the SAT, for instance, you might want to predict cumulative college grade point average (GPA), graduation rate, or income after college. The correlations between SAT scores and these factors, roughly in a range of 0.20 to 0.50, are not as high as those for persistence but are positive.⁸

Note that while the concepts of persistence and predictive value may be related, they are really distinct ideas. You can have a metric that is extremely persistent but tells you very little about what you are trying to achieve. Imagine shooting arrows that consistently land in the same spot far from a bullseye. Alternatively, you can have a statistic that is predictive but not persistent. Here, the arrows are scattered all over the target but the average of all the arrows is a bullseye. The group is accurate but no individual shot is reliable.

The goal is to find a statistic that offers a robust combination of persistence and predictive value. One way to visualize this is to plot the statistics on a simple chart (see Exhibit 1). The horizontal axis uses the correlation coefficient to measure persistence, with zero on the left and one (or negative one) on the right. Referring to the equation for true score theory, results on the left reflect mostly random error, or luck, and those on the right capture true ability, or skill.

Exhibit 1: The Persistent-Predictive Chart

Predictive	High	• Little skill • Strong relationship with goal	• Lots of skill • Strong relationship with goal
	Low	• Little skill • Weak relationship with goal	• Lots of skill • Weak relationship with goal
		Low	High
		Persistent	

Source: Credit Suisse.

The vertical axis measures predictive value, also using correlation. Statistics on the bottom of the axis have a low correlation with the objective, while those on the top correlate closely with the goal. The dream statistic is in the upper right corner, and those in the bottom left corner are of little utility.

To illustrate how this works, we can look at SAT results and cumulative college GPA. We noted that when a student takes the SAT twice, the persistence in the scores is 0.90, which is close to the right side of the chart. One study found that the correlation between SAT score and cumulative college GPA is 0.36, so a little more than a third of the way up from the bottom on the vertical axis.⁹ If the quadrant in the bottom right corner contained a circular clock face, the point would fall close to two o'clock.

A sensible way to search for a useful statistic is to start with your goal and go backward. You can then observe which statistics are most persistent and predictive of that outcome. You may be waiting for the standard warning about correlation and causation, and here it is: you should consider causation carefully when assessing the predictive value. In many instances of practical utility, correlation and causality go together.

We will examine examples from three fields: business, investing, and sports. In business, for instance, the objective might be to deliver an attractive total shareholder return. Investors seek to anticipate returns, adjusted for risk, that are in excess of an appropriate benchmark. And in baseball the goal on offense is to score runs.

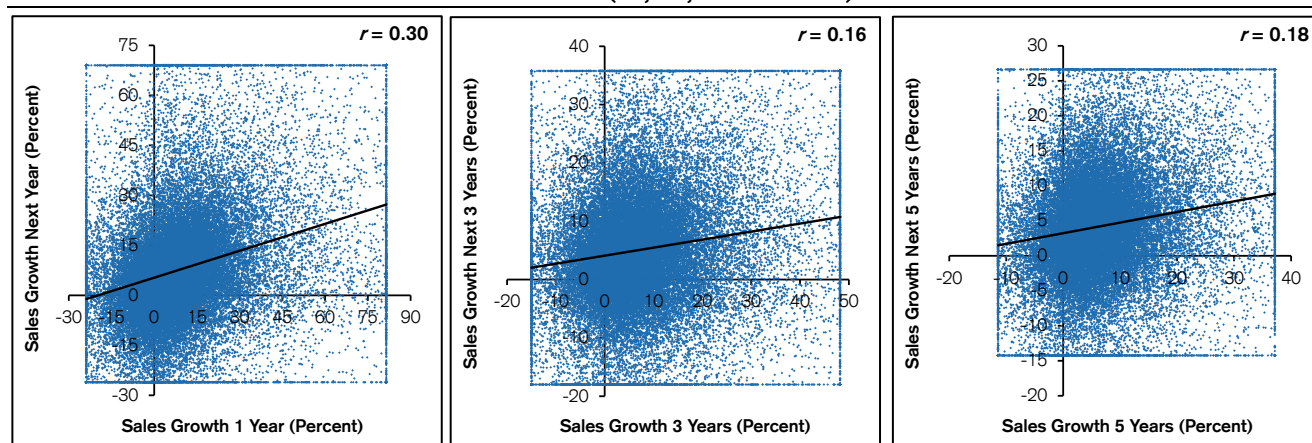
Statistics for Assessing Business

A strong case can be made that maximizing long-term shareholder value should be a company's governing objective.¹⁰ Indeed, a recent survey of executive compensation for the 250 largest companies in the S&P 500 Index found that total shareholder return (TSR) is the number one metric used in incentive compensation.¹¹

Earnings growth and sales growth are the most common statistics that companies and analysts use to anticipate TSR. Nearly 60 percent of the companies in the S&P 500 give guidance for earnings growth and nearly 40 percent do so for revenue growth.¹² Earnings and sales are also the most visible estimates that analysts produce, and the price/earnings multiple is the most popular measure of valuation.¹³

Let's start by examining the persistence and predictive value of sales growth. Exhibit 2 shows the correlation of one-, three-, and five-year sales growth rates for the top 1,000 companies in the world by market capitalization from 1950-2014. For example, the middle figure shows how well the next three years of sales growth correlate with the prior three years. All numbers are adjusted for inflation.

Exhibit 2: Persistence of Sales Growth Rates (1-, 3-, and 5-Year)



