

Beyond the Random Walk: A Guide to Stock Market Anomalies and Low-Risk Investing

VIJAY SINGAL, PH.D., CFA

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BEYOND THE RANDOM WALK

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Anomalies and Low-Risk
Investing

VIJAY SINGAL
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Printed in the United States of America
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This book is dedicated to my wife, Manisha,
and my teenage sons, Ashish and Akshay,
who, apparently believing that the book is perfect,
refused to read beyond the title page.

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Preface

This book is about anomalies in financial markets. While most people believe that markets are generally efficient, there is a consensus that pockets of inefficiency exist within broad market efficiency. Both academics and practitioners share this view. As a finance professor remarks, “You find more and more academics willing to concede that the market doesn’t look as efficient as they once thought.” For instance, Gus Sauter, who runs Vanguard Group’s massive stock indexing operations, valued at over \$100 billion, says, “I don’t believe markets are perfectly efficient.”¹

In an attempt to discover market inefficiencies, academics and practitioners have expended tens of thousands of man-years researching mispricings and anomalies. As the April 2001 issue of the *Journal of Finance* notes, “[T]housands of papers have . . . investigated the statistical behavior of stock returns and the extent to which stock prices reflect all available information.” In the process of examining the behavior of returns, the finance profession has uncovered many mispricings or inefficiencies where the direction of price movements is predictable and may suggest the formation of certain profitable trading strategies.

Unfortunately, much of current academic research in finance is not accessible to most individual and institutional investors due to its complexity.

Moreover, academic research usually stops short of suggesting practical applications. The purpose of this book is to address those limitations.

The discussions of the anomalies have two main components. The first component attempts to make relevant academic research available in a form that is understandable to practitioners, investors, students, and academics not in that particular field. It describes the anomaly, empirical evidence, and possible explanations for the anomaly, and it explores reasons for the persistence of the anomaly. The second component of each chapter introduces and implements trading strategies designed to capture the mispricing, along with a discussion of the risk and return. In addition, the step-by-step trading strategy is illustrated with real data from a recent period so that an ordinary investor would find it easy to duplicate the strategy. Readers, if they so desire, will be able to further explore literature on the subject by perusing the extensive bibliography throughout the book and by possibly conducting additional empirical analysis independently.

This book is intended for any individual interested in mispricings in the stock market. It does not presume a deep understanding of financial markets, just an interest in the stock market and a thirst for knowledge. Investors and practitioners will gain from a summary of the current research on anomalies and evidence of the success of low-risk investment strategies based on those anomalies. Their trading activities may even make the markets more efficient! Academics can use the book as a starting point for an understanding of the large field of market efficiency. The references should help steer the academic community in the right direction to further explore this exciting and important area of research. The book can help students at all levels (advanced undergraduates, MBAs, and PhDs) enhance their understanding of financial markets.

Most but not all anomalies are expected to generate tradable profits. Even if generating trading profits is not possible, information about an anomaly will help the reader better understand the mispricing and, perhaps, modify trading behavior to avoid being hurt by it.

Description of Content

This book begins with a description of market efficiency and anomalies so that readers can fully comprehend the nature of the anomalies discussed. The discussion of market efficiency and its importance is followed by answers to questions such as: What is mispricing? How do you detect a mispricing? Is there really a mispricing after correcting for biases? Why does a mispricing persist? My intent is for you to be able to judge whether the anomaly is believable and

continues to exist. This is the only chapter that I recommend you read before reading any other chapter in the book.

The introductory chapter (Chapter 1) is followed by the main part of the book (Chapters 2 to 11), where ten mispricings are discussed. Each chapter discusses one anomaly in detail along with the description, evidence, explanations, and risks and rewards of the investment strategy associated with that anomaly. I have kept each anomaly independent of the others so that if you are interested in the forward rate bias, for example, you can jump to Chapter 11 without having to trudge through the first nine anomalies. The summary at the beginning of each chapter and Table 0.1 allow you to preselect the anomalies that you are interested in reading about. While most anomalies have seemingly rational explanations related to institutional features, there are others for which rational explanations have yet to be discovered. Even if an explanation is known to exist, a nagging question remains: Why doesn't the mispricing disappear because of the actions of arbitrageurs or smart investors? That question is frequently difficult to answer. Limits of arbitrage activity are one possible explanation. Fortunately, trading by individual investors can relax that constraint, and the investors can gain while making the market more efficient. I hope this book will enable small investors to uncover and trade on the mispricings discussed.

A chapter devoted to a discussion of behavioral finance follows the individual anomalies. Whereas finance theory is based on rational investor behavior, behavioral finance theory is based on psychological precepts that generate irrational investor behavior, or at least behavior that is irrational from an economic standpoint. In the context of anomalies, the chapter on behavioral finance performs two functions. First, it provides an alternative way of thinking about the rationale behind some of the anomalies. Second, it provides useful information about mistakes that investors make, mistakes that investors should consciously try to avoid.

The last chapter of the book is a collection of other possible mispricings and is directed to readers whose appetite for anomalies is not satisfied. The most promising mispricings are described in that chapter, along with an extensive list of references that allow the reader to explore beyond the confines of the book.

The three appendices at the end of the book contain useful information for people who are new to certain aspects of trading strategies. Appendix A contains information about financial instruments, their availability, trading costs, and trading restrictions. The purpose is to provide practical information on selecting appropriate instruments for trading. Appendix B covers the intricacies of short selling.

