CHAPTER 1

Owning the Index

Is indexing a strategy or a philosophy? In this chapter we make the case that it's a little of each, and tell the story of how fifty years ago a combination of advances in computing technology and research in risk management set the groundwork for a revolution in both the science of and attitudes toward investing.

While the financial industry was initially slow to embrace the practice of indexing, the brightest minds in financial academia have been researching the subject for decades, and here we present a collection of some of the most interesting and practical findings, including the results of one groundbreaking paper published by Eugene Fama and Kenneth French in 1964, and another by the same team in 2007.

One of the most researched topics in the long-term behavior of indexes is whether there are patterns or trends in the pricing of indexes that can be identified and possibly exploited. Many investors have beliefs and assumptions that are based upon little hard evidence, and in this chapter we present the most up-to-date research in this area.

THE STORY OF INDEXING

The Standard & Poor's 500 Index (S&P 500) was created in 1957, but the first index fund didn't appear until 1973, and index funds didn't become mainstream until the mid-1980s. Why the delay?

We might not yet have index funds today if not for advances in computer technology. Robert Noyce, of Fairchild Semiconductor, invented the

first practical integrated circuit in 1959, making possible computers that didn't require roomfuls of transistors and that cost tens of thousands of dollars, rather than millions. Data processing became widely available to organizations.

This new computing power was applied to historical stock data. In 1960, the University of Chicago Graduate School of Business realized that there was an opportunity to create a database of common stock prices and calculate the expected return on equities. With the help of a $300,000 grant from Merrill Lynch, the university formed the CRSP, or Center for Research of Securities Prices.

The CRSP completed this project in 1964, and the project was able to include market data from 1926 onward, a thirty-eight-year data sample with between two and three million pieces of information. The expected return on New York Stock Exchange (NYSE) stocks was found to be 9 percent, and the results were published on the front page of the *Wall Street Journal*.

The CRSP's data set still plays a dominant role in finance, and the vast majority of academic research studies use its data as a source due to its completeness and accuracy. We'll revisit its contributions later, when we look at the research on different types of stocks and indexes.

With this data, researchers began to study the performance of individual investors and mutual funds, and they found a surprising result. The S&P 500 was beating all of them. Not every day, not every year, but over long periods of time the index delivered higher results than most market participants were getting either individually or from their investment funds.

And when the results were adjusted for risk, the gap was astonishing. Individual investors and mutual funds had lots of up and down years in which they would gain or lose large sums. In contrast, the S&P 500 had extremely low volatility and could deliver much more consistent returns, without the white-knuckle roller-coaster ride often associated with focused stock portfolios. Less risk allows investors to invest more of their money with the confidence that it will still be available next week or next year.

Even so, this research was largely confined to the academic community, and there was little demand for an S&P index fund. Even if Wall Street money managers understood the issue, they had little incentive to change, and individual retail investors didn't even know what they were missing.

John Bogle started the first index fund for retail investors on December 31, 1975, and he had little competition. Evangelizing new ideas can be a lonely business, and his fund was initially ignored and then laughed at. His timing wasn't ideal either, as the market performed poorly for the next five years. Eventually, the fund's performance statistics overcame the skeptics. The Vanguard S&P 500 Fund beat 84 percent of his competition

over the twenty-year period from 1980 to 2000, and by the 1990s, indexing was established in the marketplace.

With success came competition. New indexes were created to capture returns from other asset classes, such as bonds or small-cap stocks, and new funds were created around those indexes. Today, new indexes and associated funds are launched every day to capture smaller and smaller subsets of the market. Ironically, that presents investors with the challenges in security selection that indexing was originally designed to avoid.

Another factor currently driving new index construction is a feedback loop between the financial media and investors. Narrow-sector or country indexes are very useful to reporters and sell-side analysts who are covering a specific segment of the market, as they provide definitive statistics that can be compared to other investments. For example, an analyst might compare ten commodity ETFs and publish the results, which in turn helps to market those investments.

But additional choices are always good for educated and informed investors. The S&P 500 can be viewed as an accidental success, and many of these new indexes offer better risk and reward. We'll cover higher performance indexes in much more detail later in this chapter.

