

BLUEMOUNTAIN INVESTMENT RESEARCH

WHO IS ON THE OTHER SIDE?

Being successful as an active investment manager requires seeking, finding, and capitalizing on inefficiencies in the market. Markets cannot be perfectly efficient because there are costs to gathering information and reflecting it in prices.

Some forces push prices toward efficiency. These include a large population of smart and motivated investors, the increasingly uniform dissemination of data, and the plummeting costs of computing and trading.

However, other forces keep markets from the Platonic ideal of perfect efficiency. Some sources of valuable information remain expensive and the cost to capture an opportunity can be material.

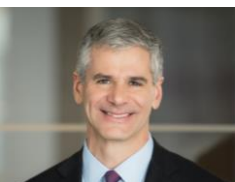
But perhaps the biggest source of market inefficiency remains the human being. As groups, we repeatedly veer to extremes in our

optimism or pessimism, leaving mispriced securities in our wake. And then there are institutions that play by rules imposed by regulation, contract, or internal policy. The result can be actions that make sense for the institution but create inefficiency in the market. In short, many inefficiencies remain.

In this report, Michael describes a taxonomy of inefficiencies, supported by a rich vein of academic research. The goal is to have a clear idea of why efficiency is constrained and why we believe we have an opportunity to generate an attractive return after an adjustment for risk. As always, we would be pleased to discuss specific examples of how we apply these principles.

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Who Is On the Other Side?

You Need Good BAIT to Land a Winner

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Executive Summary

- If you buy or sell a security and expect an excess return, you should have a good answer to the question “Who is on the other side?” In effect, you are specifying the source of your advantage, or edge. We categorize inefficiencies in four areas: behavioral, analytical, informational, and technical (BAIT).
- Market efficiency is a topic of great importance for companies and investors. Capital markets that function well are an essential contributor to the effective allocation of corporate resources.
- There are two related but distinct markets to consider: the market for information about assets and the market for assets. There is a range of costs to acquire information and trade on it. There should be a return to gathering information in the form of excess returns. Markets are “efficiently inefficient.”
- Behavioral inefficiencies may be at once the most persistent source of opportunity and the most difficult to capture. Many behavioral inefficiencies emanate from the psychology of belief formation and the psychology of decision making. It is essential to remember that these inefficiencies are generally the result of collective, not individual, actions.
- Analytical inefficiencies can provide a source of edge versus other investors through having more analytical skill, weighing information differently, updating views more effectively, operating on a different time scale, or anticipating a change in the market's narrative.
- Informational inefficiencies offer edge for investors who can legally acquire relevant information that others don't have. There is evidence that attention is costly and that some inefficiencies arise from limited attention. Research shows that complexity slows the process of information diffusion, so anticipating the impact of information can confer edge.
- Technical inefficiencies can generate excess returns for investors on the other side of forced sellers or buyers, on the correct side of securities perturbed by investor fund flows, and for investors who can act as liquidity providers when traditional arbitrageurs have limited access to capital and hence fail to fulfill their normal function.
- Institutions do the majority of the buying and selling but are generally ignored in the theory of asset pricing. Institutions matter and should be the subject of careful consideration.
- We include a checklist and a full list of references for further investigation.

Introduction

Market efficiency is a topic of great importance for companies and investors. Capital markets that function well are an essential contributor to the effective allocation of corporate resources.¹ Investors seek inefficiencies to generate excess returns, or returns that are higher than expected after adjusting for risk. Understanding efficiency requires us to examine lots of elements, including the market for information, the interplay between capital market participants, and inherent frictions.

Our goal is to create a taxonomy of the sources of inefficiency to provide active investors with a robust way to think about delivering excess returns.

Efficiency Defined. The term “efficiency” comes from physics and measures the relationship between the input of energy and the output of useful work. For instance, your body can roughly translate every 100 calories you eat into about 20-25 calories of useful work. It turns out that level of efficiency is similar to a common combustion engine. Neither your body nor a machine can translate 100 percent of its energy into work because of friction.²

Markets are not machines, but the idea of efficiency still applies. In the case of markets, the input is information and the output is an asset price that reflects fair value. Eugene Fama, a professor of finance at the University of Chicago Booth School of Business and a recipient of the 2013 Nobel Memorial Prize in Economic Sciences for his work on market efficiency, sums it up this way: “A market in which prices always ‘fully reflect’ available information is called ‘efficient.’”³ Just as a perfectly efficient machine does not exist, neither does a perfectly efficient market.

Before turning to market inefficiency, we explore some important ideas that sometimes get short shrift from academics and practitioners.⁴ To start, there are two related but distinct markets to consider. One is the market for information about assets and the other is the market for assets.

The Market for Information and the Market for Assets.

In 1980, a pair of finance professors, Sanford Grossman and Joseph Stiglitz, wrote a paper called “On the Impossibility of Informationally Efficient Markets.”⁵ They argue that markets cannot be perfectly efficient because there is a cost to gathering information and reflecting it in asset prices and therefore there must be a proportionate benefit in the form of excess returns. Because collecting information is costly, active investors need exploitable mispricings to provide a sufficient incentive to participate. Lasse Pedersen, a professor of finance, says that markets must be “efficiently inefficient.”⁶ In this market, investors seek to “buy” information and “sell” profit.

The market for assets concerns the price at which investors buy and sell fractional stakes in various assets. Some investors trade based on information, others trade on data or drivers not relevant to value, and still others free ride. For instance, investors in portfolios that mirror indexes or follow specific rules rely on active managers for proper price discovery and liquidity.

The market's ability to translate information into price is limited by costs. These are commonly called “arbitrage costs” and include costs associated with identifying and verifying mispricing, implementing and executing trades, and financing and funding securities.⁷ These costs create frictions that are commonly understated in academic research. That said, many of these costs have come down over time, which has contributed to greater efficiency in many markets. For example, Regulation Fair Disclosure, implemented in 2000, seeks to quash selective corporate disclosure. In addition, trading costs have dropped precipitously in recent decades as the result of deregulation and advances in technology.

Exhibit 1 summarizes the relationship between the markets for information and asset prices. Having a view that is different than what is priced in, as well as the ability to profit from that view, are both essential to generating excess returns.

Exhibit 1: The Markets for Information and Assets

		Cost to Implement Asset Market	
		Low	High
Cost to Acquire Information Market	Low	<ul style="list-style-type: none"> • Information obvious • Implementation easy (e.g., short-term Treasuries) 	<ul style="list-style-type: none"> • Information obvious • Implementation hard (e.g., 3Com/Palm)
	High	<ul style="list-style-type: none"> • Information nonobvious • Implementation easy (e.g., supply chain impact) 	<ul style="list-style-type: none"> • Information nonobvious • Implementation hard (e.g., VC - biotech)

Source: BlueMountain Capital Management.

Noise Traders. Robert Shiller, a professor of economics at Yale University who shared the Nobel Prize with Fama in 2013, created a model based on the concept of a noise trader.⁸ These investors trade “on noise as if it were information” and “from an objective point of view they would be better off not trading.”⁹ The model suggests that fundamental value and the cost of arbitrage jointly determine an asset price.

When arbitrage costs are low, markets tend to be efficient in the classic sense. When arbitrage costs are high, price and value can meaningfully differ from one another. Value is defined as the present value of cash flow. An influential paper on the topic defined “an efficient market as one in which price is within a factor of 2 of value, i.e., the price is more than half of value and less than twice value.”¹⁰

The main point is that it is reasonable to think about efficiency, a state where price equals value, as falling along a continuum from very inefficient to very efficient. Indeed, in an update to his classic paper on the topic, Fama proposes that a more “sensible” version of an efficient market is one in which prices incorporate information to the point “where the marginal benefits of acting on information (the profits to be made) do not exceed the marginal costs.”¹¹

This suggests a useful distinction between “prices are right” and “no free lunch.”¹² Prices are right means that price is an unbiased estimate of value. No free lunch says that there is no investment strategy that reliably generates excess returns. A common argument for market efficiency is that very few investment managers consistently deliver excess returns. If prices are

right, it stands to reason that there is no free lunch.

But the opposite is not true. There can be no free lunch even when prices are wrong if the cost and risk of correcting a mispricing are sufficiently high. Identifying and exploiting these pockets of inefficiency should be the main focus of active managers.

The joint hypothesis problem also hampers the ability to come up with a definitive answer to the question of market efficiency.¹³ The first hypothesis is that an asset-pricing model predicts asset price returns. Academics and practitioners commonly use the capital asset pricing model (CAPM), which describes the relationship between systematic risk and expected returns. The second hypothesis is that the market is efficient.

The basic problem is that you can consider an asset return anomalous only if you have an accurate asset-pricing model. As a consequence, what you deem to be an anomalous return may be the result of an inaccurate asset-pricing model, a market inefficiency, or both. Bear this in mind any time you hear or see a discussion of market anomalies.

Every time that you buy or sell a security and anticipate excess returns you should ask, “Who is on the other side?” Ideally, you should understand your counterparty’s motivation and ask why you have an edge. We also know that institutions, generally absent in asset pricing models, are very important in practice (see Appendix A: Agency Theory in Asset Management). Ed Thorp, a mathematician and

legendary hedge fund manager, suggests that you have edge when you “can generate excess risk-adjusted returns that can be logically explained in a way that is difficult to rebut.”¹⁴ In other words, you have a good answer to the question “Who is on the other side?”

The challenge is that sophisticated investors exploit the anomalies that academic research finds.¹⁵ There are actually a couple of things going on. First, a large percentage of factors that are correlated with excess returns are the result of statistical bias. When there are a lot of data and a lot of relationships, some factors will correlate with good past returns but will have no predictive value. This has led some researchers to call for a higher hurdle than what academic journals commonly demand to claim that a factor is effective.¹⁶

Second, some factors that predict excess returns get bid up by smart investors and the opportunity is competed away. This is especially true when the cost to do so is not prohibitive. This is the nature of markets. Exploitable opportunities do not last long if investors can identify and capture them at a reasonable cost.

We now turn to a taxonomy of structural inefficiencies based on behavioral, analytical, informational, or technical (BAIT) sources. Most of the inefficiencies we will describe are the result of multiple sources, but we will attempt to place opportunities in the category that makes the most sense. To be an active investor, you must believe in inefficiency and efficiency. You need inefficiency to get opportunities, and efficiency for those opportunities to turn into returns.

Behavioral Inefficiencies

A behavioral inefficiency exists when an investor, or more likely a group of investors, behave in a way that causes price and value to diverge. Behavioral inefficiencies may be at once the most persistent source of opportunity and the most difficult to capture. The persistence stems from human nature, which does not change rapidly. Ben Graham, the father of value investing, said it this way:¹⁷

Though business conditions may change, corporations and securities may change and financial institutions and regulations may change, human nature remains essentially the same. Thus the important and difficult part of sound investment, which hinges upon the investor's own temperament and attitude, is not much affected by the passing years.