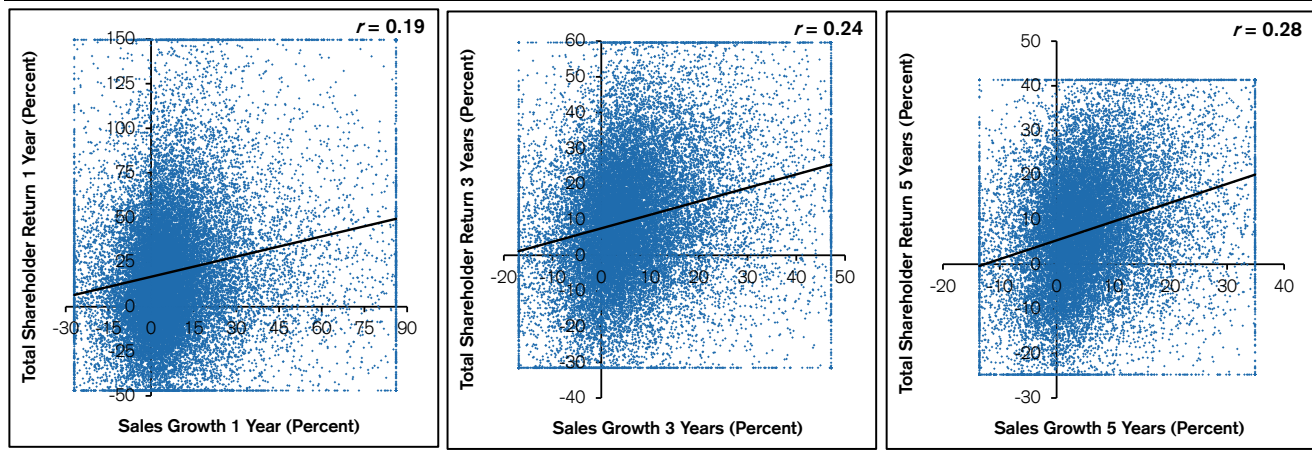
Source: Credit Suisse HOLT®.

Note: Top 1,000 global companies, 1950-2014; Calculations use annual data on a rolling 1-, 3-, and 5-year basis; Winsorized at 2nd and 98th percentiles; Depicted growth rates are annualized.

The correlation is 0.30 for one year but drops to the high teens for the three- and five-year periods. From a practical point of view, this means that executives and analysts should expect substantial regression toward the mean for multi-year sales growth forecasts.¹⁴

Exhibit 3 shows the correlation between sales growth and total shareholder return in order to assess the predictive value of sales. For example, the middle figure shows the correlation between the last three years of sales growth and total shareholder return over the same time.

Exhibit 3: Predictive Value of Sales Growth Rates (1-, 3-, and 5-Year)



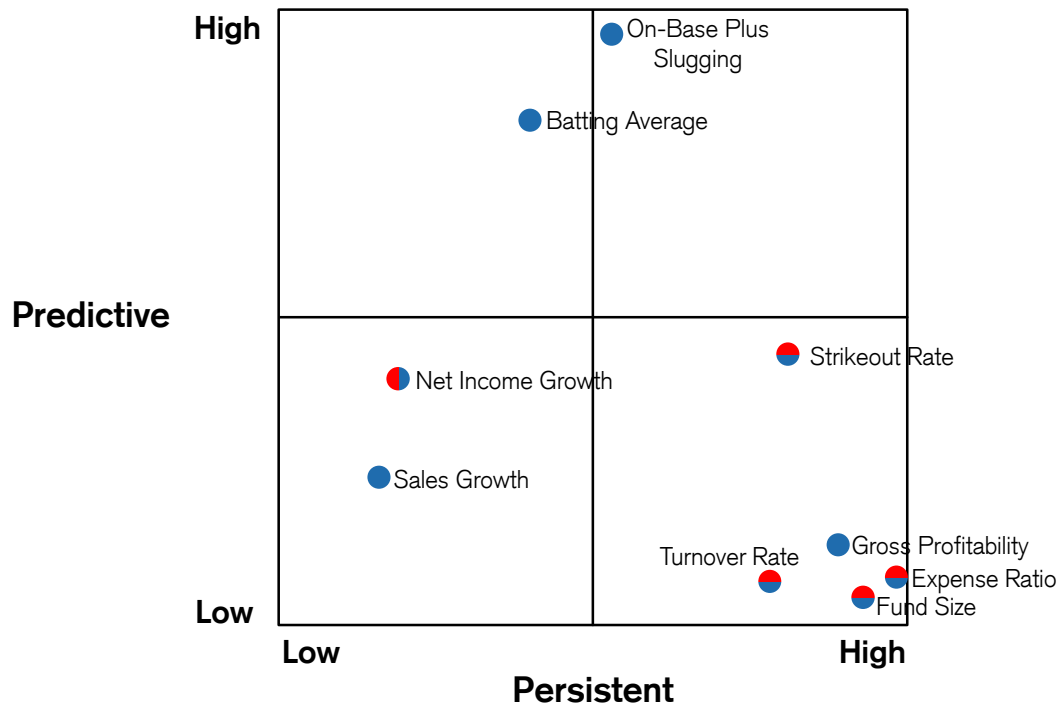
Source: Credit Suisse HOLT®.

Note: Top 1,000 global companies, 1950-2014; Calculations use annual data on a rolling 1-, 3-, and 5-year basis; Winsorized at 2nd and 98th percentiles; Depicted growth rates and TSRs are annualized.

We see that the correlation is 0.19 for one year but improves to 0.24 for three years and 0.28 for five years. If we look at the numbers for three years for both persistence and predictive value, we see that sales growth is not a strong statistic.

Exhibit 4 places the data point for the three-year persistence and predictive values of sales growth, along with other figures we will discuss, on the persistent-predictive chart. We can see that it falls in the bottom left quadrant, far from the ideal metric in the top right corner.

Exhibit 4: The Persistent-Predictive Chart

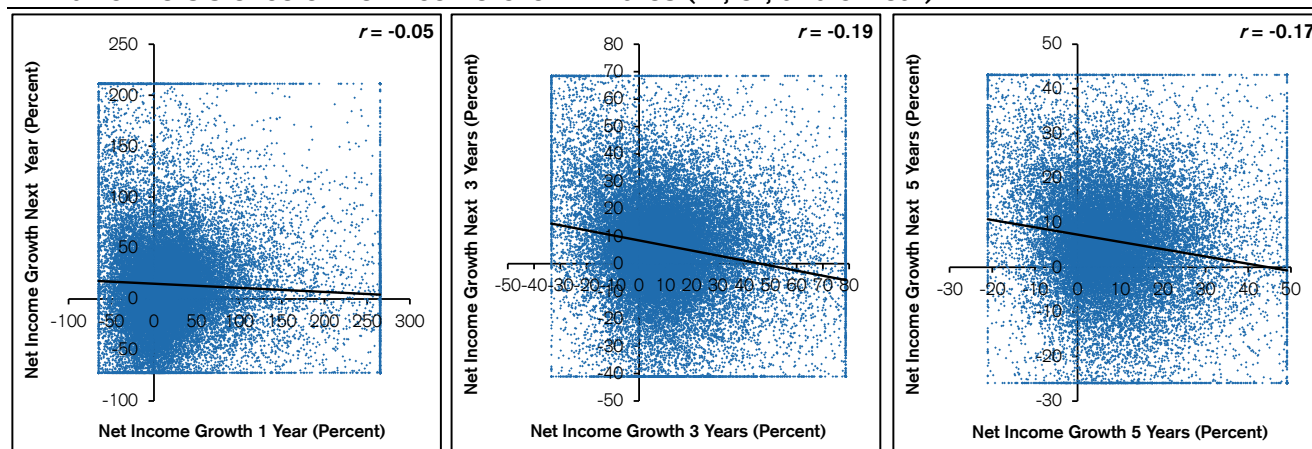


Source: Credit Suisse.