As the universe of investment choices grows, so does the availability of options and futures, both of which can be used to gain additional leverage and capital efficiency on the original index. We're at a unique point in history in which indexing and derivatives are mainstream financial products, and are now cheap and widely available to both institutional and retail investors, and at the same time a large body of academic research has emerged to support both indexing and specific investment styles.

INDEXING: STRATEGY OR PHILOSOPHY?

Active investors and index investors both have the same goal—to profit from their invested capital—yet they have very different philosophies and approaches, and seem to view the financial markets through opposite ends of the spyglass. Is one view right and one wrong? Or is there a way to reconcile the two perspectives?

Active Investment Selection

Active investing begins with the assumption that at certain points a stock price is trading above or below fair value, and that an investor can identify and profit from that differential. The process is research intensive, and ultimately decisions are subjective, combining fundamental financial

and technical analysis with qualitative factors such as predicted future trends or investor psychology.

Most active investors have an area of expertise, perhaps a country or industry or perhaps a style, such as small growth companies. Specialization allows them to identify consistent patterns in the market and provides an edge over other investors.

After the capital is committed, stock prices can move for a variety of reasons that have nothing to do with the initial analysis. A price increase could be due to the company's improved prospects, industry trends, macroeconomic factors, a bull market, market demand for a specific type of stock, a favorable geopolitical outlook, or perhaps simply because of luck.

The decision to sell is the most complex and important of all financial decisions. An active investor usually has more investment opportunities than available capital, and is constantly faced with the choice between closing a position and taking a certain profit or loss and moving the capital to another opportunity, or holding the existing position and hoping it improves.

Successful active investing means having some ability to anticipate the behavior of other active investors. Even deep-value investors have to trust that other active investors will eventually agree with their fundamental evaluations and insights, or they could be stuck holding a position for years, waiting for the valuation to improve.

In television commercials, active investing is often presented as a pursuit for a retiree or small-business owner. In actuality, most of the capital assets in the market are managed by multibillion-dollar funds with experienced management and enormous research capabilities. These funds are generally risk-averse, partly by mandate and partly because it's so easy for an investor to move their money elsewhere.

Index Investing and the Efficient Markets

Index investors don't conduct any research, at least not on individual securities. Their goal is not to profit from pricing anomalies, but to capture the average return of an asset class while reducing risk to the lowest level possible through very broad diversification. Their assumption is that the buying and selling activity of all of the active investors in the market has already pushed prices close to their fair value. This doesn't mean that markets are completely efficient, but only that they are efficient enough for indexing to work over long periods of time.

For example, consider a market with 100 stocks, with every stock trading at either 10 percent above or 10 percent below its fair value at random. Every stock in this market is mispriced, but on average, the market is exactly fairly priced.

Or consider a market in which all stocks are overpriced in some years and underpriced in others. An index investor that bought when stocks were overpriced would suffer short-term losses as the market oscillates to underpricing, but would then earn huge gains as the market shifts back to a higher pricing level.

Index investors have only a single market view: that over long periods of time, the index will provide a reasonable rate of return. Their view is not affected by the actions of individual stocks or industries, and even major geopolitical events may only slightly change the level of their near-term projections, but not affect their long-term expectations.

Because index investors are not trying to time moves in and out of individual stocks, their holding period is essentially infinite and their transaction costs are very low. They do not have to watch the market every day or research dozens of stocks. Indexing is very time efficient, but nevertheless requires knowledge of the various securities available and expertise in portfolio management.

As only the largest investors can afford to construct indexes cost-effectively, an index investor's efforts are focused on building a broad portfolio of fund investments that captures and combines the returns of various asset classes, such as U.S. equities, bonds, or foreign stocks. This requires a detailed understanding of the discipline of portfolio management and of the different products available in the marketplace.

Reconciling Indexing and Active Investing

Many index investors look down on active investors and view their attempts to forecast the market as little more than educated guesses and wishful thinking. However, index investors and value investors, a subset of active investors, actually have many characteristics in common. They both have long horizons and believe that markets are efficient in the long run; after all, an efficient market is the only mechanism aside from chance that could reward a value investor.