Table 0.1: Summary of Anomalies discussed in the book

Chapter Number	2	2	3	4	5
Chapter Title	The January Effect	The New December Effect	The Weekend Effect	Short-Term Price Drift	Momentum in Industry Portfolios
Frequency of mispricing	Once a year	Once a year	Once a weekend	Daily	Daily
Level of difficulty in understanding the mispricing	Easy	Easy	Easy	Not difficult to marginally difficult	Not difficult to marginally difficult
Abnormal return based on past evidence*	Not possible. Theoretically, 10%.	About 2%	0.20% per weekend	1.5% to 3% per stock. 18–36% annualized	0%–5% per year
Abnormal return using real time data*	1% every January. Investors can also change trading patterns.	1.5% to 3.0% in December. Investors can also change trading patterns.	Not possible. But investors can change trading patterns.	30 to 38% annualized	10% per year
Financial Instruments for arbitrage	Mutual funds	Mutual funds, ETFs, and futures	Not applicable	Individual stocks; short-selling only for stocks with negative news	Mutual funds
Level of difficulty in strategy implementation	Easy	Easy	Easy	Easy to marginally difficult without short-selling	Easy
Time commitment per transaction	one hour	one hour	—	two hours	three hours
Transactions per year	One; change in trading patterns	One; change in trading patterns	Change in trading patterns	Many	10–12

6	7	8	9	10	11
Mispricing of Mutual Funds	Trading by Insiders	Changes to the S&P 500 Index	Merger Arbitrage	International Investing	Forward Rate Bias
Event based	Daily	Event based	Event based	Continuous	Continuous
Not very difficult	Easy	Easy	Not difficult to marginally difficult	Not difficult to marginally difficult	Difficult
1% to 50% annualized	7% to 10% annualized	36% to 48% annualized	4% to 10% annualized	2% to 8% per year	2% to 5% per year
5% to 7% annualized	30% to 57% annualized	> 100% annualized	16% annualized	Not available. But investors must include foreign stocks.	13% to 15% per year
Mutual funds	Individual stocks; short selling is optional	Individual stocks; short-selling is optional	Individual stocks; short selling only for stock mergers	Mutual funds; American Depository Receipts; ETFs	Currency futures
Easy with funds already identified; difficult to find new funds	Not difficult without short-selling	Easy without short-selling	Easy for cash mergers; marginally difficult for stock mergers	Easy	Easy
30 minutes	one hour	two hours	three hours	one hour	three hours
15–50	Many	About 50	20 to 100	A few	10–12

*Abnormal return is the return in excess of the normal return associated with this level of risk.

Buying stocks or selling stocks that you own is easy. However, short selling (selling stocks that you do not own) is a somewhat different and more complex strategy and is described in that appendix. Appendix C explains the basics of hedging. Hedging can be used to control risk associated with certain trading strategies. The appendices are not required reading for frequent traders.

Why Did I Write This Book?

If stock market experts were so expert, they would be buying stock, not selling advice.

Norman R. Augustine

I share the skepticism of this statement and agree with the assertion that any person will use his informed position to make profits for himself first. However, the statement implicitly assumes that strategic trading will generate arbitrage profits that have no risk and require no investment. Unfortunately, arbitrage is rarely risk free or costless (see next chapter for an in-depth discussion on the *limits of arbitrage*). So, although I have the knowledge, the ability, and the willingness to craft an informed trading strategy that outperforms the market, I am constrained by the lack of adequate financial resources (I am only a professor of finance after all!) to take advantage of the many profitable opportunities that I discuss in this book.

Not to say that I have not profited from my expertise—as a small investor I have implemented, and continue to implement the strategies in this book—generally, managing to beat the market and make the desired level of profit. Yet, due to the resource constraint mentioned above, it is more profitable for me, both personally and professionally, to leverage my know-how in the form of this book, than to try and earn direct profits through the implementation of the strategies I have highlighted in the pages that follow.

In one sense then, this book itself can be treated as an anomaly (considering the above quotation), which, if fully exploited by its audience, would help to push the market back to its ideal of efficiency. This is another reason why I am writing this book instead of using my knowledge only for personal benefit.

Notes

1. Both quotes in this paragraph are from the August 2001 issue of the *Institutional Investor*, 30–33.

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BEYOND THE RANDOM WALK

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Market Efficiency and Anomalies

This chapter addresses common questions related to market efficiency and anomalies. If prices properly reflect available information, then markets are said to be efficient. Although markets are known to be broadly efficient, there may be pockets of inefficiency that lead to mispricings or anomalies.

In general, claims of anomalous pricing must be viewed with skepticism. The discussion describes reasons for skepticism as well as causes for persistence of some anomalies. Moreover, even when profits can't be made by trading on anomalous prices, it may be possible to alter trading behavior to avoid losses due to these anomalies.

What Is Market Efficiency?

Market efficiency in this book refers to the informational efficiency of markets as opposed to structural efficiency, administrative efficiency, or operational efficiency. That is, this chapter focuses on the efficiency with which information is reflected in prices. If new information becomes available about a stock (change in earnings), an industry (change in demand), or the economy (change in expected growth), an efficient market will reflect that information in a few minutes, even a few seconds. However, if only half of that information is reflected in the stock price immediately and the remaining half takes several days, then the market is less than fully efficient. Markets that are less than fully efficient open an opportunity for making profits because the inefficiency causes a mispricing in stocks. If a stock is slow to react and takes several days to fully reflect new

information, then buying the stock immediately after good news and holding it for a few days would generate extra profit. However, if many people know about this inefficiency, they will all act the same way. As a result, the price will reflect the new information more quickly and the inefficiency will eventually disappear.