Note: Blue indicates a positive correlation. Red on the left represents a negative correlation in persistence while red at the top shows a negative correlation in predictive value; Calculations reflect 3-year periods for business and investing and 1-season periods for sports.

We now turn to earnings growth. Exhibit 5 shows the persistence of net income growth over one-, three-, and five-year periods. None of the correlations, in a range from -0.05 to -0.19, are strong, and all of them are negative. That means that growth rates above the average are often followed by growth rates below the average. That's the bad news.

Exhibit 5: Persistence of Net Income Growth Rates (1-, 3-, and 5-Year)

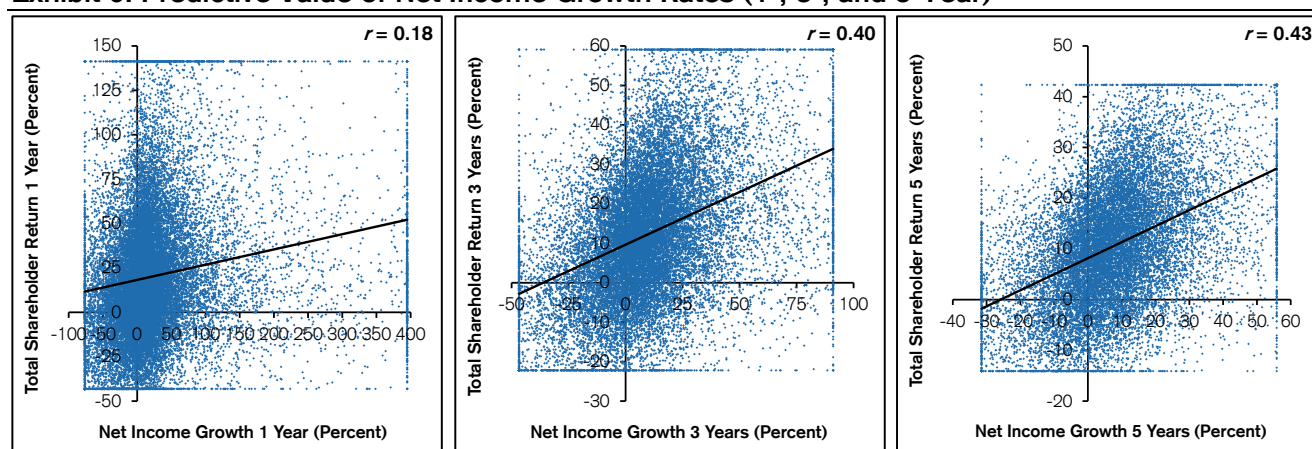


Source: Credit Suisse HOLT®.

Note: Top 1,000 global companies, 1950-2014; Calculations use annual data on a rolling 1-, 3-, and 5-year basis; Winsorized at 2nd and 98th percentiles; Depicted growth rates are annualized.

The good news is that net income growth has a higher correlation with total shareholder return than sales growth does. Exhibit 6 shows that the correlation coefficient is 0.18 for one year but increases to about 0.40 for the three- and five-year assessments.

Exhibit 6: Predictive Value of Net Income Growth Rates (1-, 3-, and 5-Year)



Source: Credit Suisse HOLT®.

Note: Top 1,000 global companies, 1950-2014; Calculations use annual data on a rolling 1-, 3-, and 5-year basis; Winsorized at 2nd and 98th percentiles; Depicted growth rates and TSRs are annualized.

Exhibit 4 shows that net income growth is more predictive of TSR than sales growth. But its persistence is comparable, albeit with a negative correlation. This research corroborates findings by financial economists.¹⁵

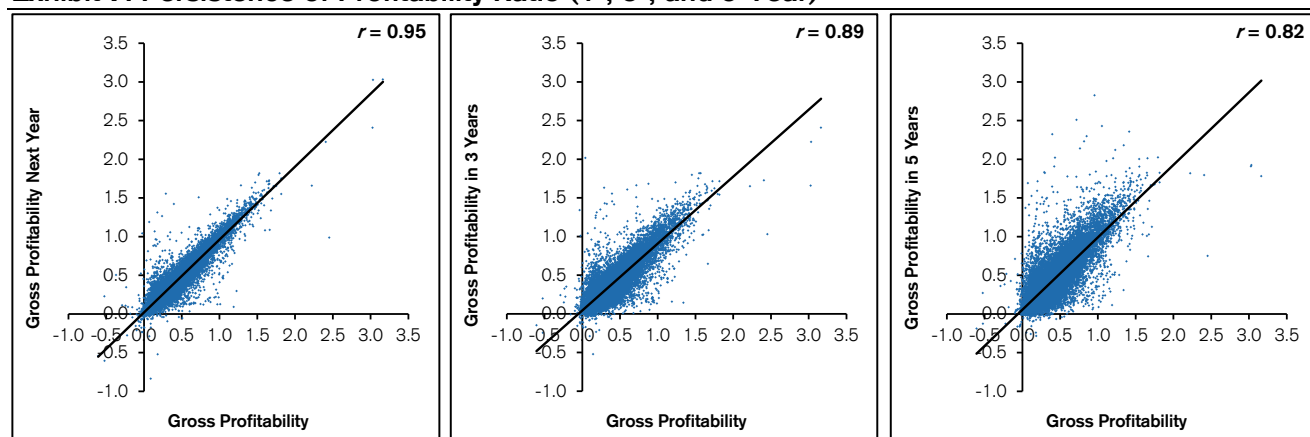
“Profitability” is a business statistic that has gained attention in recent years. Robert Novy-Marx, a professor of finance at the Simon Business School at the University of Rochester, defines profitability as a company’s revenues minus cost of goods sold, scaled by assets—or, more simply, as gross profit divided by assets.¹⁶

Research by Novy-Marx suggests that firms with high profitability outperform those with low profitability even though the high profitability firms generally start with more lofty valuations.