The difficulty stems from the fact that humans are social beings and investing is inherently a social activity. Graham used the parable of Mr. Market to make the point: You own a small stake in a private company that costs you \$1,000. 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. Mr. Market represents the collective action of investors.

In his telling of the story, Warren Buffett, chairman and chief executive officer (CEO) of Berkshire Hathaway and Graham's most successful student, goes on to say that Mr. Market has "incurable emotional problems." He writes, "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. Mr. Market is there to serve you, not to guide you. It is his pocketbook, not his wisdom, that you will find useful."¹⁸ The point is that while markets generally offer sensible prices, there have been and will continue to be bouts of extreme optimism and pessimism.

This leads to why behavioral inefficiencies are so hard to exploit. The very driver of behavioral inefficiency, correlated beliefs, makes it difficult to take advantage of the opportunity. Most of us have a powerful desire to be part of the crowd and an aversion to being separate from the crowd. The psychological pull to conform is strongest at the extremes of fear and greed.¹⁹

There are at least a couple of good reasons to consider the behavioral influence on asset prices. First, only a fraction of asset price moves can be directly linked to changes in fundamentals, such as revisions in cash flow or interest rate expectations. This has been established by studies of the biggest moves in the stock market since the 1940s that looked to the media for a fundamental explanation after the fact. In many cases, there is no clear fundamental driver of value. Exhibit 2 shows a summary of the top 10 moves in the Center for Research in Security Prices (CRSP) value-weighted index of stocks and the media's explanation for the change.

A recent study concluded, "Only a minority of the 50 largest moves in the last 25 years can be tied to fundamental economic information that could have had a pronounced impact on cash-flow forecasts or discount rates."²⁰ These studies make it clear that asset price changes have fundamental and behavioral sources.

Exhibit 2: Largest Moves in U.S. Equities, 1988-2018

	Date	Return	News
1	October 13, 2008	11.5%	Governments throughout the world announce moves to support troubled banks.
2	October 28, 2008	9.5%	Late rally on Wall Street as rebound in stocks defies latest economic news.
3	October 15, 2008	-9.0%	Falling retail sales and rising wholesale prices spikes fears of recession and erases Monday's record rally.
4	December 1, 2008	-8.9%	Obama reveals national security team. NBER says U.S. entered recession in December 2007. Bernanke warns of weak economic conditions.
5	September 29, 2008	-8.3%	\$700 billion TARP bill rejected by House of Representatives. President Bush disappointed.
6	October 9, 2008	-7.3%	Rising fears of global recession pushed Wall Street into freefall. U.S. Treasury may take stakes in major banks.
7	November 20, 2008	-7.0%	Another wave of selling roiled Wall Street. Democrats say no to current plan for auto bailout telling industry to come back next month with a detailed plan.
8	March 23, 2009	6.9%	Secretary Geithner makes second attempt at unveiling Obama Administration's plan to deal with the banking crisis. Obama wants to expand clean energy effort.
9	August 8, 2011	-6.9%	Wall Street had its worst day since the 2008 financial crisis, as fearful investors reacted to the United States losing its coveted AAA credit rating.
10	November 13, 2008	6.8%	Dow down 300 points on the morning reverses on new investor confidence and ends up 553.

Source: Bradford Cornell, "What Moves Stock Prices: Another Look," *Journal of Portfolio Management*, Vol. 39, No. 3, Spring 2013, 32-038.

Note: Returns reflect CRSP value-weighted index of firms in the New York, American, and NASDAQ stock exchanges.

Another reason to consider behavioral influence is that we observe certain patterns in nearly all markets.²¹ For example, we have seen bubbles and crashes in a multitude of geographies (e.g., Americas, Europe, and Asia) and asset classes (e.g., stocks, real estate, and cryptocurrencies). There is even evidence of similar behaviors in other primates. For instance, capuchin monkeys exhibit loss aversion, the tendency to suffer more from losses than to enjoy gains of a similar size.²²

Beware of Behavioral Finance. Behavioral economics shows how psychological factors can lead individuals or organizations to make decisions that deviate from economic theory. It also shows how the use of heuristics, or rules of thumb, can lead to biases that affect choices. This body of research is extremely valuable to anyone who seeks to make thoughtful and unbiased decisions.

But it is important to recognize that individual errors, however widespread, are rarely relevant in determining market efficiency. The interaction of investors with little information or rationality can yield prices with surprising efficiency. The essential conditions include the presence of investors with sufficiently heterogeneous views and decision

rules and having an effective way to aggregate the information. The researchers who wrote one of the seminal papers on the topic summarize their finding as follows:²³

Allocative efficiency of a double auction market derives largely from its structure, independent of traders' motivation, intelligence, or learning. Adam Smith's invisible hand may be more powerful than some may have thought; it can generate aggregate rationality not only from individual rationality but also from individual irrationality.

The lesson is that you cannot extrapolate from individuals, who fail to operate according to the rules of rationality, to markets. The reason is that individual errors can cancel out, leading to accurate prices. You can be an overconfident buyer and I can be an overconfident seller and the net result is a correct price. The key is understanding when the wisdom of crowds flips to the madness of crowds. And the essential insight is that it has to do with a violation of one or more of the core conditions for a wise crowd.

Critical to understanding behavioral sources of inefficiency is identifying when the beliefs of

investors correlate with one another and push price away from value. Some strong believers in efficient markets claim that behavioral explanations are a compilation of stories that researchers craft to fit the facts.²⁴ Nicholas Barberis, a professor of finance at the Yale School of Management, suggests that many of the key concepts in behavioral finance are based on the psychology of belief formation and the psychology of decision making.²⁵

Overextrapolation. Overextrapolation, the excessive projection of recent experience, is one of the key ideas behind the psychology of belief formation. For example, financial economists have shown that investor expectations for future stock returns in the next year are highly correlated with returns in the past year. Exhibit 3 shows the percentage of household equity and fixed income investments that are allocated to equities and subsequent five-year stock market returns. Investors expect high returns after realizing high returns and expect low returns after realizing low returns.²⁶

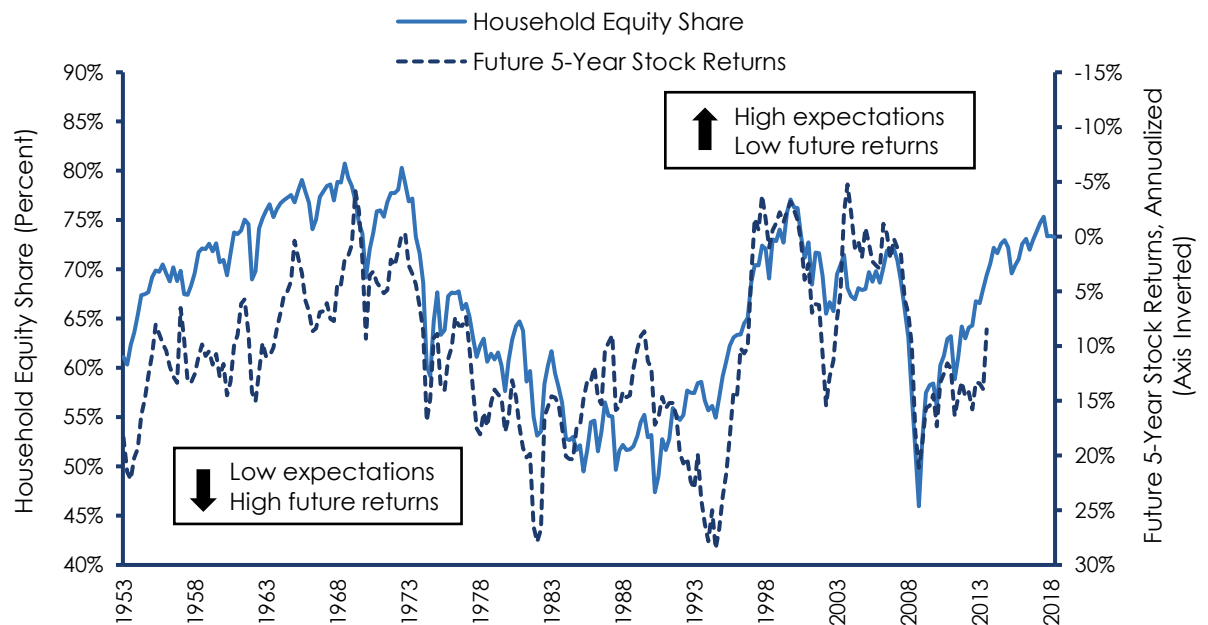
Because stock prices are more volatile than corporate earnings, valuations tend to be higher following a period of strong price advances and lower subsequent to price declines. In contrast with expectations as the result of overextrapolation, high valuations are associated

with low expected returns, and low valuations with high expected returns. This relationship holds for asset classes beyond stocks, including bonds, real estate, and sovereign debt.²⁷

Avoiding this type of overextrapolation demands the ability to “disregard mob fears or enthusiasms and to focus on a few simple fundamentals.”²⁸ Seth Klarman, founder, chief executive officer, and portfolio manager of The Baupost Group, captured the concept beautifully when he said, “Value investing is at its core the marriage of a contrarian streak and a calculator.”²⁹ The “contrarian” part demands an examination of the other side of the popular view. The “calculator” part ensures that valuation is sufficiently extreme to generate excess returns.

Academics have developed a model of a financial bubble, a sharp rise in an asset price over a short period of time leading to a lofty valuation, based on extrapolation. The model reflects the fact that almost all bubbles are preceded by good fundamental news and have abnormally high trading volume driven by “wavering extrapolators.”³⁰ The main challenge to investing following sharp price increases is they are not reliably associated with unusually low prospective returns. However, these run-ups are associated with a greater probability of a crash.³¹

Exhibit 3: Household Equity Share and Future Five-Year Stock Returns, 1953-2018



Source: Bloomberg and Board of Governors of the Federal Reserve System, Division of Research and Statistics, Balance Sheet of Households and Nonprofit Organizations and Households' Financial Assets and Liabilities.

Note: Stock returns are total shareholder returns for the S&P 500; Through the third quarter of 2018.

Overextrapolation is also associated with the momentum effect, the observation that the direction of a stock's return in the next six months tends to follow the direction of the stock's return in the prior six months. For example, a stock that has done well in the last half year will do well in the upcoming six months before reversing. More strictly, a strategy to take advantage of the momentum effect is more rigorous than the simple extrapolation by return chasers.³²

Performance chasing is another manifestation of overextrapolation.³³ Both retail and institutional investors have a tendency to buy funds that have done well and sell those that have performed poorly. For example, a study of pension plan sponsors found that in the two years preceding a decision to fire or hire, the investors they fired had underperformed, and the investors they hired had outperformed, their benchmarks.