Index investors hold many more positions than active investors. This diversification reduces investment focus, but also reduces risk. It would be extremely unlikely that an active investor could construct a portfolio with lower volatility than the S&P 500 unless he or she purchased more than one hundred large stocks, which would in turn make in-depth analysis impossible.

In the past five years, the S&P 500 index fund has delivered better performance than 61 percent of actively managed mutual funds, which means that the average mutual fund has less return and more risk. But this still implies that there are actively managed funds that have higher returns, and perhaps also higher risk-adjusted returns. PIMCO Director Bill Gross was able to beat the S&P 500 for 15 years in a row with a value investing style.

The success of active investing, value investing, and index investing seems to suggest that the market is at least somewhat efficient in the long term, but inefficient enough in the short term for some active investors to make profits in excess of the average. Index investing depends upon both active and value investors to set prices in the marketplace, and the profits from indexing come from the continual appreciation of the average price level over time.

In exchange, index investors provide liquidity. At any price, and in any market, they are willing buyers for a security. Although their purchases are individually infrequent, collectively they can provide a steady stream of buy and sell orders at current price levels. This liquidity helps the capital markets function efficiently.

This philosophy of how markets reward investors is flexible enough to recognize that many different styles of investing will work in many different types of markets. In this book, we will not call active investors fools or gamblers, as many books and articles on indexing do. We as indexers should appreciate their efforts to set prices, and in turn we hope that they will appreciate our market participation and additional liquidity.

Our only advice to active investors is that, especially for large-cap stocks, the discipline of investing should be approached professionally. Billion-dollar mutual funds and hedge funds have a number of advantages over the typical trader, including former industry CEOs on the board, access to proprietary data sources, and low trading costs. These funds are eager to take investors' savings, and it's all too common to see amateurs who experience losses respond by taking on additional risk and ultimately turn a modest failure into a major disaster.

INDEX RISK AND REWARD

Individually, equities are very risky, but when combined into broad, diversified portfolios, the risk plummets. This wasn't clearly understood until Harry M. Markowitz and William F. Sharpe studied risk management in the 1960s.

Prior to that point, investors were encouraged to hold only a few high-performing stocks in order to get the highest returns. Sharpe's focus on risk-adjusted returns reframed the problem and changed the debate into how to get the highest return for the lowest risk. Two investments could be compared by assuming an identical risk tolerance and then calculating the expected return, given that constraint.

Meanwhile, Markowitz showed that every additional investment an investor could hold in their portfolio had the potential to reduce risk. The logical conclusion, given an efficient market with every asset priced at or near fair value and taking into account a market's volatility, is that an

investor should own every investment available in proportion to the market. This portfolio strategy is called a market-cap weighted index.

Of course, this is an academic perspective, and, as we will show in this chapter and the next, there are many assets that add additional volatility but do not appear to provide additional return, and market-cap weighting may not be optimal. But currently, the market-cap weighted total stock market index is the most analyzed index in both academia and the financial industry, and the S&P 500 is an excellent proxy, so that's where we will begin the analysis.

Drift and Noise

Stock price returns have been studied for at least one hundred years in order to detect technical patterns, with very little success. Instead, index returns have been found to be a random walk with an upward drift.

On a daily basis or even weekly basis, the upward drift, or index drift as it's also called, is imperceptible. The mean weekly return of $100 invested in the S&P 500 index is 21 cents. It's a fraction of a percent of return combined with typically zero to three points of noise that results in additional upward or downward movement. It took researchers many years of studying market returns to determine that index drift even existed.

Mathematically, the index is considered a submartingale. A martingale is a random series in which each number is equal to the previous number plus a random factor. For a martingale, the most accurate prediction for the next number is the previous number, because the random factor is unpredictable and is only a source of error. A submartingale is a class of martingale in which the base number is steadily increasing over time, but still has a random component.

The up and down weeks of the index tend to cancel each other out, leaving a small net. For every year since 1950, we analyzed the number of up weeks and down weeks and their respective contributions. The result is that the index moves upward about 43 points a year, and then downward about 34 points a year. The difference, 9 points, is the average appreciation.