Eugene Fama and Kenneth French, finance professors renowned for their work on asset pricing, include profitability as one of the factors that helps explain changes in asset prices. The others include beta (a measure of the sensitivity of an asset's returns to market returns), size, valuation, and investment.¹⁷ While their definition of profitability differs somewhat from that of Novy-Marx, it captures the same essence.

Exhibit 7 shows that the Novy-Marx definition of profitability is very persistent over one-, three-, and five-year periods. For example, the correlation between profitability in the current year and three years in the future is 0.89. But even the five-year correlation is relatively high at 0.82. This universe includes the top 1,000 firms in the world measured by market capitalization from 1950 to 2014. The sample includes dead companies but excludes firms in the financial services and utilities sectors.

Exhibit 7: Persistence of Profitability Ratio (1-, 3-, and 5-Year)

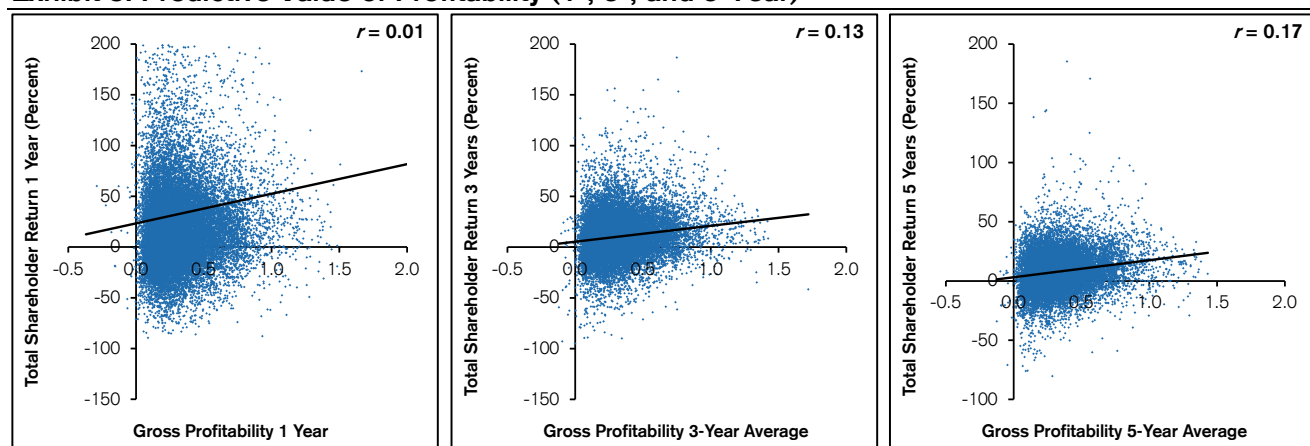


Source: Credit Suisse HOLT®.

Note: Top 1,000 global companies excluding financials and utilities, 1950-2014; Calculations use annual data on a rolling 1-, 3-, and 5-year basis.

Exhibit 8 shows that the simple correlation between profitability and three-year TSR is low at 0.13. However, neither Novy-Marx nor Fama and French recommend simply using the correlation between the measure and stock returns to explain outcomes.

Exhibit 8: Predictive Value of Profitability (1-, 3-, and 5-Year)

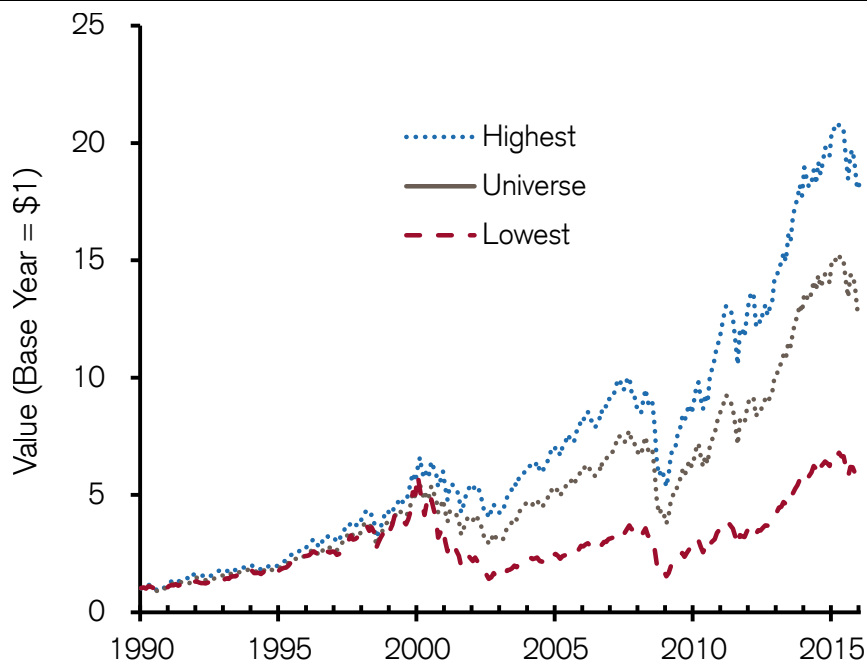


Source: Credit Suisse HOLT®.

Note: Top 1,000 global companies excluding financials and utilities, 1985-2014; Calculations use annual data on a rolling basis; TSRs are annualized.

Rather, the most effective way to use the profitability ratio is to rank stocks in quintiles by profitability and build portfolios for each. Exhibit 9 shows the cumulative growth in value of \$1 for the quintiles with the highest and lowest profitability, as well as that for the whole universe. The sample includes the largest 1,000 U.S. industrial and service companies from 1990 through January 2016. The portfolios are rebalanced monthly.

Exhibit 9: Total Return for the Highest and Lowest Quintiles of Profitability (1990-January 2016)



Source: Credit Suisse HOLT®.