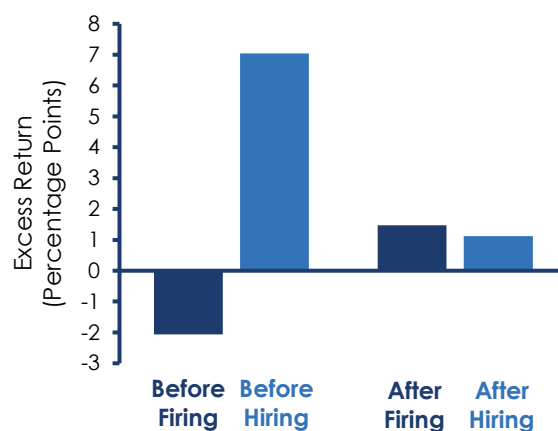
The decision to fire or hire is evidence of overextrapolation. Exhibit 4 shows the result of one study of more than 3,400 plan sponsors. The data reveal that the fired managers generate higher returns than the hired managers in the following two years.³⁴ Economists doing related work conclude, "Clearly, plan sponsors could have saved hundreds of billions of dollars in assets if they had simply stayed the course."³⁵

Overconfidence is another notable aspect of the psychology of belief formation. It has a few forms:

- Overestimation means you think you are better than you are (you think you type 60 words per minute but actually type only 40).
- Overplacement means you think you are better than others (93 percent of American drivers rate their skill as above the median).
- Overprecision means you believe you know the truth with greater accuracy than you actually do (ask portfolio managers for an estimate with a 90 percent confidence interval and they are correct only about 50 percent of the time).³⁶

Overconfidence is associated with lots of trading activity, which is mostly deleterious to investment returns.³⁷ Overconfidence tends to build when asset prices are rising. For example, growth stocks, defined as the top quintile of stocks based on price-to-book ratios, generally have substantially higher turnover than value stocks, the bottom quintile of stocks based on price-to-book ratios.³⁸

Exhibit 4: Plan Sponsors Buy High and Sell Low



Source: Amit Goyal and Sunil Wahal, "The Selection and Termination of Investment Management Firms by Plan Sponsors," *Journal of Finance*, Vol. 63, No. 4, August 2008, 1805-1847.

Note: Performance reflects 2-year cumulative excess returns relative to an appropriate benchmark.

Sentiment. Finance academics have created sentiment indexes to capture when investors appear too optimistic or pessimistic.³⁹ Measures that explain sentiment include trading volume, indicators of valuation, and the volume and returns to initial public offerings. Sentiment most affects the stocks of speculative companies. These are typically small market capitalization companies that are young and growing rapidly. They have a future that is less clear than that of older companies, and arbitrage costs are higher. High sentiment regarding speculative companies is associated with low excess returns.

Even a simple sentiment indicator such as a company's appearance on the cover of a business magazine can provide a signal. On average, positive magazine cover stories follow strong stock price performance and negative stories follow weak stock price performance. The researchers studying the topic conclude that "positive stories generally indicate the end of superior performance and negative news generally indicates the end of poor performance."⁴⁰

The Wisdom (and Madness) of Crowds. We now turn to the issue of when and how the wisdom of crowds, where markets are efficient, transitions to the madness of crowds, where markets are inefficient. This may be the most important recurring behavioral opportunity.

For a crowd to be wise, the members need to have heterogeneous views. To be more formal, consider the diversity prediction theorem, which says that given a crowd of predictive models, the collective error equals the average individual error minus the prediction diversity.⁴¹ You can think of “collective error” as the wisdom of the crowd, “average individual error” as smarts, and “prediction diversity” as the difference among predictive models. In markets, price veers from value when investors come to believe the same thing, or act as if they do. In other words, when investors lose diversity markets lose efficiency.

One way to animate the concept is to examine an agent-based model. These models create agents in silico, endow them with decision rules and objectives, allow them to interact with one another, and provide them with the ability to learn and adapt.

Blake LeBaron, a professor of economics at Brandeis University and an expert in agent-based modeling, built such a model.⁴² He included 1,000 agents with well-defined objectives for portfolio allocations, a risk-free asset, an asset that pays a dividend at a rate calibrated to the empirical record in the last half century, and 250 active decision rules. The agents made or lost money as they traded and he eliminated those with the lowest levels of wealth. He also evolved the decision rules by removing those the agents did not use and replacing them with new ones. The

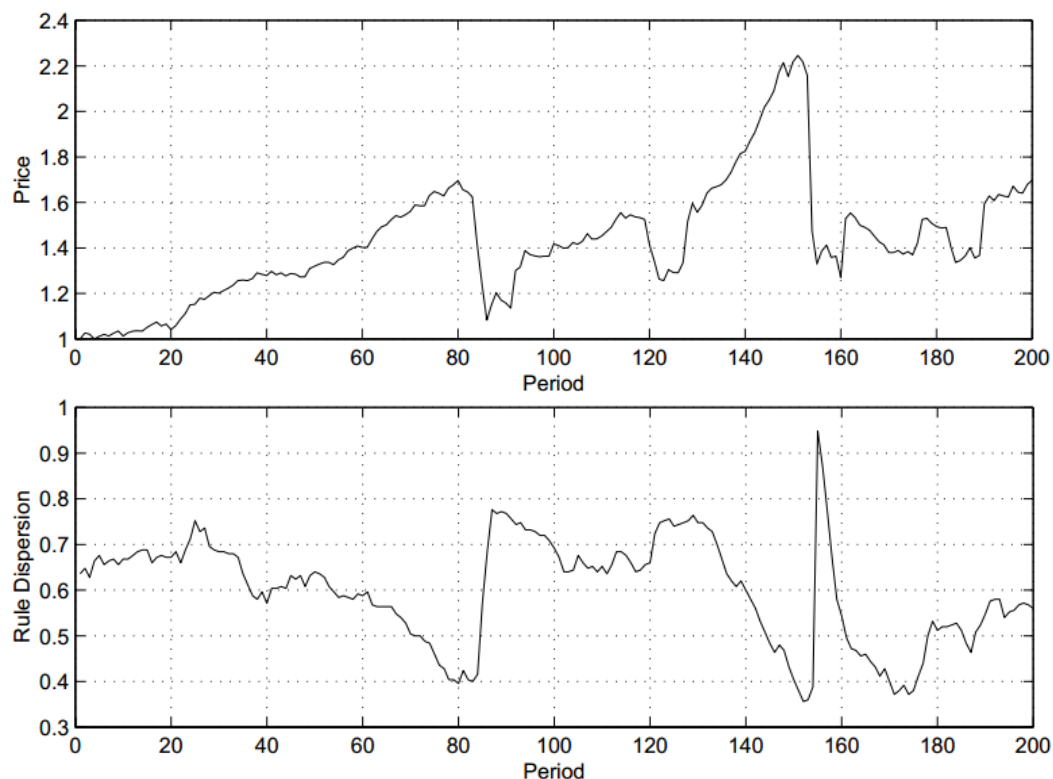
beauty of LeBaron's model is we can observe the interaction between diversity and asset prices.

LeBaron's model replicates many of the empirical features of markets, including clustered volatility, variable trading volumes, and fat tails. For the purpose of this discussion, the crucial observation is that sharp rises in the asset price are preceded by a reduction in the number of rules the traders used (see exhibit 5). LeBaron describes it this way:⁴³

During the run-up to a crash, population diversity falls. Agents begin to use very similar trading strategies as their common good performance begins to self-reinforce. This makes the population very brittle, in that a small reduction in the demand for shares could have a strong destabilizing impact on the market. The economic mechanism here is clear. Traders have a hard time finding anyone to sell to in a falling market since everyone else is following very similar strategies. In the Walrasian setup used here, this forces the price to drop by a large magnitude to clear the market. The population homogeneity translates into a reduction in market liquidity.

Because the traders were using the same rules, diversity dropped and they pushed the asset price into bubble territory. At the same time, the market's fragility rose.

Exhibit 5: Agent-Based Model of Asset Prices



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.

The model underscores some important lessons about behavioral inefficiency. The first is that as the agents lose diversity by imitating one another, the initial impact is that they get richer. This is why betting against a bubble is so hard. Positive feedback pushes price away from value and creates lots of paper gains along the way. Being wrong in the short term, even if you are correct in the long term, introduces career risk where poor results put a portfolio manager's job in jeopardy.⁴⁴

Second, the market's reaction to a reduction in diversity is non-linear. As diversity falls, the market's fragility rises. But the higher asset price obscures the underlying vulnerability. At a critical point, however, an incremental reduction in diversity leads to a large drop in the asset price. Crowded trades work until they don't.⁴⁵

Crowding not only induces mispricing, it also creates a lack of liquidity.⁴⁶ When the buyers are using the same rule and the population of sellers using different rules has nothing left to sell, the model reveals that the price has to drop sharply to clear the market. The non-linear relationship

between diversity and price makes the sharp decline appear shocking in retrospect.

How Beliefs Spread. The final lesson is how investor beliefs come to be correlated. There is a large body of research on this topic, but at the core you need to understand a model of how ideas or information propagate across a network.⁴⁷

Epidemiologists use a model to describe the spread of disease that is analogous to the spread of beliefs, including fads and fashions.⁴⁸ The model considers the degree of contagiousness, the degree of interaction, and the degree of recovery. The model's output is intuitive. The higher the contagiousness and interaction, the higher the likelihood that a disease or belief will spread.

Investors attempting to assess belief propagation in markets need to bear in mind a few points. First, it is inherently difficult to anticipate which ideas or products will be popular.⁴⁹ For example, film and music studios struggle to create hits.

Second, humans are inherently social and most have a desire to conform to the crowd's beliefs.

Scientists even have a sense of the neurobiological basis for conformity.⁵⁰ Informational cascades occur when individuals follow the decisions of those who precede them without regard to their personal information. For a fad or fashion, conforming means you won't stand out in a way that makes you uncomfortable.

In markets, diversity breakdowns often include both new investors participating and seasoned investors sitting it out. These new investors are commonly individuals.⁵¹ When individuals buy an investment or investment theme, the probability of a diversity breakdown rises. The dot-com boom and Bitcoin are two good illustrations. Likewise, when seasoned investors stop betting against the investment or investment theme, they contribute to the lack of diversity. With no countervailing opinion voting in the market, decision rules converge and diversity suffers.

But asset markets have an additional element: If you join the crowd early enough in the belief that an asset price is going up and buy accordingly, your wealth initially increases. This reinforces the notion that you made a good decision. The asset price influences you and makes you richer, which feels good. Until it doesn't.

Finally, investors feel the pressure to conform. The CFA Institute surveyed more than 700 investors and found that "being influenced by peers to follow trends" was the behavioral bias that affected decision making the most.⁵² It is difficult to beat your peers if you are doing the exact same thing that they are doing.

How does an investor effectively take advantage of behavioral inefficiencies?