The idea behind efficient capital markets is quite simple but compelling. If you know that a stock is undervalued, then you will buy the stock until it is fairly valued. Or if the stock is overvalued, then you will sell the stock until it is fairly valued. Thus, market participants will ensure that prices are always accurate based on publicly available information.¹ The implicit assumption here is that trading based on nonpublic information, that is, insider trading, is illegal. Markets are said to be “semi-strong” form efficient if the prices are unbiased based on all publicly available information. If prices are unbiased based on all information (public and private), then markets are “strong” form efficient. Empirical evidence suggests that markets in the United States and other developed countries are essentially informationally efficient in the semi-strong form, though pockets of inefficiency may exist.

Who Cares about Market Efficiency?

Market efficiency is important for everyone because markets set prices. In particular, stock markets set prices for shares of stock. Currency markets set exchange rates. Commodity markets set prices of commodities such as wheat and corn. Setting correct prices is important because prices determine how available resources are allocated among different uses. If the price of a product is low relative to its cost, the investment in that product will fall. On the other hand, high prices encourage a greater allocation of resources. Thus, correct prices are important for resource allocation and, consequently, for economic growth. Unfortunately, correct prices are impossible to achieve because they require perfect foresight and information. The best a market can do is to form prices that reflect all available information.

Now, consider market efficiency for each constituent in turn: investors, companies, the government, and consumers. Investors are suppliers of capital that companies need for investment and operations. The investors earn a return on the capital they supply. If investors find that prices are predictable, then smart investors can earn extra return at the expense of naive or unsophisticated investors. This implies that unsophisticated investors earn a return that

is less than the return that they should receive. In such an environment, unsophisticated investors will be reluctant to supply capital. The reduction in the availability of capital means that companies must pay a higher return for the capital due to restricted supply. However, the investors' capital does not disappear from the market altogether. The money not invested in corporate securities may be deposited with financial institutions, which may then lend that money to corporations. However, the cost of that money will be higher than if the companies could borrow directly from investors.

Besides the cost implication, companies care about market efficiency in another way. If markets are efficient aggregators of information, then companies can learn from the stock price reaction. For example, when AT&T bid for NCR in December 1990, AT&T's stock price promptly fell more than 6 percent, while NCR's price jumped 44 percent. Robert Allen, AT&T chairman, chided the markets for not appreciating the long-term benefits that would accrue to AT&T as a result of this combination. It took five years, but the market was proven right. AT&T bought NCR for \$7.48 billion in 1991 but, after losses totaling \$3.85 billion over the next five years, it was forced to spin off NCR in 1996 at less than half the purchase price, about \$3.5 billion. Most companies, however, listen to the market's verdict on big decisions. Some mergers are aborted because of tepid reception by the market.

In addition to investors and companies, the government and the public are concerned about market efficiency because of the effect on economic growth. If the markets do not set prices based on all available information, then allocation of resources based on market prices will be flawed. Industries that deserve more capital will not get that capital, while industries that are not deserving of greater investment will. For example, if technology companies are overvalued by the market, then too many resources will be invested in technology companies, resulting in a misallocation. Also, market inefficiency in the form of speculative bubbles can affect the financial institutions and, through them, the entire economy. For example, Japan's stock market and real estate bubble in the 1980s has left the Japanese banking sector with nonperforming assets, affecting the country's economy.² Improper utilization of limited capital means suboptimal use of funds and underachievement in terms of growth and social welfare. Under such conditions, it is the government's responsibility and duty to intervene in financial markets to ensure optimal resource allocation. Whether the government can achieve the desired effect is an open question.

Thus, market efficiency is important so that optimal investment ensures optimal growth and maximizes social welfare.

Can Capital Markets Be Fully Efficient?

While market efficiency is desirable, there are three limitations in achieving that ideal: the cost of information, the cost of trading, and the limits of arbitrage. Strictly speaking, *arbitrage* refers to a profit earned with zero risk and zero investment. However, in this book the term is used in its more popular interpretation, that is, a superior risk-return trade-off that probably requires both risk and investment.

LIMITATION 1: COST OF INFORMATION

In an article aptly titled “On the Impossibility of Informationally Efficient Markets,” Sandy Grossman and Joe Stiglitz go about proving just that. The concept behind the impossibility of informationally efficient markets is straightforward. Let us assume that markets are fully efficient, that is, they instantaneously reflect new information in prices. If that is the case, then no investor or market participant has any incentive to generate or report new information because the value of that information is zero. That is, when a company announces its earnings, no one wastes time trying to analyze that information because the price already reflects it. There is no value in even reading the corporate announcement. But if no one has any incentive to react to new information, then it is impossible to reflect new information in prices.

The implication of this is that markets can’t be fully efficient because no one has the incentive to make them so. Market participants must be compensated in some way for making the market more efficient. Arbitrageurs and speculators must get something in return. Thus, instead of achieving instantaneous adjustment to new information, prices can adjust to new information only with a time lag. This time lag allows market participants to earn a reasonable return on their cost of obtaining and processing the information. If the return is abnormally high, it will attract more information processors, leading to a reduction in time lag. The net result is that prices take time to reflect new information because obtaining and processing that information is costly. However, if the delay is short enough (a few minutes), the markets are still considered efficient. But if they take several hours or several days, then the markets are not efficient.