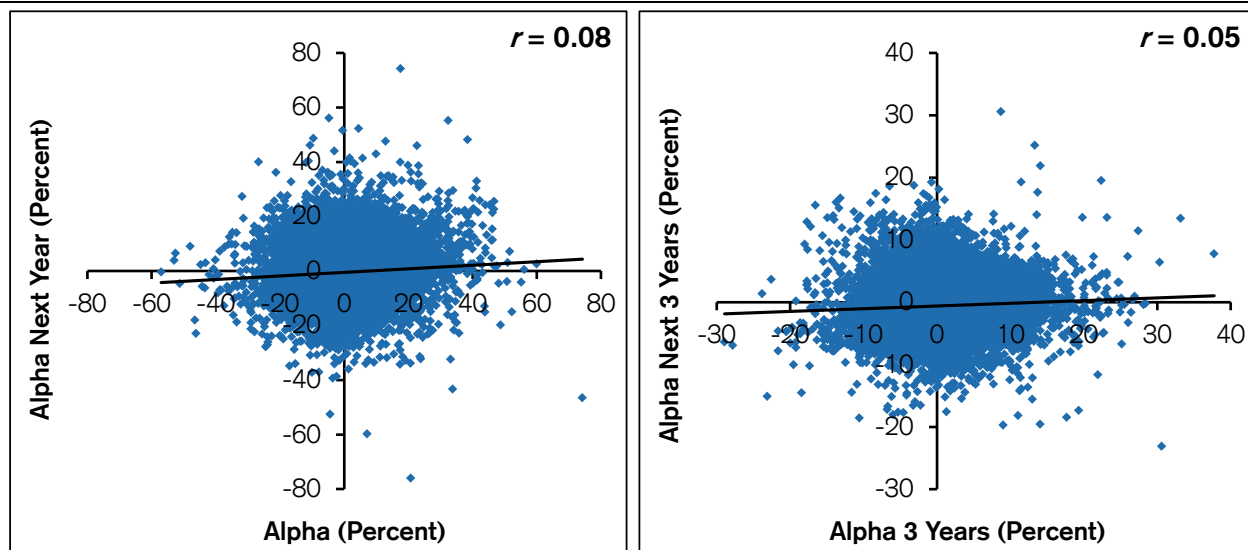
Note: Gross profitability is calculated using the average of the assets at the beginning and the end of the fiscal year.

While we have dwelled on financial measures, companies and investors can also examine non-financial measures such as customer satisfaction, safety, and product quality measures in the same way.¹⁸ The exercise of examining statistics for persistence and predictive value allows analysts to model more thoughtfully, places appropriate emphasis on what matters, and reduces the risk of focusing on the wrong metrics.

Statistics for Assessing Investing

While there may be some debate about the proper corporate objective, investors seek to generate excess returns, adjusted for risk, relative to an appropriate benchmark.¹⁹ In finance, these excess returns are called “alpha.” A focus on alpha makes sense because investors can generally buy an index or exchange-traded fund that offers a low-cost alternative to an active manager.

Since alpha is the goal, we can’t run it through the persistent and predictive framework. But we can assess the persistence of alpha. The left side of exhibit 10 shows the year-to-year persistence of alpha for U.S. mutual funds that manage stocks of large capitalization companies. The correlation is 0.08, which demonstrates that persistence in alpha is low. The right side shows that the correlation between the next three years of alpha and the prior three years is even lower. Academic work generally supports the view that alpha does not have a great deal of persistence, although some researchers find higher levels of persistence by carefully considering additional factors.²⁰

Exhibit 10: Persistence of Alpha (1- and 3-Year)

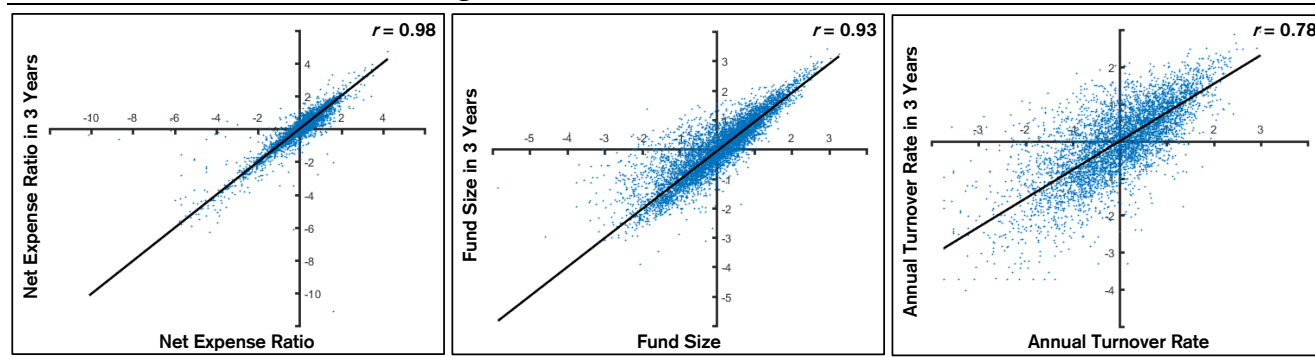
Source: Markov Processes International, Morningstar, and Credit Suisse.

Note: U.S. large cap equity mutual funds, 2000-2015; Calculations use quarterly data on a rolling 1- and 3-year basis.

Alpha must sum to zero over time because for all of the investors who “win” positive excess returns there must be investors who “lose” an equivalent amount. But alpha is zero only before costs. Alpha for investors is negative in the aggregate after expenses.²¹

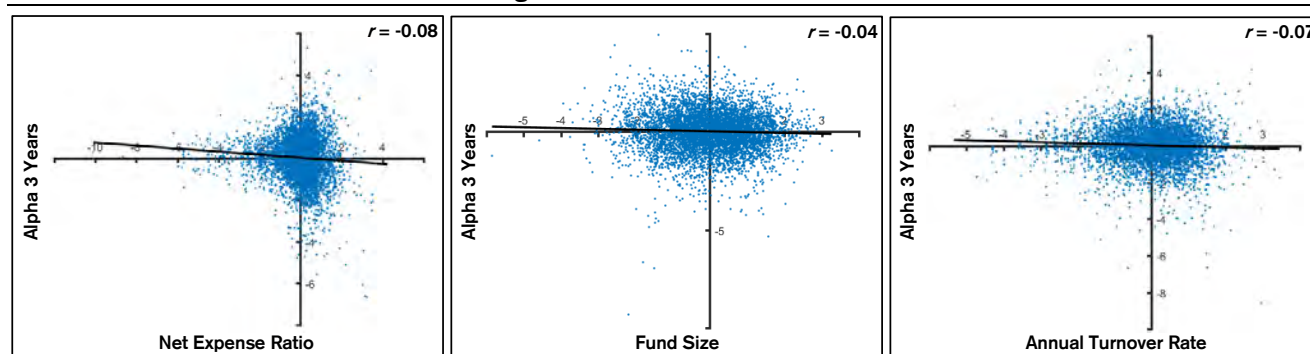
Expense ratios for mutual funds are very persistent, with a correlation of 0.98 (left panel of Exhibit 11). This correlation compares the current annual net expense ratio to that three years hence. The predictive value of expense ratios is -0.08, indicating a weak link between fees and alpha for a broad sample of mutual funds (left panel of Exhibit 12).