- **Be mindful of sentiment and overextrapolation.** Using Graham's metaphor, Mr. Market is generally reasonable and price is roughly equivalent to value. But Mr. Market is prone to extremes. When sentiment is uniformly positive or negative, be prepared to visit the opposite side of the argument. But being a contrarian for the sake of being a contrarian is a bad idea, and the consensus can be correct.

- **Rely on valuation.** When markets go to extremes, valuations tend to follow. The crucial question is, "What expectations for future financial results are implied by the current price?"⁵³ When sentiment shifts are excessive, expectations become unduly high or low. Do the math. Figure out what you have to believe to justify the prevailing price, and compare that to plausible scenarios.
- **Lean on facts.** When an asset price is under the spell of extreme sentiment, make an effort to explicitly separate facts from opinions. A fact is information that is presumed to have objective reality and therefore can be disproved. An opinion is a belief that is more than an impression but does not meet the standard of positive knowledge. As a result, an opinion may be difficult to disprove. Both facts and opinions are useful for investors, but facts should rule the day.⁵⁴
- **Timing.** Behavioral inefficiencies can have different time cycles. For example, momentum tends to reverse over a relatively short period of time of less than a year. Large bubbles can take years to burst. A number of prominent value investors, including Julian Robertson at Tiger Management, closed their funds following the dot-com boom in the late 1990s. The main point is that taking advantage of behavioral inefficiencies can take more time than investment managers perceive they can afford.

Benjamin Graham offered what might be the best advice. 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.)"⁵⁵

Analytical Inefficiencies

An analytical inefficiency arises when all participants have the same, or very similar, information and one investor can analyze it better than the others can. Financial and non-financial information include items such as analyst earnings estimates and revisions, management forecasts, earnings management, sentiment, and insider trades.⁵⁶ An analytical edge versus other investors can arise from having more analytical skill, weighing information differently, updating views more effectively, operating on a different time scale, or anticipating a change in the market's narrative.

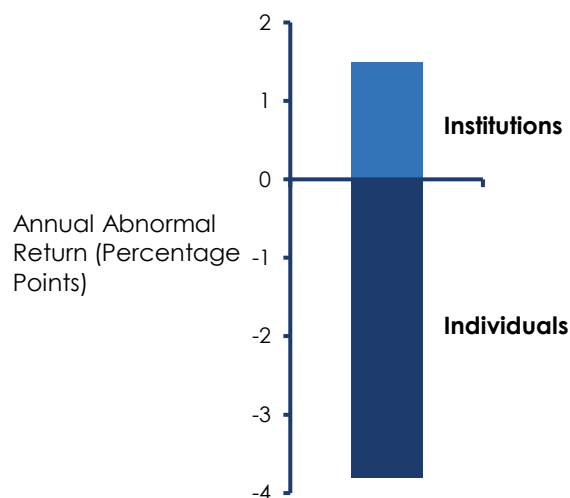
Analytical Skill. The game of tennis provides an analogy for understanding analytical skill.⁵⁷ Imagine a match between a tennis professional and a weekend warrior. They use the same equipment, play on the same court, and abide by the same rules. But the professional will have a better technique and strategy and will be prone to fewer errors. In the world of investing, institutions are the professionals and individuals are the weekend warriors.

Institutional investors generally beat individual investors when they go head-to-head, which means that individuals can be a good source of excess returns for institutions. A comprehensive survey of the behavior of individual investors noted that "the evidence indicates that the average individual investor underperforms the market—both before and after fees."⁵⁸

For the market as a whole, excess positive and negative returns must sum to zero before fees. The magnitude of positive and negative returns is associated with differential skill. A comprehensive study of all of the investors in Taiwan revealed that institutions earned abnormal excess returns of 1.5 percentage points while individuals lost 3.8 percentage points (see exhibit 6).⁵⁹ The individuals suffered from a lack of skill and an excess of confidence.

Institutions generally have better information and analytical skills than individuals do. For example, institutions tend to buy stocks from individuals in cases when the stock underreacts to good news about future cash flows, outperforming individuals by 1.4 percentage points per year in these cases.⁶⁰ In addition, initial public offerings with high participation rates by retail investors underperform those dominated by institutions.⁶¹

Exhibit 6: When Institutions Compete with Individuals, Institutions Tend to Win



Source: Source: 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. 2, No. 2, February 2009, 609-632.

Note: Returns are after commissions and transaction taxes and before fees.

Information Weighting. Another source of analytical edge exists when one investor has the same information as other investors but weighs the information differently. One simple analogy is sizing in portfolio construction. We each construct a portfolio using the exact same list of stocks. We have the same information. Our returns over time will be the result of how we weigh the positions. What distinguishes us is not what we have to work with but how we use what we have.

Our conviction in a particular hypothesis combines two types of evidence. The first is the strength, or extremeness, of the evidence, and the second is the weight, or predictive validity. For instance, say you have a hypothesis that a coin is biased in favor of tails. The ratio of flips that land on tails to those that land on heads indicates strength, and the number of flips, or sample size, reflects the weight.⁶²

There are formal rules for how to combine strength and weight correctly. But most people do not follow the theory. In particular, the strength of evidence tends to loom larger in decisions than the weight of evidence. As a result, a pattern of over- and underconfidence emerges (see exhibit 7).

Exhibit 7: Trade-Off between Signal Weight and Strength

		Strength (Extremeness)	
		Low	High
Weight (Predictive Validity)	Low	Not yet relevant	Over-confidence
	High	Under-confidence	Obvious

Source: Dale Griffin and Amos Tversky, "The Weighing of Evidence and the Determinants of Confidence," *Cognitive Psychology*, Vol. 24, No. 3, July 1992, 411-435.

When the strength is high and the weight is low, people tend to be overconfident. Continuing with the example of the coin toss, this would be the case when tails shows up 7 times in the first 10 flips (which will happen 12 percent of the time with a fair coin). The strength is high but the weight is low. This mechanism is consistent with the overconfidence and overextrapolation discussed in the behavioral section.

In particular, you should be very alert to the risk of overreacting to outcomes based on small sample sizes and a related concept, recency bias, which is the result of placing too much weight on recent events.⁶³ Surveys of investors and executives consistently show a strong inclination to incorrectly expect the near-term future to be similar to the recent past.

When strength is low and the weight is high, people tend to be under-confident. In this case, the signal is faint but meaningful because of the large sample size. It's one thing to have 7 tails out of 10 flips and another thing altogether to have 5,100 or more tails out of 10,000 flips (which will happen only about 2 percent of the time with a fair coin). The way to avoid this mistake is to consider base rates, or the results of an appropriate reference class.⁶⁴

Be a Good Bayesian. The next source of analytical edge is updating your views better than others. At issue is how well you integrate new information with your prior beliefs. The proper way to do this is to use Bayes's Theorem. The theorem tells you the probability that a theory or belief is true conditional on some event happening. But the truth is even people who know the theorem rarely apply it formally. What's

essential is to be open to new information and to be willing to change your mind.

The primary reason that we fail to sufficiently update our beliefs in light of new information is that we suffer from confirmation bias. The bias manifests in a couple of ways. We tend to seek information that confirms our belief and dismiss or discount information that disconfirms it. Further, we generally interpret ambiguous information in a way that is consistent with our prior belief. Once we believe something, the mistakes we make often serve to preserve our view.⁶⁵

Phil Tetlock, a professor of psychology at the University of Pennsylvania, raises some other common mistakes. One mistake is overreacting to information that superficially appears to explain causality but in fact does not. You see this in the analysis of merger and acquisition (M&A) deals. For example, equity analysts sometimes upgrade a stock following the announcement of an acquisition as the result of anticipated earnings accretion, only to see the stock drop. A change in earnings is not the best way to capture causality in M&A.

Overreaction to new information can also be the result of the contrast effect. The idea is that good news is perceived as more impressive than it should be if it is preceded by bad news, and less impressive than it should be if it follows good news. These are errors in perception that lead to mispricing, and a strategy to capture the contrast effect appears to generate excess returns.⁶⁶

Another mistake is for the decision maker to underreact to information that he or she fails to recognize as causal. Continuing with the theme of M&A, meaningful but underappreciated information includes a comparison of the present value of synergies with the premium pledged. This requires some modest calculations but is demonstrably more relevant than earnings changes based on accounting figures. Decision makers who are able to distinguish between what information matters and what doesn't have an analytical edge.

Time Arbitrage. As far back as the 1970s, Jack Treynor, an economist and luminary in the investment industry, discussed the idea that an investor can gain an edge by operating on a different timescale than others. Treynor distinguished:

between two kinds of investment ideas: (a) those whose implications are straightforward and obvious, take relatively little special expertise to evaluate, and consequently travel quickly (e.g., "hot stocks"); and (b) those that require reflection, judgment, special expertise, etc., for their evaluation, and consequently travel slowly . . . Pursuit of the second kind of idea . . . is, of course, the only meaningful definition of "long-term investing."⁶⁷

To explain why this opportunity exists, Treynor refers to John Maynard Keynes, the renowned economist, who adds two essential elements to the case. Keynes suggests,

The energies and skill of the professional investor . . . are, in fact, largely concerned, not with making superior long-term forecasts of the probable yield of an investment over its whole life, but with foreseeing changes in the conventional basis of valuation a short time ahead of the general public. They are concerned, not with what an investment is really worth to a man who buys it "for keeps", but with what the market will value it at, under the influence of mass psychology, three months or a year hence.

He goes on to emphasize how challenging it is to be a long-term investor:

Finally it is the long-term investor, he who most promotes the public interest, who will in practice come in for most criticism, wherever investment funds are managed by committees or boards or banks. For it is in the essence of his behaviour that he should be

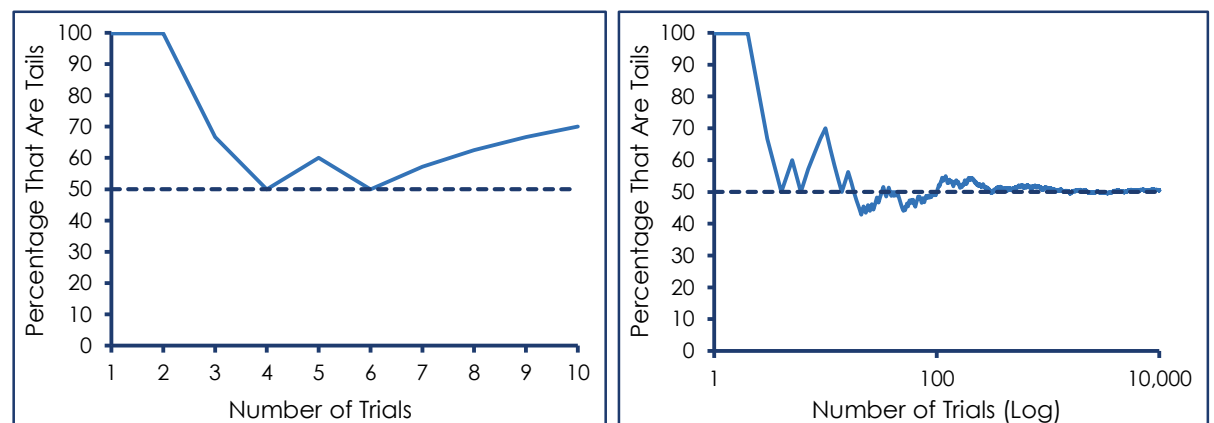
eccentric, unconventional and rash in the eyes of average opinion. If he is successful, that will only confirm the general belief in his rashness; and if in the short run he is unsuccessful, which is very likely, he will not receive much mercy. Worldly wisdom teaches that it is better for reputation to fail conventionally than to succeed unconventionally.⁶⁸

Both Treynor and Keynes emphasize the importance of time horizon and suggest that outsized returns are available to the long-term investor. But they make clear that long-term investing requires "reflection and judgment" and that those who practice it will "come in for most criticism." This is a blend of analytical and behavioral issues.