LIMITATION 2: COST OF TRADING

Like the cost of information, traders incur costs while trading: their time, brokerage costs, and other related costs (see Appendix A for a discussion). When the cost of trading is high, financial assets are likely to remain mispriced for longer periods than when the cost of trading is low. In essence, like with the cost of information, the arbitrageurs or other traders must get an adequate return after accounting for costs to engage in an activity that makes the market more efficient. To the extent that trading activity is limited, prices will not reflect all available information. One factor that can have a large influence on prices is the difficulty in short selling. If short selling (that is, selling a stock that you do not own) is more difficult than buying long (that is, buying a stock that you do not own), then prices are likely to be biased upward. And if certain stocks are more difficult (and therefore more costly) to short-sell, the upward bias in prices is likely to be greater for those stocks. Thus, the greater the cost of trading, the greater the mispricing.

LIMITATION 3: LIMITS OF ARBITRAGE

The above discussion on why markets should be efficient suggests the presence of investors who would trade if they see a price that is inconsistent with their information, and would continue to trade until the price reflects the information they have available. On a simpler scale, consider two financial assets (say, stocks X and Y) that are equally risky but generate different returns. Obviously, one of the two assets is mispriced. If asset X generates the higher return and has a lower price, while asset Y generates the lower return and has a higher price, then to take advantage of the mispricing, arbitrageurs would buy asset X while at the same time short-selling Y. With the activities of like-minded arbitrageurs, the prices will converge and make them reflect the fundamental value associated with each asset.

There are four problems with this ideal scenario, however. First, it is not clear when, if ever, the prices will return to equilibrium levels or when the mispricing will disappear. If uninformed traders can continue to influence prices, then the prices of X and Y may actually diverge even more before eventually converging. If the divergence is significant, arbitrageurs may be forced to close their positions prematurely. Arbitrageurs who took short positions in Internet stocks in 1998 or 1999 on the belief that the stocks were overvalued would have been wiped out before the prices eventually fell. In fact, many short sellers went bankrupt in the late 1990s

due to the ascent of the stock market. Even Warren Buffett, whom many regard as a smart investor, proclaimed that he had misread the new economy by not riding the technology wave. Today we know that he was correct to be skeptical of high Internet stock valuations, but at the time the prolonged period over which the mispricing seemed to persist caused him to accept defeat.

Second, it is rare to find two assets with exactly the same risk. Assume that X gives a higher return because it has a slightly higher risk than Y. However, smart investors believe that X's return is much higher than it should be based on differences in risk. Accordingly, they would like to implement a strategy of buying X while short-selling Y. But the risk inherent in such a strategy may deter them from arbitraging the mispricing. Thus, in cases where no close substitutes are available, the mispricing of a security may continue indefinitely.

Third and probably more important, we implicitly assumed that arbitrageurs have an unlimited amount of capital to take advantage of mispriced assets. That is not true. Just like everyone else, arbitrageurs have a limited amount of capital, which they devote to the most profitable strategies or to the most egregious mispricings while ignoring the remaining mispricings. The problem of limited capital becomes more severe in a bull market. Though there are potentially more mispricings in a bull market, the arbitrage capital is even more limited because most investors want to ride the market rather than find nebulous mispricings that generate relatively small returns.

Finally, most arbitrageurs act as agents because they manage other people's money. As agents, arbitrageurs must abide by the constraints imposed on them by the owners of capital (the principals). The principals are unwilling to give the agents a free hand in the pursuit of extra returns because the principals are concerned that the agents may not actually earn those extra returns and that the risk associated with those returns may be unacceptably high. Therefore, the typical mandate given to an agent will specify permitted strategies, the amount of capital at risk including the effects of leverage, and the maximum possible loss. For example, an arbitrageur may be allowed to invest only in merger arbitrage securities or only in distressed securities, with loss limited to 10 percent of the capital invested. While these constraints protect the owners of capital, they also limit the operation of arbitrage activities in the market. In addition, an arbitrageur's ability to attract more capital can be severely constrained when opportunities become more attractive if principals use an arbitrageur's past performance to judge his ability. As-

sume that an arbitrageur believes that a stock is undervalued by 10 percent and buys that stock. Assume further that the mispricing gets worse over the next few weeks and the stock becomes undervalued by 20 percent. The arbitrageur should probably increase his stake in the stock. However, in the meantime, due to the worsening mispricing, the arbitrageur has lost 10 percent of the capital. Principals observe the loss of 10 percent and may not believe that the arbitrageur has any superior skills. Instead of giving him or her more capital, they may ask the arbitrageur to immediately sell that stock, further depressing the stock price and making the mispricing even more acute. It is easy to see that there are serious limits of arbitrage activity that may cause mispricings to persist.

What about the small investor? Why can't the millions of small investors seek out and trade on these mispricings, especially the small mispricings that are ignored by professional arbitrageurs or where arbitrage activity is limited by constraints imposed on the arbitrageur? In general, the small investors do not have the expertise and knowledge to identify and profitably trade mispricings. If this book is able to educate investors so that they trade away the mispricings or trade in a more rational manner, the markets will become more efficient aggregators of information, with concurrent improvement in social welfare.

What Is a Pricing Anomaly?

A mispricing is any *predictable* deviation from a normal or expected return. For example, assume that IBM's stock is expected to earn a normal return of 15 percent a year. If the current stock price is \$100, then the price should increase to \$115 after one year, assuming that IBM does not distribute any dividends. If a market timer *predicts* that IBM will actually appreciate by 20 percent or more this year, and IBM does earn more than the normal return repeatedly and consistently in a predictable manner, then it is a mispricing. Similarly, a *predictable* deviation on the downside (less than 15 percent) is also a mispricing. On the other hand, an unpredictable movement in price is not a mispricing. For example, if the actual price after a year is \$90 or \$130, that is not a mispricing even though the actual return is different from the expected return. Deviations from the normal return are expected and, by definition, must occur for risky securities. On average, however, the deviation must be close to zero.