Notwithstanding the weak correlation between fees and returns, it stands to reason that low expenses are better than high expenses over time. Funds in the quintile with the lowest fees generate higher total returns than funds in the quintile with the highest fees. For instance, one study of funds invested in U.S. equities found that funds in the cheapest quintile generated returns that were 125-150 basis points higher than those in the most expensive quintile.²² Similar to profitability, segregation of the data provides clearer results.

Exhibit 11: Persistence of Investing Statistics

Source: Markov Processes International, Morningstar, and Credit Suisse.

Note: U.S. equity mutual funds, 2000-2015; Calculations use monthly data on a rolling 3-year basis, and data is normalized.

Exhibit 12: Predictive Value of Investing Statistics

Source: Markov Processes International, Morningstar, and Credit Suisse.

Note: U.S. equity mutual funds, 2000-2015; Calculations use monthly data on a rolling 3-year basis, and data is normalized.

Size is among the most useful statistics in assessing a fund. The persistence of fund size is 0.93 (middle panel of Exhibit 11), which suggests the impact that performance and flows have on size is relatively modest. The correlation between fund size and alpha is -0.04 (middle panel of Exhibit 12), which says that the largest funds deliver below-average alpha as a group. This finding, too, is revealed in the academic literature.²³

Two finance professors, Jonathan Berk and Richard Green, developed a model to explain this result.²⁴ They suggest a world where there are skillful investment managers and both the managers and investors recognize this skill. The manager's ability to deliver excess returns is limited by assets under management such that each incremental dollar an investor adds reduces the expected return of the portfolio.

In such a world, a skillful manager attains assets through inflows until the expected return of the portfolio falls to a level roughly equal to that of the market. Berk and Green suggest that equilibrium is realized when all managers, irrespective of their level of skill, have identical expected returns. The model doesn't explain the modest negative slope of the correlation, but makes clear that the capacity of a manager to deliver value tends to be constrained by the size of the assets under management.

Investors commonly conflate recent results with skill. As a result, they have a tendency to invest in funds that have done well and to withdraw money from funds that have done poorly. This is true for institutional investors as well as individuals.²⁵ These flows benefit the fund's results when they are positive and detract from performance when they are negative. One study suggests that one-third of the alpha in the hedge fund industry is the result of fund flows.²⁶

There has been a great deal of hand wringing over the topic of short-termism, a tendency to make decisions that appear beneficial in the short term at the expense of decisions that have a higher payoff in the long term.²⁷ A rise in portfolio turnover for mutual funds is a purported manifestation of this short-termism.²⁸

The portfolio turnover rate, which typically reflects results for one year, is the lesser of the total amount of new securities that the fund buys or sells, divided by the average monthly total assets of the fund. For instance, an equity mutual fund that bought \$50 million of new stocks with average assets of \$100 million had a portfolio turnover rate of 50 percent. You impute the holding period by dividing one by the rate. For instance, a 50 percent turnover rate equals a two-year holding period ($1/.50 = 2$).

Turnover is higher today than it was in the 1960s, implying shorter holding periods. While higher turnover may simply reflect better information, the rise of institutional investors, lower taxes, and sharply lower transaction costs, there remains a distinct sense that investors today have a shorter time horizon than in the past.²⁹ One survey suggested a holding period of 2.8 years or more qualified as a long-term investment.³⁰

Portfolio turnover is persistent, with a correlation of 0.78, since it is largely within the manager's control (right panel of Exhibit 11). Investment processes vary in their optimal trading activity. Strategies that result in active trading generally incur higher costs, and are less tax efficient, than strategies that trade less frequently. Turnover is not very predictive, with a correlation of -0.07. So while trading costs may make a difference, the overall impact is modest.³¹

Quantitatively assessing the differential skill of money managers is a challenge because it is hard to beat the market. Indeed, the correlations near zero in Exhibit 12 indicate that results include a great deal of luck. This reflects the "paradox of skill": when absolute skill is high and relative skill is narrow in competitive realms, luck plays a big role in outcomes.

But the data suggest we can improve the probability of success by focusing on fair fees, smaller funds, and high active share. Active share is a measure of how different a portfolio is from its benchmark.³² Further, investors should seek congruence between an investment firm's perceived source of edge and the process to find edge. It is less important to ask how frequently a portfolio manager trades and more important to determine whether the manager's process serves the goal.

Statistics for Assessing Sports

We relegate the discussion of persistence and predictive value for offense in baseball to the appendix, but we include the results in exhibit 4. The most sophisticated statistics today are much more complex than those we depict, although even these simple measures can explain a great deal.

Summary

Companies, investors, and sports teams commonly have goals they want to achieve. As a result, each group monitors certain measures to determine whether they are on track. These same measures are commonly used by outsiders to assess and anticipate results.

The main message is that statistics vary in their persistence and predictive value. The ideal statistic is both persistent, indicating the presence of skill, and predictive of the desired outcome. Poor statistics are either unreliable because of a large dose of luck or are unrelated to the end goal.

Exhibit 13 summarizes the statistics we consider in this report. We create a score for each one, in a range from zero to one, that indicates the aggregate strength of the measure.³³ A score of zero says the statistic has no utility at all, and a score of one says the result is perfectly persistent and predictive. Note that the sports statistics we consider are much more useful than those for investing or business.