Investors use the term "time arbitrage" to reflect cases where the market reflects short-term noise as if it were long-term signal. Returning to the example of the coin toss, an opportunity for time arbitrage exists if the market prices a fair coin as if it is biased after 7 of the first 10 flips are tails.

There are three elements to successfully taking advantage of time arbitrage. The first is that the investor must be able to accurately separate signal from noise. In the coin toss example, the signal is an even split between tails and heads, and the noise is the appearance of a bias toward tails. The second is the signal must eventually reveal itself. That is, after lots of flips, the ratio of tails to heads settles very close to one-to-one (see exhibit 8). The third is you must have access to capital that is sufficiently patient to allow the results to materialize.

Exhibit 8: A Simple Model of Time Arbitrage



Source: BlueMountain Capital Management.

There are two related reasons opportunities arise with regard to time horizon. The first is a concept called “myopic loss aversion,” developed by the economists Shlomo Benartzi and Richard Thaler. Benartzi and Thaler tried to address the empirical puzzle of why the equity risk premium, the premium for owning stocks versus less-risky bonds, is higher than theory would suggest.⁶⁹

Benartzi and Thaler attempt to explain the historical equity risk premium by combining two ideas. The first is loss aversion, which says humans suffer losses roughly twice as much as they enjoy equivalent gains.⁷⁰ That you should be twice as upset at losing \$100 as you are happy at winning \$100 is inconsistent with classical utility theory.

The second idea is myopia, which means “nearsightedness.” This reflects how frequently you look at your investment portfolio. The stock market tends to go up over time, but it rises by fits and starts. Based on nearly a century of data, the probability you will see a gain in your diversified U.S. stock portfolio is roughly 51 percent for a day, 53 percent for a week, and 75 percent for a year. Look out a decade or more and the probability of a profit is very close to 100 percent.

Both ideas are well established on their own, but together they address the issue of investor time horizon in a new way. The more frequently an investor looks at his or her portfolio, the more likely he or she is to observe losses and suffer from loss aversion. As a result, an investor examining his or her portfolio all the time requires a higher return to compensate for suffering from losses than one who looks at his or her portfolio infrequently and hence suffers less. A long-term investor is willing to pay a higher price for the same asset than is a short-term investor.⁷¹ Evidence from the field suggests that professional investors are not immune from myopic loss aversion.⁷²

The portfolio evaluation period consistent with the realized equity risk premium from 1926 through 1990 was about one year. Investors may not be able to select their degree of loss aversion, but they can select how frequently they evaluate their portfolios. Using a simulation technique grounded in realistic parameters, researchers at the investment firm Renaissance Technologies found that the evaluation period that worked best was longer than three years. They summarize their analysis by noting that “the most profitable degree of patience is very different from that found in current industry practice.”⁷³

The second idea related to opportunity and time horizon is that we differ in our degrees of loss aversion, and the degree we suffer changes as the result of recent experience. You can gain an analytical edge by making consistent decisions with regard to the opportunity set.

One fascinating experiment showed how hard that is to do.⁷⁴ Researchers created a simple investment game and drew players from two groups: patients with brain damage and ordinary subjects. The patients with brain damage had normal intelligence, and no harm was done to the regions of their brains that handled logic and cognitive reasoning. The regions of the brain that were harmed controlled emotions, including the usual ability to experience fear or anxiety. They didn’t suffer after they lost.

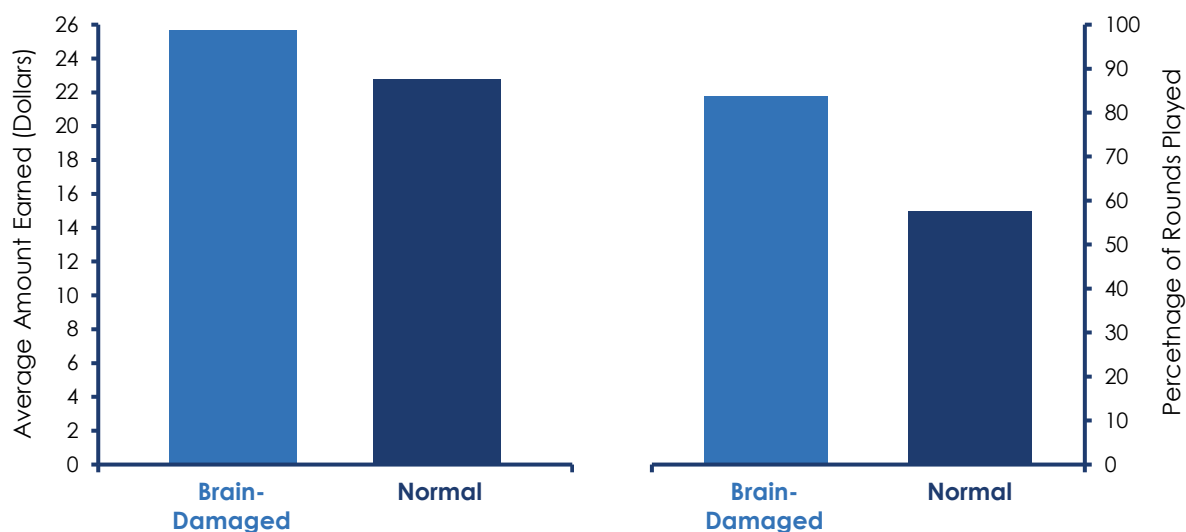
The researchers gave each participant \$20, and the game consisted of 20 rounds of coin tosses. For each round, individuals could play or sit out. If they played, they passed \$1 to the experimenter who flipped a fair coin and paid \$2.50 for tails and nothing for heads. The subjects got to keep their dollar if they sat out the round. The objective was to end up with as much money as possible.

The game is not hard to figure out. The expected value of handing \$1 to the experimenter is \$1.25, higher than the value of keeping it. The ideal strategy is to invest in every round. All of the participants appeared to grasp the basic math.

But the patients with brain damage ended up with 13 percent more money, on average, than the normal patients did. The difference was the subjects with brain damage participated in 45 percent more rounds than did the players in the control group. In particular, the brain-damaged subjects played roughly 80 percent of the rounds after having lost compared to the 40 percent played by ordinary participants (see exhibit 9).

Nearly all of the players participated in the early rounds. But an interesting pattern emerged. Normal players appeared to suffer from loss aversion after they lost a round and sat out subsequent rounds at a higher rate than the patients with brain damage who did not suffer from loss aversion. Loss aversion caused normal participants to forgo a positive expected value bet after having lost when a heads appeared on a toss. Even though the financial proposition was consistently attractive, the recent experience of the normal participants colored their actions.⁷⁵

Exhibit 9: Loss Aversion Leads to Suboptimal Decision Making



Brain-damaged subjects make more money . . . because they play more rounds.

Source: Baba Shiv, George Loewenstein, Antoine Bechara, Hanna Damasio, and Antonio R. Damasio, "Investment Behavior and the Negative Side of Emotion," *Psychological Science*, Vol. 16, No. 6, June 2005, 435-439.

Here is a final thought on long-term investing. Gathering information and reflecting it in stock prices is a costly endeavor. Long-term investing allows a shareholder to amortize that cost over an extended holding period. As Cliff Asness, founder, Managing Principal, and Chief Investment Officer at AQR Capital Management, has said, "Having, and sticking to, a true long term perspective is the closest you can come to possessing an investing super power [sic]."⁷⁶

The Power of Stories. The concluding possible source of analytical edge is anticipating how the narrative about a company will change, leading to a revision in the valuation the market accords the stock. The change in a stock price over time reflects a change in expectations. Fundamental results, including sales growth and profits, exert a large influence in shaping expectations. But the stories that investors tell, and believe, also play a meaningful role in revisions of expectations.⁷⁷

Psychologists have shown that "alternative descriptions of the same event often produce systematically different judgments."⁷⁸ A debate between Aswath Damodaran, a professor of finance at the Stern School of Business at New York University and a recognized expert in valuation, and Bill Gurley, a leading venture

capitalist at Benchmark Capital, serves as a good example. Both are believers in valuing businesses using a discounted cash flow model.

In June 2014, Damodaran suggested a valuation for Uber, an online transportation network, of \$5.9 billion. His analysis came on the heels of a round of fundraising that valued the company at \$17 billion. In July 2014, Gurley, whose firm was an early investor, responded with a piece called "How to Miss By a Mile," suggesting that Damodaran considered a total addressable market that was too small.⁷⁹ At the heart of their disagreement was a description: the professor thought Uber was going after the global taxi and car-service market and the venture capitalist assumed vastly more cases for using Uber, including replacing the need to own a car.

At the end of the day, the value of a company's stock is the cash it distributes to its shareholders over the company's life. But a company's stock price along the way can contribute to the company's reputation, capacity to raise capital, and ability to pay employees with equity. Damodaran and Gurley agreed on the tools of analysis but differed on the narrative to drive the analysis.

How does an investor effectively take advantage of analytical inefficiencies?