If a mispricing is well known and persistent, then it is referred to as an anomaly. In their article on anomalies in the *Review of Financial*

Studies, Michael Brennan of UCLA and Yihong Xia of the University of Pennsylvania define an anomaly as “a statistically significant difference between the realized average returns . . . and the returns that are predicted by a particular asset pricing model.” Thus, persistent realization of abnormal returns (actual return minus the expected return) is referred to as an anomaly. The persistence in abnormal returns results in predictability of returns.

When Is a Mispricing Not a Mispricing?

Investment professionals, academics, and novice traders spend a great deal of time and effort to discover mispricings because these phenomena have the potential to make someone very rich. Therefore, mispricings are frequently touted by market timers, brokers, and other investment professionals. It is important to know how to judge the validity of a mispricing. In this section, the limitations and biases in the process of discovering mispricings are discussed along with simple tests to detect whether the mispricings can be attributed to such limitations. An understanding of these biases can be used to test other mispricings. Moreover, it will be natural to become more skeptical of mispricings or anomalies that are frequently cited as evidence against market efficiency. The intent here is not to actually check for limitations of the mispricing, but to judge whether flaws in the discovery process may have caused the observed mispricing.

MEASUREMENT OF ABNORMAL RETURN

If markets are efficient, then the expected *abnormal* return is zero. On the other hand, if the abnormal return is nonzero *and* it is possible to predict the direction of the deviation, then the pricing constitutes an anomaly. Since abnormal return is the actual return minus the normal return, a problem arises in defining the normal return (the term is used interchangeably with *expected return*). How do you define or measure normal return?

In the IBM example, it was assumed that the normal return is 15 percent. Is the 15 percent assumption correct? Who can say? Unfortunately, there is no accepted method for estimating a stock's normal return. Theoretical models include Nobel laureate William Sharpe's capital asset pricing model (CAPM) and Steve Ross's arbitrage pricing theory (APT). APT cannot be applied in a practical way because there are too many unknowns. CAPM is determinis-

tic, but the CAPM does not have much empirical support. In the words of Eugene Fama, “[I]nferences about market efficiency can be sensitive to the assumed model for expected returns” (Fama 1998, 288).

Other models exist using alternate measures of risk derived from statistical methods and historical returns. Researchers have also discovered that stock return depends on such factors as size, the ratio of market value to book value, beta, momentum, and so on. However, these are empirical returns that do not necessarily have strong theoretical support. Further, there is no guarantee that these factors will continue to have explanatory power in the future. So, the question remains: what is IBM’s normal return? There is no exact and generally accepted measure of expected return. However, it is possible to say that a particular return is too high or too low. For example, a normal return of 50 percent for IBM is too high and a return of 0 percent is probably too low. One way of getting a reasonable estimate is to estimate its relative return—relative to another firm with similar characteristics. The idea is to identify a similar (or control) firm—similar on several dimensions known to explain the cross section of returns, such as size, market-to-book ratio, and so on. Then measure the abnormal return for the sample firm as the difference between the sample firm’s return and the control firm’s return. Coke and Pepsi are good examples. If Coke and Pepsi are considered similar firms, then to find Coke’s abnormal return, Pepsi’s return would be used as the normal return. The difference between Coke’s actual return and Pepsi’s return is the abnormal return earned by Coke. Generally, it is better to use a group of firms as a control instead of using a single control firm so that one firm’s chaotic price movements don’t significantly influence the abnormal return calculation.

How critical is it to estimate IBM’s normal return accurately for detecting a mispricing? Should it be 15 percent or 25 percent per year? The normal return becomes crucial only in long-term mispricings. Consider that IBM’s return based on a particular mispricing is 25 percent over one year. The return is abnormal if the normal annual return is assumed to be 15 percent, but not if the normal annual return is 25 percent. On the other hand, if the mispricing occurs over short periods of time, then the normal return becomes essentially inconsequential. If IBM’s stock earns 1 percent in a *day*, then the normal return does not really matter—whether it is 0.06 percent per day (15 percent per year based on 250 trading days per year) or 0.1 percent per day (25 percent per year). In either case, the mispricing is large: 0.94 percent or 0.90 percent for a day. This means that, holding the magnitude of mispricing

constant, long-term mispricings should generally be subject to a much greater degree of skepticism than short-term mispricings.

As Fama states, “[A]n advantage of this approach [short-period event studies] is that because daily expected returns are close to zero, the model for expected returns does not have a big effect on inferences about abnormal returns” (Fama 1998, 283). He continues to stress the problem with long-term normal returns: “the bad-model problem is ubiquitous, but it is more serious in long-term returns. The reason is that bad-model errors in expected returns grow faster with the return horizon than the volatility of returns” (Fama 1998, 285).

DATA MINING

If you look hard enough at almost any bunch of numbers, you can find a pattern. Since anomalies are predictable patterns in returns, a person who studies hundreds of different relationships and millions of different observations is likely to find a pattern; this is called data mining. For example, try to find a relationship between the stock return and any number of different variables, such as the weather in New York, the number of sunspots, the height of ocean waves, growth in world population, or the number of birds in San Francisco. Given a large enough number of possible relationships and enough tries, it is possible to find a statistically significant relationship between a stock return and another variable. That relationship does not really exist: it is there just by chance. Further, as Fama states, “splashy results get more attention, and this creates an incentive to find them” (Fama 1998, 287). Fischer Black once said, “[M]ost of the so-called anomalies that have plagued the literature on investments seem likely the result of data-mining” (Fischer Black 1993, 9).