Exhibit 13: Scores of Nine Statistics on Persistent-Predictive Chart

	Persistent (r)	Predictive (r)	Score
<u>Business</u>			
Sales Growth	0.16	0.24	0.20
Net Income Growth	-0.19	0.40	0.29
Gross Profitability	0.89	0.13	0.38
<u>Investing</u>			
Annual Net Expense Ratio	0.98	-0.08	0.35
Fund Size	0.93	-0.04	0.32
Annual Turnover Rate	0.78	-0.07	0.32
<u>Sports</u>			
Batting Average	0.40	0.82	0.56
On-Base Plus Slugging	0.53	0.96	0.67
Strikeout Rate	0.81	-0.44	0.58

Source: Credit Suisse.

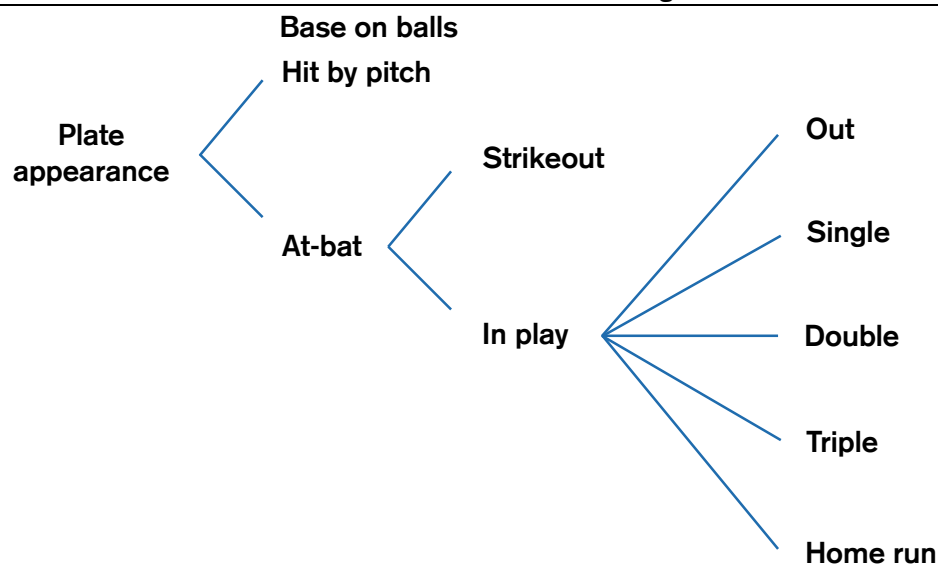
With this simple framework in hand, you can now test some of your favorite metrics. Naturally, you must be careful to gather sufficient sample sizes. But in general it is our experience that many are surprised when they see their favorite statistic plotted on exhibit 4.

Appendix: Baseball Statistics

The use of statistics has become more widespread in all sports but is particularly popular in baseball. Batting average is the traditional statistic that general managers and fans use to assess offensive players, and earned run average is popular for pitchers. In recent decades, the sabermetrics community and front offices of teams have developed more useful statistics to assess players.³⁴ We focus on hitting statistics.

Exhibit 14 shows the common outcomes that occur when a player goes up to home plate. Note that an “at-bat” is different than a “plate appearance.” A batter records a plate appearance no matter what happens but only records an at-bat if he strikes out or puts the ball in play (leaving aside rare events).

Exhibit 14: Breakdown of Common Outcomes in Baseball Hitting



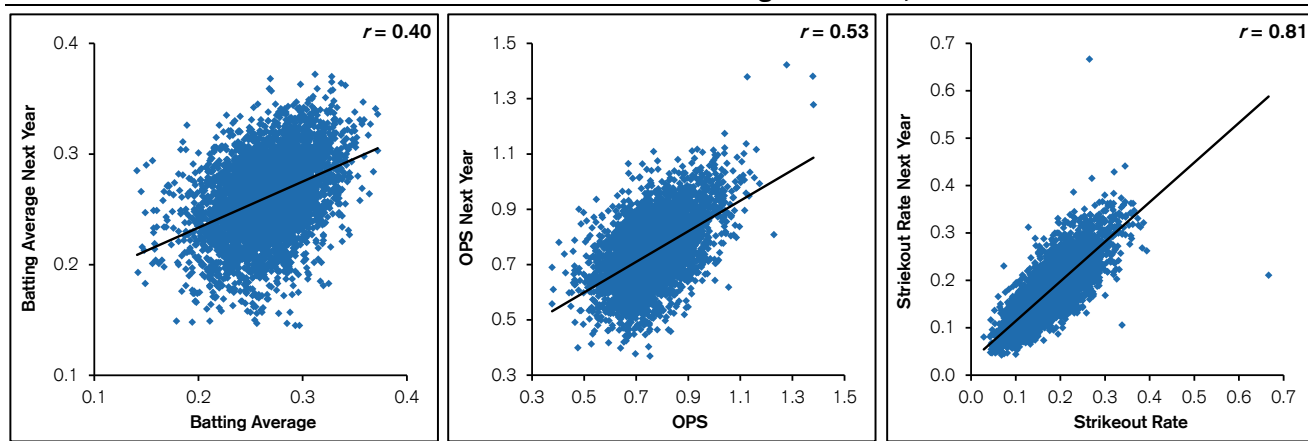
Source: Based on Jim Albert, “A Batting Average: Does It Represent Ability or Luck?” Working Paper, April 17, 2004.

Batting average equals hits (singles, doubles, triples, or home runs) divided by at-bats. Strikeout rate is the number of times a batter strikes out divided by the number of plate appearances. On-base percentage plus slugging percentage (OPS) has become more popular, especially since it was featured in Michael Lewis’s book, *Moneyball*.³⁵ On-base percentage roughly equals the number of hits a batter gets plus the number of times he walks divided by the number of plate appearances. Slugging percentage equals total bases divided by at-bats, with a single worth one base, a double worth two bases, and so on.

Exhibit 15 shows scatter plots for these three statistics using data from Major League Baseball in the 2000 through 2015 seasons. We include all players with 100 or more at-bats, an average sample of 338 players per season.

Both batting average ($r = 0.40$) and OPS ($r = 0.53$) have a respectable correlation from year to year. Strikeout rate, the plot on the far right, has a high correlation from year to year ($r = 0.81$) and thus is a solid indicator of skill.