- **Find easy games.** The idea is to find situations where you have more analytical skill than your competitors. We highlighted the case of institutions competing against individuals. Research shows that “dumb money” creates market anomalies that the “smart money” can correct.⁸⁰
- **Weight available information effectively.** Be mindful of how you combine the strength, or extremeness, of a signal with its weight, or predictive value. We tend to fall for the recency bias, placing too much weight on recent events and not enough weight on a fuller series of results. The key is to learn how to blend the inside view, our assessment based on our own circumstances and experience, with the outside view, the outcomes for the appropriate reference class.
- **Update effectively.** Once we have made up our mind, the confirmation bias often blocks our ability to update our views when new information arrives. And even when we incorporate new information, we commonly under- or overestimate its significance. One means to deal with this is to write down the signposts you expect to see, including probabilities, if your thesis unfolds as you expect. Use those signposts to examine whether your thesis remains intact or you have to change your mind.
- **Make time your friend.** An investment process can be tailored to a long- or short-term holding period. Jack Treynor argued that “slow traveling” ideas, those that require reflection, judgment, and special expertise, are the impetus for long-term investing. Taking a long view is difficult because of client pressures and career risk. Indeed, stress encourages us to shorten our time horizon and can lead us to suffer even more because of loss aversion.⁸¹
- **Recognize the power of stories.** We know that different descriptions can lead to different decisions. Insight into how the story about a company may change over time will allow you to anticipate material changes in valuation. Reported fundamentals matter, but so do the stories that the investment community tells.⁸²

Informational Inefficiencies

An information inefficiency arises when some market participants have different information than others and can trade profitably on that asymmetry. As Grossman and Stiglitz pointed out, gathering information relevant to value can be expensive and investors who do so can reasonably expect to earn excess returns. But regulation has ensured that companies disclose and disseminate information uniformly, and technology makes it quick and cheap to do so. As a consequence, the cost of gathering legal, non-traditional information has escalated.

An informational edge can take a few forms. The first is to legally acquire relevant information that others don't have. Second, there is substantial evidence that attention is costly and that some inefficiencies arise from limited attention as a result. Paying attention to the right information can provide edge. Finally, there is research that shows that complexity slows the process of information diffusion, so anticipating the impact of information can confer edge.

Find Out First. The first and most obvious source of informational edge is to know things relevant to value that others don't yet know. It is useful to distinguish between data and information. Data is the plural of datum, which means "something given." Data need not be useful. Information organizes data in a way that is useful. Technically, information reduces uncertainty. Access to data does not confer an informational edge. An ability to translate data into information, or access to information directly, can be a source of edge. This source of edge may be linked to size and scale. Bigger investment firms can amortize the cost of data and have the ability to turn it into information more cost effectively than smaller firms can.

There is no doubt that some investors generate excess returns by acquiring information that other investors don't have. For example, some hedge funds made lots of money by using the Freedom of Information Act to collect non-public information about pharmaceutical companies from the U.S. Food and Drug Administration.⁸³ You can imagine a host of innovative, if costly, means to acquire useful information, including hiring top law firms to interpret legal issues, working with consultants to grasp political dynamics, or engaging a firm that specializes in analyzing

storm damage to assess the potential costs. There has been an explosion in data gathering, from credit card receipts to satellite images counting cars in parking lots, which has created an arms race in the investment community.

The mosaic theory, which the legendary investor Phil Fisher called "scuttlebutt," describes an approach that gathers public and non-public information from a variety of sources, including suppliers, competitors, customers, and former employees in an attempt to create an edge.⁸⁴ The value in the approach relies not on a single piece of information but rather on how various pieces of information combine to form a view that is different from that of the market. The synthesis of information is more important than any one bit of information.

Consistent with Grossman and Stiglitz, there is a high cost and benefit of information gathering. Investors who can translate information into asset prices benefit by earning excess returns. Society benefits by having asset prices that are more efficient.

Regulation has focused on making access to corporate information uniform. Regulation Fair Disclosure (Reg FD) was implemented in October 2000 in the United States. Reg FD prohibits companies "from privately disclosing material information to select investors or securities markets professionals without simultaneously disclosing the same information to the public."⁸⁵ On balance, the evidence shows the implementation of Reg FD led to greater informational efficiency and that some investment firms that had previously benefited from privileged disclosure lost an informational edge.⁸⁶

There is illuminating evidence of Reg FD's effect on market efficiency. When enacted in 2000, credit rating agencies were exempt from the regulation. That meant credit analysts had access to confidential information unavailable to equity analysts. In 2010, the Dodd-Frank legislation repealed that exemption. The research shows that the informational effect of bond rating upgrades and downgrades was greater after Reg FD than before it, and that the effect faded after the credit agencies lost access to that privileged information in 2010.⁸⁷

Another source of asymmetric information that leads to wealth transfers is the repurchase and issuance of equity by corporations. Generally speaking, firms buy back stock when it is undervalued and issue stock when it is overvalued, which benefits ongoing shareholders at the expense of the shareholders who sell or buy. Companies are able to do this because executives have better information about the company's prospects than investors do. Speaking to the relevance of this information asymmetry and the potential for excess returns, the economists who did this research suggest that "these wealth transfers can be predicted using a variety of firm characteristics and that future wealth transfers are an important determinant of current stock prices."⁸⁸

Pay Attention. On Sunday, May 3, 1998, the *New York Times* published an article on the front page about a potential breakthrough in cancer treatment via an injection of drugs that halt the blood supply to tumors. The article mentioned Entremed, a company that had the licensing rights to the technology.⁸⁹ The next day, the stock skyrocketed from around \$12 to more than \$51 per share on volume 78 times the daily average. The elevated stock price persisted through the rest of the year.

What makes this story remarkable is that the science magazine, *Nature*, and the *New York Times* ran stories covering the substance of this research in late 1997.⁹⁰ There was no new news.

This brings us to our second source of informational edge: paying attention.⁹¹ There is substantial evidence that investors have limited attention and hence do not incorporate all available information. This presents opportunity to investors who can assimilate relevant information.

One simple model is based on the fraction of investors who are inattentive. When that fraction is very low, markets tend to be informationally efficient. When that fraction is high, asset prices fail to reflect available information and an opportunity for a variant perception arises.

Research in psychology suggests that a few factors determine the fraction of inattentive investors, including the salience of the information, the resources investors use to address the information, and how easily investors can process the information. In general, investors have a harder time paying attention the more

stimuli they face that competes for that attention. Information can get lost in the shuffle.

You can think of the process of making investment decisions in two parts. The first relates to attention and the second relates to preferences. Researchers found that individual investors, in particular, are drawn to stocks that grab attention. For example, stocks that host Jim Cramer recommends on the television show *Mad Money* enjoy large short-term gains.⁹² As a result, investment decisions can be more sensitive to the choice of what investors pay attention to than to their preferences. This effect is much less pronounced with institutional investors, who have more time and can allocate their attention with more rigor.⁹³

Task Complexity. Task complexity is the final source of informational edge. As Lee and So summarize in their survey paper, "Signal complexity impedes the speed of market price adjustment." The idea is that the market takes longer to digest new information when the implications are not obvious than when they are obvious.

To study this concept, financial economists examined how new information about an industry affected companies with a single business versus conglomerates with multiple businesses. The authors provide a hypothetical example of new information that reveals that chocolate consumption improves longevity. The stock price of a company that is in the chocolate business only would react more quickly than the stock of a conglomerate that has a fraction of its business in chocolate. The economists "find strong evidence that easy-to-analyze firms incorporate industry information first, and hence their returns strongly predict the future updating of firm values that require more complicated analyses."⁹⁴

Another case of task complexity is how the market reacts to information related to trading partners in a supply chain. In cases when two companies have businesses that are related, for example one supplies the other, the market reflects new information about the first company into the stock of the second company with a lag. Investors can generate excess returns purchasing shares of the supplier following the release of positive news about its customer.⁹⁵

How does an investor effectively take advantage of informational inefficiencies?

- **Gather legal information that others do not have.** This source of edge is very difficult to attain and is potentially very costly. Capturing information that the market has yet to digest produces excess returns for the investor and creates a benefit for society in the form of more efficient prices. A related idea is to capture lots of weak signals that, when combined, generate a strong signal.⁹⁶
- **Recognize that not all information is immediately reflected in prices.** Investors have limited attention, and hence information that is relevant to value is not always immediately expressed in stock

prices. Information that garners lots of attention tends to be assimilated more readily than information that is more subtle.

- **The less direct the impact, the slower the market may be to reflect information.** While it is generally reasonable to assume that information is rapidly reflected in prices, evidence shows that the market is less efficient at incorporating information if the task of doing so is complex. Informational edge may arise from seeing the implication of new information on parts of the market where the impact is not obvious immediately.

Technical Inefficiencies

A technical inefficiency arises when some market participants have to buy or sell securities for reasons that are unrelated to fundamental value. Laws, regulations, contracts, and internal policies may impose rules that shape the actions of certain institutions. These actions may make sense for an individual firm but can create inefficiency. Further, some trades are prompted by limits, requirements, or constraints that the buyer or seller cannot avoid.

Here is a simple example. William Sharpe, an economist who won the Nobel Prize in 1990, wrote a paper about active management that advances two basic arguments. The first is that the return on the average dollar managed actively will equal that of a dollar managed passively before costs. The second is that the return on the average dollar managed actively will be less than that of a dollar managed passively after costs.⁹⁷

Sharpe's analysis, while practical, ignores the fact that index funds have to buy and sell securities in order to reflect actions including stock sales and purchases by companies, as well as inclusions and deletions from the index. The annual cost of this trading is estimated to be as low as 20 basis points for funds that track well-known equity indexes and can be larger for bond funds.⁹⁸ A similar argument applies to the arbitrage costs of keeping the price equal to the net asset value for exchange-traded funds.⁹⁹ We need active managers to take the other side of these trades.

There are a few examples of opportunity for technical edge. Importantly, each case requires access to capital. One is to be on the other side of forced sellers or buyers. For example, some investors receive margin calls following a drawdown and have to sell assets. Second is to consider the opposite side of securities perturbed by investor fund flows. In this case, investment managers have to buy or sell securities and do so with a predictable pattern. The final opportunity is to step in when traditional arbitrageurs have limited access to capital and hence fail to fulfill their normal function.

Forced Buyers or Sellers. A straightforward example of forced sellers is insurance companies that must own investment-grade bonds. Indeed, many insurance companies have portfolios that look similar. Regulatory requirements compel

insurance companies to sell bonds that the credit agencies downgrade from investment grade to high yield. Research shows that these fire sales lead to an increase in yield spreads beyond what the fundamentals justify. This creates a temporary mispricing, which tends to get corrected within months of the event.¹⁰⁰

The leverage cycle, developed by John Geanakoplos, a professor of economics at Yale University, provides a useful framework for understanding forced selling. Central to Geanakoplos's argument is that to understand booms and crashes, the ability to borrow is more important than the level of interest rates.¹⁰¹

One measure of the ability to borrow is the amount of debt, relative to equity, a buyer can access to buy an asset. When the equity amount is low and the debt amount is high, the ability to borrow is easy. Leverage availability is procyclical. It tends to be easier to borrow after asset prices are up and harder to borrow after they are down.

Geanakoplos argues that some buyers place a higher value on an asset than others for a host of potential reasons, including more optimism and higher risk tolerance. These optimists use debt to bid up asset prices when leverage is easily accessible.

Optimistic buyers who have bid up asset prices fueled by debt create a setup for a crash. First, asset prices drop because of bad news, which heightens volatility, uncertainty, and disagreement. The price decrease commonly follows a sharp price increase.