An example of data mining is illustrative. Take a researcher who believes that Nasdaq 100 returns are predictable on an intraday basis. He is determined to find this predictability to impress his boss. He can generate and test for thousands of different relationships to discover a pattern. He begins by calculating the six one-hour returns for each day: 10 A.M.–11 A.M. return, 11 A.M.–12 noon return, and so on. He analyzes the hourly returns to see whether the return during the first hour is related to the return during the second hour, whether the second-hour return is related to the return during the third hour, and so on. Then he tries to find significant correlations among 13 half-hour returns, and among 26 quarter-hour returns, and among 78 five-minute returns, and among 390 one-minute returns. Unsuccessful but persistent, he introduces filters, that is, se-

lects only those observations where the Nasdaq 100 return is more than two standard deviations away from the mean. Again he fails to discover anything interesting. Next he introduces volume as a variable. Only those observations that have trading volume in the top 10 percent are selected. He continues this process until he discovers a pattern. Finally he finds that on high-volume days, a negative Nasdaq 100 return in the 3:00–3:30 P.M. period is followed by a negative return in the 3:30–4:00 P.M. period with a 90 percent probability. This is data mining at its best, but the boss is not impressed, and I hope you are not either.

Artificial anomalies need to be separated from real anomalies. Perhaps the most important thing is to assess the intuitiveness of the relationship discovered by researchers. Does it make sense? Can the number of birds in San Francisco really mean anything for stock returns? If it doesn't make intuitive and economic sense, then it is probably a case of data mining. Another way to check for data mining is to use an out-of-sample test, which is testing the same relationship using data from a different country or for an entirely different period. If data mining worked in this case, it may not work for a different sample. If it is not possible to get another data set, then test the relationship over subperiods of the data. The results must hold for subperiods as well as for the whole period unless there is a valid reason for a change in the observed relationship.

SURVIVORSHIP BIAS

Another source of unreliability of an anomaly is survivorship bias, which exists whenever results are based on existing entities. For example, a simple study of existing mutual funds will find that mutual funds, on average, outperform their benchmarks. The problem with such a sample is survivorship. Only well-performing funds continue to survive, while the underperformers die. Thus, a sample of existing mutual funds will not contain funds that underperformed and died. If all funds, dead and alive, are included in the sample, then the funds, on average, do not outperform their benchmarks. The sample of existing mutual funds has a survivorship bias and will result in an overestimation of fund performance.

Survivorship is important in market timing studies, as market timing newsletters or services use many strategies and frequently add new strategies and discontinue others. Which ones does the market timer add? The ones that have shown great promise based on past trends. Which ones are discontinued? The ones that no longer show continuing profitability. The record displayed by the market

timer shows only the successful strategies and not the unsuccessful strategies, giving readers the false impression of market timing prowess where none exists.

Survivorship bias is widespread in many spheres of the investment world. People with a good investment record are retained, while others are dumped. It seems as if all the investment firms have analysts who can predict the market. What about the guests on CNBC? Are they really good stock pickers, or are they simply lucky?

SMALL SAMPLE BIAS

Mispricings may be caused by a small sample bias. Usually the small sample refers to the period of observation. For example, riskier stocks should earn higher returns than other stocks. Since stocks with small market capitalization (size) are considered riskier than large-size stocks, small-size stocks are expected to earn higher returns. However, during the 1995–99 period, the large-size stocks outperformed the small-size stocks. Looking at this limited time period, one may conclude that a mispricing exists. However, over long periods (1926–2002 or 1962–2002) small-size stocks did earn higher returns than large-size stocks. The small sample bias is especially relevant to anomalies that do not have a reasonable explanation, especially if it appears that the mispricing has occurred just by chance.

SELECTION BIAS

Another bias that may creep into the discovery of mispricings is selection bias, that is, the sample may be biased in favor of finding the desired result. Assume you want to measure the ownership of cell phones in the general American population. If you polled only people working in Manhattan, your estimate will be biased upward because the sample is biased and the result is falsely attributed to the entire American population, including rural and less urban areas.

In the case of stock market studies, a selection bias can creep in when the results arise from a certain part of the sample but seem to be representative of the entire market. For example, consider the January effect. According to the January effect, firms gain abnormally in the first few days of January. However, the effect is not broad-based; rather, it is due to firms that are small in size. Once the small firms are removed, the January effect disappears. The discovery of the small-firm effect is important, because it is necessary to attribute the effect to only the small firms and not to the entire stock market.

NONSYNCHRONOUS TRADING

Stocks trade with different frequencies. Some stocks may trade continuously, that is, several times a minute, such as Pfizer, Intel, and Cisco. Other stocks may not trade for several hours or even several days. If a stock trades only once every day, at 10 A.M., the return based on that day's 10 A.M. trade will capture market movements that took place over the last twenty-four hours. The closing price at 4:00 P.M. will reflect the price of the last trade, which actually took place at 10 A.M., without accounting for any market movements that have taken place since 10 A.M. If the market jumped after 10 A.M., then the next day's return (but not today's return) of this stock will reflect the increase in price. If you construct a portfolio of such inactively traded stocks, then it will seem that these stocks have predictable returns—that is, the stock price will change in accordance with the market, but with a delay. Since you can predict returns, a natural strategy is to buy this portfolio whenever the market goes up after 10 A.M. and sell this portfolio if the market goes down after 10 A.M. The problem with returns caused by nonsynchronous trading is that those returns are not actually tradable. The 10 A.M. price is not a price at which a trade can be executed. As soon as any trader tries to trade, the price will move to reflect market movements, and the excess returns will disappear.