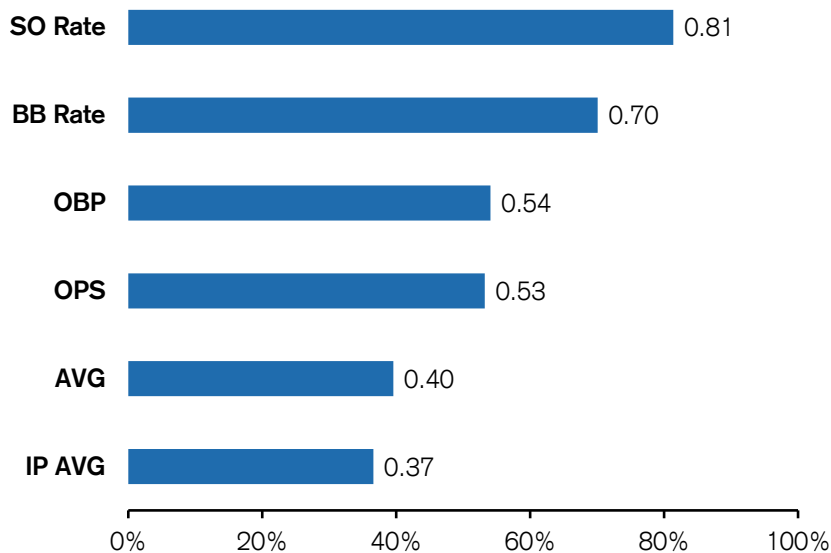
The difference in correlations is not surprising. There are more variables in determining whether a batted ball becomes a hit than there are in determining whether a batter will strike out. For example, a batted ball can result in either a hit or an out depending on how well the ball was hit, where it was hit, the skill of the defense, the field, and the weather. On the other hand, the strikeout rate largely reflects a one-on-one battle between the pitcher and batter. The only other meaningful variable is the judgment of the umpire.

Exhibit 15: Season-to-Season Persistence of Three Hitting Statistics, 2000-2015

Source: Based on Jim Albert, "A Batting Average: Does It Represent Ability or Luck?" Working Paper, April 17, 2004; *Baseball Prospectus*.

Note: Minimum of 100 at-bats.

Exhibit 16 shows the coefficient of correlations for six batting statistics again using data from the 2000 through 2015 seasons. The base-on-ball rate, which measures how frequently a player is walked, is another strong measure of skill. On-base percentage and OPS are in the middle of the ranking, and batting average and in-play average (the percentage of times a batter gets a hit when putting a ball in play) are toward the bottom.

Exhibit 16: Season-to-Season Persistence of Six Hitting Statistics, 2000-2015

Source: Based on Jim Albert, "A Batting Average: Does It Represent Ability or Luck?" Working Paper, April 17, 2004; *Baseball Prospectus*.

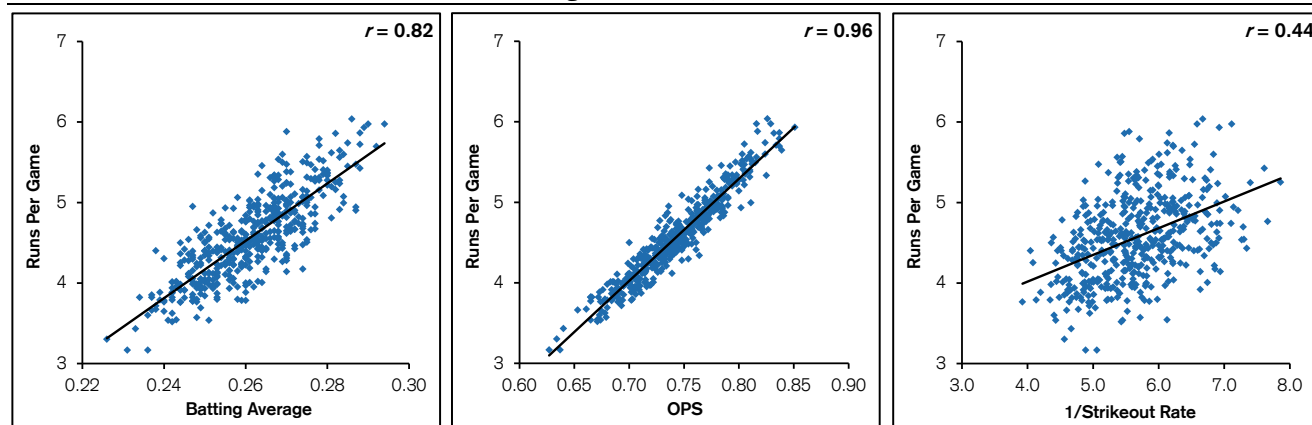
Note: Minimum of 100 at-bats; Definitions: SO rate: Strikeout rate (strikeouts/plate appearances); BB rate: Base on balls rate (base on balls/plate appearances); OBP: On-base percentage $([\text{hits} + \text{base on balls} + \text{hit by pitch}]/[\text{at-bats} + \text{base on balls} + \text{hit by pitch} + \text{sacrifice flies}])$; OPS: On-base percentage + slugging percentage (slugging percentage = total bases/at-bats); AVG: Batting average (hits/at-bats); IP AVG: In-play average (hits/[at-bats - strikeouts]); IP AVG is a simplified version of Batting average on balls in play (BABIP).

We now turn to the predictive value of baseball statistics. The ultimate goal of a team is to win games, which requires a team to score more runs than it allows. Since we are focused on offensive statistics, we calculate how the statistics correlate with total runs scored.

Exhibit 17 shows the results for the three statistics in Exhibit 13 (batting average, OPS, and strikeout rate). The plots show only 30 data points for each year because we are using a team's average for each statistic and comparing that to the team's total runs scored.

The coefficient of correlation shows that OPS has an extremely high correlation with run production ($r = 0.96$). Batting average has a weaker but still fairly strong relationship ($r = 0.82$). And the inverse of the strikeout rate (a higher number equals fewer strikeouts) has a fairly weak relationship ($r = 0.44$).

Exhibit 17: Predictive Value of Three Hitting Statistics, 2000-2015



Source: Based on Jim Albert, "A Batting Average: Does It Represent Ability or Luck?" Working Paper, April 17, 2004; Baseball Prospectus.

This analysis makes it clear that OPS is superior to batting average. In terms of persistence, OPS (0.53) is better than batting average (0.40). But it tells an even clearer story in predicting the desired outcome. A team's OPS has a 0.96 correlation with a team's total runs, making batting average (0.82) pale in comparison. The strikeout rate shows very strong persistence but has limited use overall because of its weak relationship to total runs scored.

* * *

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