The initial drop in asset prices triggers a big decline in the wealth of optimistic asset owners. The drawdown in asset prices forces the optimists to sell assets to meet their margin requirements. This leads to additional declines in asset values, which triggers further selling, and so forth. These optimistic asset owners are selling for reasons that are unrelated to their view of fundamental value.

Before prices find a new equilibrium, lenders make borrowing harder by requiring owners to put up more equity against their assets. This wipes out some buyers, leaving even fewer investors to support asset prices. Spillovers, when owners in one asset class cover their losses by selling assets in other classes, become a risk. Investors who

survive or can step in have a technical edge and can exploit an attractive opportunity.

The leverage cycle shows that asset prices can drop meaningfully below fair value because of forced selling stemming from margin calls and more stringent margin requirements. This is a fire sale.¹⁰² This creates a technical edge for investors who can take the other side of the sale.

The Importance of Fund Flows. Technical edge can also arise from funds buying or selling specific securities as a result of investor inflows or outflows. Here's the basic outline.¹⁰³ Investors tend to give money to investment funds that have done well and withdraw money from investment funds that have done poorly. Investment managers who receive additional capital tend to buy the securities they already own, and those who face withdrawals have to sell securities in the portfolio.

As a result, positive flows tend to create positive price pressure and negative flows create negative price pressure. These effects are particularly pronounced for securities that are hard to trade and hence have a high cost of liquidity. This adds or detracts from fund results in the short run, but the price effects reverse within months or in some cases years. One analysis concludes that one-third of hedge fund excess return, or alpha, is attributable to investor flows.¹⁰⁴

One of the ways we can think about "Who is on the other side?" is by sorting between trades induced by fundamental value and those induced by liquidity. Stocks bought or sold for fundamental reasons reveal "stock-picking skill," while stocks traded for liquidity reasons exhibit "negative performance effects."¹⁰⁵ There is some evidence that sophisticated funds already take advantage of this technical inefficiency.¹⁰⁶

When Arbitrageurs Fail to Show Up. A technical inefficiency can also arise when arbitrageurs have insufficient capital to close gaps between price and value. With pure arbitrage, an investor buys and sells identical assets that have different prices, say gold in London and New York, and locks in a profit. There is no risk and no capital needed. These opportunities are scarce. With risk arbitrage, an investor buys and sells assets but is not assured a profit, hence the introduction of "risk."¹⁰⁷ Arbitrageurs are plentiful in the investment community, and under normal conditions they have sufficient capital to profitably remove divergences between price

and value. But they do not have unlimited capital.

Professional arbitrageurs are generally agents. Their capital comes from principals such as wealthy individuals, endowments, or pension funds. They negotiate with prime brokers to set the amount and cost of leverage they can use. History shows that both principals and lenders retrench in instances of extreme stress, and meaningful arbitrage opportunities persist. This can create advantage.

Long-Term Capital Management (LTCM) is a case study that incorporates many of the sources of inefficiency we have discussed. Founded in 1994, LTCM enjoyed compound annual returns in excess of 30 percent in its first 4 years, but effectively went bust in 1998. The demise was the result of exposure to Russia, which devalued its currency and defaulted on its debt, in August 1998, and losses in highly leveraged positions, among other issues. A consortium of banks bailed out the fund and eventually liquidated it at a modest profit.

One aspect of LTCM's troubles that tends to get short shrift is the degree to which other funds and banks mimicked the fund's positions. Consistent with Blake LeBaron's agent-based model, other financial institutions copied LTCM's trades, hence making them crowded and increasing the market's fragility. Also similar to LeBaron's model, imitation was a benefit to returns early on but made finding new profitable trades more difficult.

In July 1998, Sandy Weill, then CEO of the Travelers Group, decided to shut down the U.S. arbitrage desk of Salomon Brothers. Travelers had acquired Salomon in the fall of 1997 and had just agreed to merge with Citicorp. Salomon decided to let a separate group within the firm liquidate the arbitrage book, which meant that the process of unwinding the positions was quicker and lost more money than would normally be the case. This created stress for LTCM and other firms that had similar trades.¹⁰⁸

Leverage also played a role in LTCM's demise. The leverage ratio at the firm was 27-to-1 in early 1998, which means the firm borrowed roughly \$96 to finance an investment of \$100. Many of LTCM's positions demanded and justified high leverage in order to generate satisfactory returns, and that leverage ratio was equivalent to the average of the five largest investment banks at the time.

Substantial leverage can make sense for convergence trades that have low risk and are part of a well-diversified portfolio. Using five-year historical data, the correlation between LTCM's positions was less than 0.10 through early 1998 (where zero means there is no correlation at all and 1.0 means perfect correlation). To stress test the portfolio, LTCM's risk managers assumed the correlations could reach 0.30, a figure they deemed improbable. The correlation skyrocketed to 0.70 as the crisis unfolded, rendering traditional risk management tools essentially useless.¹⁰⁹

By early September 1998, after having lost 44 percent of its capital in August, LTCM sent out a communication to its clients that the opportunity set looked unusually attractive. The missive immediately became public. Rather than having the intended outcome of securing additional capital, it created additional pressure on LTCM's positions and sparked concern among counterparties. In so doing, LTCM is also a vivid example of the leverage cycle.

The story of LTCM reveals how technical inefficiencies arise as the result of a lack of well-capitalized arbitrageurs. While the conditions were extreme, these episodes occur in markets from time to time. Access to capital is key to the ability to take advantage of these chances.

Before leaving the topic of technical inefficiencies, it is worth mentioning two other areas: spin-offs and the impact on stock prices of adding and removing stocks from prominent indexes. Both have been sources of opportunity historically, but they appear to be more muted opportunities today. It is worth watching each, especially spin-offs, for potential technical edge.

A spin-off is the result of a distribution of shares of a wholly-owned subsidiary to a parent company's shareholders on a pro-rata and tax-free basis. Joel Greenblatt, founder of Gotham Capital, explains that the opportunity for technical edge arises because, "Once the spinoff's shares are distributed to the parent company's shareholders, they are typically sold immediately without regard to price or fundamental value."¹¹⁰

Historically, spin-offs have created value on average for the companies spun off as well as the parents.¹¹¹ One meta-analysis of the literature on spin-offs summarized their findings by saying: "The main conclusion is consistent: spin-offs are

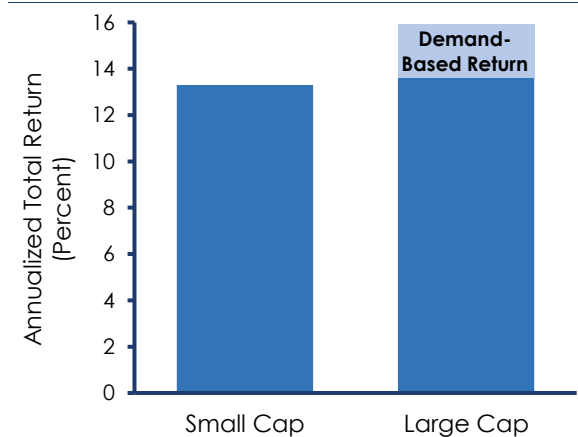
associated with strongly significant abnormal returns." Factors that contribute to this value creation include sharpened corporate focus, better information for investors, enhanced merger and acquisition opportunities, and in some cases tax treatment.¹¹²

As good of an investment opportunity that spin-offs have been historically, they have not delivered as much value in recent years. For example, the Invesco S&P Spin-Off ETF (CSD) has lagged the S&P 500 by about 17 percentage points cumulatively in the 2 years ended December 2018. That said, spin-offs potentially combine analytical, informational, and technical inefficiencies and are worth monitoring in the search for edge.

In classic economic theory, demand curves for stocks are close to flat by means of arbitrage between perfect substitutes. Because there are few perfect substitutes in the world, stocks and other assets are subject to demand shocks. If the demand curve shifts up, the stock price has to rise to clear the market.

Demand shocks can have a meaningful impact on asset price valuation. For instance, financial economists showed that the institutionalization of investment management in the 1980s and 1990s led to demand for large capitalization stocks. By their estimate, this demand contributed 230 basis points to the aggregate 260 basis point outperformance of large capitalization versus small capitalization stocks from 1980 through 1996 (see exhibit 10).¹¹³

Exhibit 10: Demand Shock and Large Cap versus Small Cap Performance (1980-1996)



Source: Paul A. Gompers and Andrew Metrick, "Institutional Investors and Equity Prices," *Quarterly Journal of Economics*, Vol. 116, No. 1, February 2001, 229-259.

One of the ways that financial economists study demand curves for stocks is through inclusions and deletions from prominent indexes such as the S&P 500. Inclusion in the index, for example, creates demand from index funds with no change in the fundamentals of the company. This is a textbook case of a technical inefficiency, where index funds have to buy for reasons that have nothing to do with value.

The substantial body of research on this topic shows that demand curves slope down and as a result inclusion into an index has a positive, if temporary, impact on the stock price.¹¹⁴ However, more recent work suggests that effect has become much more muted in the past decade, reflecting greater transparency and lower transaction costs.¹¹⁵ Index funds have to buy and sell in order to be aligned with the index itself. But the big index funds do this very efficiently.

How does an investor effectively take advantage of technical inefficiencies?

- **Be on the lookout for forced sellers.** From time to time, certain market participants are compelled to buy or sell securities without regard for fundamental value. The unwinding of the leverage cycle, where optimistic buyers have to sell as the result of margin calls, is a good example.

- **Watch investor flows and the buying and selling that results.** The basic story is that inflows are the result of good short-term returns and that managers who receive inflows generally buy more of what they own, which itself creates a near-term boost. Outflows generally follow poor performance, and managers have to sell what they own.
- **Seek situations where arbitrageurs are stretched.** Under normal conditions, arbitrageurs do a very good job of aligning price and value. But from time to time, arbitrageurs lack access to the capital they need to close gaps between price and value.
- **Keep an eye on spin-offs.** For a long time, spin-offs have been a great illustration of a technical inefficiency. But in recent years, perhaps as a result of the publication of these results, spin-offs have not fared as well. Still, we believe it is worthwhile to evaluate spin-offs as they are announced to see if an informational or analytical opportunity exists.

Summary

Markets cannot be fully informationally efficient because there is a cost to gather information and reflect it in asset prices. The degree of efficiency is a function of how difficult it is to acquire information and the friction associated with buying and selling securities to capture value.

There is a continuum of efficiency across countries and asset classes. Exhibit 11 summarizes some of the qualitative determinants of efficiency, most of which are discussed in the report.

There are quantitative methods to assess the degree of efficiency, including a measure of

entropy, or lack of predictability.¹¹⁶ David Swenson, chief investment officer of the Yale endowment, proposes a simpler measure based on the distribution of returns for active managers.¹¹⁷ His notion is intuitive: asset classes that have a wide dispersion of returns for active managers tend to have more opportunities, and hence are less efficient, than those that have narrow dispersion. Exhibit 12 shows dispersion based on annual returns, net of fees, for a dozen asset classes. Dispersion is highest for venture capital and lowest for taxable bond portfolios.