There is a way to take advantage of stocks that trade infrequently or at different times: trade mutual funds, where a buy does not necessarily trigger a trade in the underlying stock. Those cases are discussed in Chapter 6, "Mispricing of Mutual Funds."

RISK

Most investors demand a higher return for a riskier position than for a less risky position. That is why bank deposits give a lower return than stocks, because stocks are riskier than bank deposits. Small-size stocks have higher returns than large stocks because small stocks are riskier than large stocks. This means that a riskier strategy must also generate a higher return. Therefore, it is important to control for risk when comparing trading strategies designed to take advantage of mispricings. Further, historical risk estimates may not be appropriate if the mispricing is around certain corporate or market events, because volatility, and hence risk, generally increases around those events. Thus, anomalies that are event-driven must generate higher returns to compensate for the risk associated with those events. However, risk is probably not important if only a short holding period is required.

In any case, the abnormal returns computed for any mispricing must account for the level of risk inherent in exploiting that anomaly. Inaccurate estimates of risk are more likely to affect anomalies that require long holding periods or anomalies that have very small abnormal returns even with short holding periods. Therefore, care must be taken to ensure that adequate compensation is provided for risk.

EXPLANATION FOR THE MISPRICING

It is necessary to reiterate the importance of a reasonable and intuitive explanation as a basis for the anomaly. Anomalies that are based on reasonable explanations are less likely to be the figment of someone's imagination or data mining and are more credible. Some anomalies exist because of government regulations or arise from institutional constraints. For example, the January effect is best explained by capital gains taxes. That is not to say that all anomalies must have rational explanations. However, an anomaly with a rational explanation is more believable than one without.

Can New Mispricings Be Discovered?

Until now, the discussion has focused on known anomalies. But investors, academics, and practitioners are constantly trying to discover new mispricings. Any new mispricing can potentially result in large profits to the explorer. While one must be skeptical of new mispricings—whether it is predicting when a stock split will be announced or which firm will be acquired—one must acknowledge the possibility of discovering new mispricings. Just because a pattern can't be discovered may not mean that it doesn't exist. At the same time, one must be wary of new mispricings and ensure that they meet the tests listed above.

Why Does a Mispricing Persist?

If a mispricing exists, then smart investors and arbitrageurs should take advantage of it to earn abnormal returns. As more and more arbitrageurs participate, the mispricing should disappear. In general, persistence of an anomaly is a cause for concern. However, there could be a number of reasons for an anomaly's continuation, as discussed below.

THE MISPRICING IS NOT WELL UNDERSTOOD

It is possible that a mispricing is well known but not well understood. For example, the weekend effect is well known. According to the weekend effect, first discovered in the 1970s, the return on the last trading day of the week is highly positive. On the other hand, the return on the first trading day of the week is usually negative. Until recently the weekend effect did not have a good explanation. Without a satisfactory and intuitive explanation, the mispricing does not meet one of the key conditions for acceptance. Though there is overwhelming evidence of its existence based on past data, investors are wary of trading on it because the mispricing may cease to exist at any time or may not occur during the current period. As Gabriel Hawawini and Donald Keim remark, “[that] effects have persisted for nearly 100 years in no way guarantees their persistence in the future” (Hawawini and Keim, 2000, 35).

Further, without knowledge of a reason, it is difficult to identify stocks that will exhibit the mispricing. Is it only among small stocks? Is it among large stocks? Is it among stocks that have listed options? Or maybe among stocks that just issued new equity? It becomes very risky for an arbitrageur to try to profit from a mispricing without knowing why it exists. As a consequence, the mispricing may not be arbitrated by risk-averse investors.

ARBITRAGE IS TOO COSTLY

Sometimes the anomaly is known and understood but the arbitrage is too costly to transact. These costs have three components. The first component is the bid-ask spread, which is the difference between the highest price that any buyer is willing to pay (the bid price) and the lowest price that a seller wants (the asking price). As all arbitrage strategies require a buy and a sell, the spread contributes to the total cost of transacting. Second, brokerage fees must be paid. Finally, each large trade can have a market impact. Even an actively traded stock such as General Electric may find it difficult to absorb a million-share order without moving the price. A large buy will cause the price to rise, meaning you pay more than the price indicated by the quotes. Similarly, a large sell will cause the price to decline. In both cases, the market impact of the order has the effect of increasing the trading costs.

Anomalies with high transactions costs may persist because large institutions or arbitrageurs may be reluctant to trade if large dollar positions cannot be taken without moving the price or if the bid-ask spreads are large. For example, the January effect has been known

for decades and is caused by tax-loss selling of small-size stocks. Nonetheless, the January effect persists because it is necessary to trade hundreds of small-size stocks. Small stocks have high bid-ask spreads and low liquidity, making the potential benefit insufficient to offset the transaction costs.