Exhibit 11: Market Efficiency Continuum

Less efficient

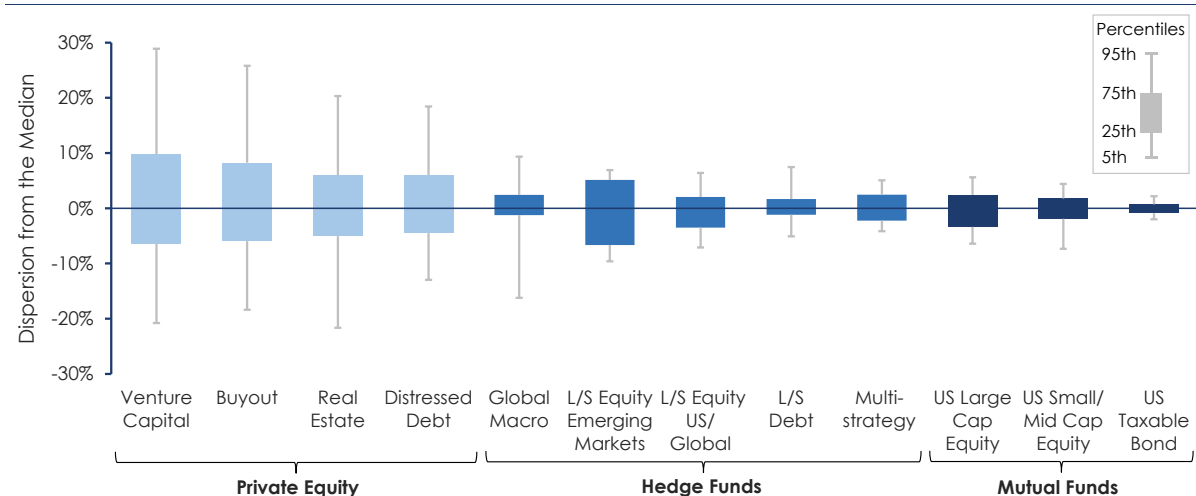
Limited analyst coverage
Information is complex
Low investor diversity (crowded)
Market extrapolates noise
Recent market extreme (fear or greed)
Forced buyers or sellers
Few substitutes
Constrained ability to short
Costly to finance
Arbitrageurs have limited access to capital

More efficient

Lots of analyst coverage
Information is straightforward
High investor diversity
Market reflects signal
Neutral market conditions
Natural flow of buyers and sellers
Lots of substitutes
Easy to short
Cheap to finance
Arbitrageurs well financed

Source: BlueMountain Capital Management.

Exhibit 12: Dispersion of Returns for Active Managers in Various Asset Classes



Source: Preqin and Morningstar Direct.

Note: L/S=long/short; Calculations for private equity investments based on net internal rate of return since inception for vintage years 2000-2015; Calculations for hedge funds and mutual funds based on trailing 5-year annualized returns through 12/31/2018 using returns net of expenses with income reinvested.

We categorize market inefficiencies in four areas: behavioral, analytical, informational, and technical. There is overlap between these categories. Behavioral inefficiencies are likely the most enduring because human nature has not changed much over time and is unlikely to change much in the future. Behavioral inefficiencies are also among the most difficult to capture because of our individual tendencies to stick with the crowd and due to pressure from clients during inevitable periods of underperformance.

To generate excess returns, investors should be skillful and seek easy games.¹¹⁸ In investing as in

poker, the key to winning is participating in a game where there is differential skill and you are the most skilled player. This is a challenge because markets are generally highly competitive, low-skill games are often small, and agency costs commonly compel the wrong behaviors.

The main goal of this report is to encourage a good answer to the question of "Who is on the other side?" A further objective is to understand how an investment firm is organized, including its alignment with clients, so as to have the greatest opportunity to take advantage of pockets of inefficiency.

Checklist for Identifying Market Inefficiencies

<input type="checkbox"/>	Are investors overextrapolating from recent results, leading to unrealistic expectations?
<input type="checkbox"/>	Is there evidence of performance chasing in a security, sector, or asset class?
<input type="checkbox"/>	Do sentiment indicators suggest extreme fear or greed?
<input type="checkbox"/>	Do investors have correlated views that create fragility in the market?
<input type="checkbox"/>	Do you have a different time horizon, allowing you to take advantage of time arbitrage?
<input type="checkbox"/>	Are you more analytically skillful than the other investors you are competing with?
<input type="checkbox"/>	Are you placing different, and more precise, weights on information?
<input type="checkbox"/>	Are you accurately updating your views based on new information?
<input type="checkbox"/>	Do you have reason to believe that the story about a security will change?
<input type="checkbox"/>	Do you understand a complex investment opportunity better than others?
<input type="checkbox"/>	Have you legally acquired information that other investors don't have?
<input type="checkbox"/>	Are you paying attention to all relevant information?
<input type="checkbox"/>	Are you trading with forced buyers or sellers?
<input type="checkbox"/>	Can you take the other side of fund flows?
<input type="checkbox"/>	Can you step in when arbitrageurs are tapped out?

Appendix A: Agency Theory in Asset Management

In the 2001 address to the American Finance Association, Franklin Allen, a professor emeritus of finance at the Wharton School at the University of Pennsylvania, drew attention to a puzzling dichotomy: the role of institutions is central to the study of corporate finance but is nearly absent in the study of asset pricing.¹¹⁹ For example, researchers have extensively studied agency theory, which considers potential conflicts between principals (owners) and agents (those who make decisions on behalf of principals), in corporate finance for decades. Yet agency theory is rarely used in academic work on asset pricing, including the CAPM model and the Black-Scholes options pricing model.

There is an edifying distinction in asset management between the business of investing and the profession of investing.¹²⁰ The business of investing dwells on generating profit for the investment firm, often by growing assets under management and charging healthy fees. The profession of investing focuses on managing portfolios to maximize long-term, risk-adjusted returns. Of course, a vibrant business is essential to the profession if only to attract and retain talent. Agency costs arise when an investment firm prioritizes the business over the profession. Pointing out this principal-agent problem may be useful, but it says little about actual asset pricing.

There are a couple of plausible reasons that the principal-agent problem and financial institutions do not play a large role in asset-pricing models. The first is that there was not much of a principal-agent problem as asset pricing theory developed. For instance, individuals directly owned more than 90 percent of equities in the United States in 1950 and still owned just under 50 percent in 1980.¹²¹ At the time that core theories about asset pricing were established in the 1960s and 1970s, financial institutions were simply not the dominant factor that they are today. A lack of agents led to a lack of agency theory for asset pricing.

The other reason reflects the theoretical foundations for the efficient market hypothesis.¹²² There are essentially three ways to get to efficient markets. The first is to assume that investors are rational, which means they understand their preferences and the distribution of asset price returns, and they know how to make an optimal trade-off between risk and reward.

No one believes investors can actually do this, but it may be a useful model to the extent the market behaves as if this is what is going on. Milton Friedman, who was a professor of economics at the University of Chicago and won the Nobel Prize in 1976, used the analogy of an expert billiards player. His point is that the billiards player is certainly not solving “complicated mathematical formulas” to sink her shots but you can make good predictions about her results by assuming that she does.¹²³ The market’s empirical results, especially at extremes, undermines this argument.

Another way to get to efficient markets is to assume that a smart subset of investors, arbitrageurs, cruise markets and close gaps between price and value. The allure of arbitrageurs is that we can relax the assumption that all investors are rational and retain a plausible mechanism to attain efficiency. As we have seen, arbitrageurs are active in markets but have failed to ensure efficiency at key times.¹²⁴

The final way to achieve efficiency is through the wisdom of crowds. Here, a price that is equivalent to value is the result of an effective aggregation of the views of a group of investors who are cognitively diverse and have appropriate incentives.¹²⁵ This approach does not work when the key conditions are not in place.¹²⁶

Each case takes for granted the institutions and mechanisms on the path to efficiency.¹²⁷ And in each case, we now know that the institutions make a big difference. Many of the gaps between theory and practice are the source of the inefficiencies that we describe in this report.

Appendix B: Factors—Risk or Behavioral?

One lively debate in finance is whether the excess returns of certain factors, relative to the capital asset pricing model, reflect risk or mispricing due to behavioral issues. Practitioners cannot viably use most of the 450-plus such anomalies that finance researchers have identified and many that they can implement are less robust than the research suggests.¹²⁸ The ability to implement and robustness are essential standards for empirical finance.

Within this “factor zoo,”¹²⁹ six factors are widely used in the investment community, including beta (measured through the capital asset pricing model),¹³⁰ size (small capitalization stocks generate higher returns than large capitalization stocks), value (low-multiple stocks outperform high-multiple ones),¹³¹ momentum (stocks that rise continue to rise in the short term),¹³² quality (high-quality companies outperform low-quality companies),¹³³ and asset growth (low asset growth companies outperform high asset growth companies).¹³⁴ Eugene Fama and Kenneth French, a professor of finance at the Tuck School of Business at Dartmouth College, recommend a five-factor model that includes all of the above save momentum.¹³⁵

The critical question is whether the excess returns these factors imply reflect risk or a combination of arbitrage costs and behavioral mistakes by investors.¹³⁶ If the returns are the result of risk the CAPM misses, the factors are useful for capturing that risk. This brings you back to efficient markets, where your long-term returns as an investor are commensurate with the risk that you accept.

The answer is that the excess returns from factors reflect both risk and behavioral mistakes. But some may be more behaviorally-oriented than others. Andrew Ang, a former professor of finance at Columbia Business School and now the head of factor investing strategies at BlackRock, a large asset management firm, recommends asking whether a factor works based on whether it rewards risk, takes advantage of a structural impediment, or capitalizes on behavioral biases.¹³⁷

While explaining the exact source of excess returns for any factor is inherently difficult, solid evidence suggests that the value,¹³⁸ momentum,¹³⁹ and quality¹⁴⁰ factors have a large dose of behavioral influence. Risk appears to be the main driver of excess returns for the CAPM and size factors.

The source of excess return from a given factor is relevant for answering the question of who is on the other side of a trade. If excess returns relative to the CAPM's predictions reflect risk, then the factors are helpful in making sure you are receiving proper compensation. If excess returns reflect behavioral issues, they suggest a source of returns that are both extra and recurring. But the sums that winners earn must be offset by the sums that losers surrender.

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- You then want to assess the reliability of that driver. In other words, you measure the persistence of sales growth rates. The correlation between sales growth rates from one year to the next is about 0.30. Finally, you want to integrate the base rate. The base rate would be the actual rate of sales growth for all comparable companies. The reliability correlation gives you a hint about how to blend the individual company's results with the base rate. If the correlation is low, you should place nearly all of the weight on the base rate. These are cases when the strength is low and the weight, via the base rate, is high.
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