PROFIT POTENTIAL IS INSUFFICIENT

Certain anomalies may generate small profits that cannot be multiplied easily. In those cases, institutions may not be interested because there is a limited profit potential. Imagine a \$1 billion mutual fund trying to make a profit of \$10,000 on a few trades. The return is only 0.001 percent. The fund manager could probably spend time more profitably on other pursuits. This is especially true of trading in small-cap stocks, where the institutions can't take large positions for fear of moving the price. Such mispricings are ideally suited to individual trading.

ARBITRAGE IS NOT POSSIBLE DUE TO TRADING RESTRICTIONS

A known mispricing may persist if institutional features limit trading. This is especially true for restrictions on short selling. For example, it is not possible to short-sell initial public offerings (IPOs) for a few days after the issue because shares are not available to borrow. The mispricing, if any, may persist for a few days, until short selling becomes possible. Again in the case of IPOs, the underwriters engage in price stabilization activities that can, in some cases, keep the price at an inflated level for almost a month.

A case in point is the spin-off of Palm by 3Com. 3Com sold a fraction of Palm as an IPO in March 2000 but retained 95 percent of its shares. At that time it announced that it would spin off the remaining shares to 3Com shareholders at the rate of 1.5 Palm shares for every 3Com share. Even assuming that 3Com was worthless without Palm, 3Com's share price should have been approximately 1.5 times Palm's share price because a single 3Com share gave the right to own 1.5 Palm shares. On the first trading day after the IPO, Palm's price was \$95. Using the ratio of 1.5:1, 3Com's price should have been about \$142.50. However, 3Com's price was only \$82. A simple strategy to earn an arbitrage profit would have been to buy 1 share of 3Com and short-sell 1.5 shares of Palm. But arbitrageurs could not employ this strategy because shares of Palm were not available to short-sell. In this case, the mispricing existed, and persisted for several days, because of trading restrictions.

BEHAVIORAL BIASES MAY AFFECT INVESTMENT DECISIONS

If investors are reluctant to realize losses, are quick to take profits, do not diversify enough, and suffer from other instances of irrational behavior, then mispricings may occur. They may persist because investors do not change their behavior even in light of new information. The behavioral biases and the manner in which they affect investment decisions are discussed in Chapter 12.

Underreaction to earnings news can be explained by behavioral biases. If the earnings announcement is positive, the stock price rises. But the rise is stymied by the premature selling initiated by individual investors who sell to realize gains. As the selling pressure abates, the stock price slowly rises to the correct level. On the other hand, if the earnings announcement is negative, the stock price falls. But it does not fall sufficiently because individual investors continue to hold on to the stock hoping to recoup their losses. The stock eventually reaches the correct price but with a delay due to the behavioral biases of the investors.

However, irrational investor behavior can explain persistence only in conjunction with other explanations. Even if some investors are irrational, arbitrageurs should take advantage of that irrationality and in the process cause the mispricing to disappear.

Until investors learn to think and act rationally and minimize emotional trades, mispricings are also likely to be caused by irrational behavior.

LIMITS OF ARBITRAGE REVISITED

One reason for persistence of mispricings is the limits of arbitrage. As discussed in “Can Capital Markets Be Fully Efficient?” earlier in this chapter, arbitrageurs may not have the capital or the freedom to pursue the mispricings as aggressively as they would otherwise. However, the limits placed on arbitrageurs allow individual investors to gain from the knowledge provided in this book. If individual investors begin to target mispricings effectively, there will be one less reason for the persistence of mispricings in financial markets.

Can Valid Anomalies Be Unprofitable?

Besides analyzing anomalies, this book contains suggestions for implementing trading strategies designed to take advantage of mispricings. Many anomalies are especially suited to individual investors because the profit potential is small by institutional standards, the mispricing

appears infrequently, or the trading costs are high. Where trading costs are high, individual investors, like institutional investors, cannot make arbitrage profits. However, individual investors can alter the timing of their trades so that they are not negatively affected by known mispricings. For example, based on the weekend effect, if an investor wants to sell a stock, he should sell it on a Friday instead of the following Monday.

At the same time, readers must recognize the limitations of this book and factors that may make these anomalies disappear or appear not to exist.

DOCUMENTED ANOMALIES ARE BASED ON AVERAGES

Just because an anomaly exists does not mean that all trades will be profitable. For example, in the case of changes to the S&P 500, stocks deleted from the S&P 500 index lose value and will usually recoup their losses within a few weeks. This statement is based on an analysis of over three hundred deletions between 1962 and 2002. Does it imply that the next stock deleted from the index is *likely* to appreciate? Yes. But *will* it appreciate? Maybe not. Similarly, the results do not imply that the next twenty stocks deleted from the index will necessarily appreciate, though they are likely to. But the results do imply that if you follow this strategy for the next two to three years *and no significant changes take place in how the market reacts to these deletions*, then you will earn risk-adjusted returns that are larger than the normal return. However, an unsuccessful run of any mispricing can cost the investor a significant loss of capital.

POSITIVE ABNORMAL RETURNS DO NOT MEAN POSITIVE RETURNS

The anomalous evidence presented generally focuses on abnormal returns. Since an abnormal return is the actual return minus the normal return, the actual return could be negative even though the abnormal return is positive. Consider implementing a trading strategy with a 10 percent annual abnormal return. If the market drops 23 percent during a year, as it did in 2002, then the actual return is only -13 percent. Though -13 percent is much better than -23 percent, it is still a loss. Therefore, the anomalies discussed do not suggest absolute profitability, only profitability relative to the normal return.

CONDITIONS GOVERNING ANOMALIES MAY CHANGE

An anomaly may disappear because of a change in conditions. In many cases the anomalies exist because of individual or institutional