The data is similar if we look at the index on a daily, weekly, monthly, quarterly, or annual basis. Most of the moves of the index are small and have very little effect, often being canceled out by another small move. Then there are a few large moves that are canceled out by other large moves. But the result is that there are a few more positive moves than negative moves, and that's where the appreciation comes from.

Years that are classified as "up years" or "down years" are simply years in which there were more positive returns than negative. The effect of random noise in short-term returns, such as 3 months or 6 months, is vast. It doesn't start to subside until we get to longer periods such as multiple years.

Over long periods, index drift overwhelms the noise (see Table 1.1). Here we show the average return, the average standard deviation, and a standard deviation range for different holding periods. On average, holding an index for four years was worth about forty points of return with a forty-point standard deviation.

The combination of noise and index drift helps explain why both buy-and-hold and trading strategies work on the index. Buy-and-hold focuses on the drift, and trading profits from the noise. There is some reliability associated with each effect, and an investor who purchases the index at a random point and waits for it to rise will likely not wait long on average—both the drift and the noise have the potential to push the price upward.

As a test, we took the closing dividend-adjusted monthly prices for the S&P 500 from 1950 to 2006, and then calculated how many days it took to generate a 1 percent increase, using daily closing prices. Based upon average appreciation, we would expect the results to be about five weeks. But sometimes it takes only one day, and sometimes it takes many years.

Given the random and independent nature of the noise, it is simply not safe to make directional bets on the index as part of an indexing strategy. All of the statistics show that, on average, the longer an investor is invested in the index, and the more money they invest, the more they will make. Short positions depart from this principle and will tend to lose money over time.

Every investment starts with a view, and the view of an indexer should be that in the short term, the index is unpredictable, but in the long term it will move upward. That's the view that we will build our investment strategies around. That doesn't mean that we can't create short-term strategies, only that they will tend to have more value and certainty when repeated over periods of months or years as a part of a long-term strategy.

Momentum, Mean Reversion, and Market Cycles

Can we do better than to merely treat the index as a martingale? There are two other predictive models that are widely assumed to exist and are commonly applied to the index: mean reversion and momentum.

Mean reversion is the tendency for a price or factor or economic indicator to revert to a mean value over time. For example, U.S. gross domestic products (GDP) growth rates tend to be mean reverting over a period of a few years. The average annual rate for the United States over the past twenty-eight years is 3 percent, and after years in which it is lower, it tends to rise, and vice versa (see Table 1.2).

The correlation between one year's GDP growth and the average growth for the next two years is –0.33, and based upon that statistical relationship, the best guess possible for next year's growth would be 3.0 percent, plus or minus a small adjustment based on the current value.

TABLE 1.1 S&P 500 Index Returns, Average by Holding Period (January 1950 to September 2007, rolling sets)

Weeks	1	2	4	8	13	26	52	104	208	364
Avg. Return	0.17%	0.34%	0.68%	1.36%	2.22%	4.47%	9.10%	18.56%	39.79%	77.65%
Avg. Stdev	1.95%	2.74%	3.93%	5.56%	7.08%	10.43%	15.56%	23.28%	38.38%	61.53%
10% Best	2.33%	3.38%	5.07%	7.52%	10.44%	17.84%	29.06%	50.39%	90.61%	159.65%
10% Worst	−2.10%	−3.02%	−4.11%	−5.23%	−6.27%	−8.84%	−12.33%	−9.25%	−7.16%	1.22%

Source: Yahoo! Finance (source for all market statistics).

TABLE 1.2 U.S. GDP Growth Data Series: 1979 to 2006

Year	GDP Growth Rate (%)
1979	3.16
1980	−0.23
1981	2.52
1982	−1.94
1983	4.52
1984	7.19
1985	4.13
1986	3.47
1987	3.38
1988	4.13
1989	3.54
1990	1.88
1991	−0.17
1992	3.32
1993	2.67
1994	4.02
1995	2.50
1996	3.70
1997	4.50
1998	4.17
1999	4.45
2000	3.66
2001	0.75
2002	1.60
2003	2.51
2004	3.91
2005	3.22
2006	3.32
Average	3.00
Standard Deviation	1.78

Source: U.S. Department of Commerce.

Note that this does not imply that current GDP growth rates can be used to predict future growth with any reasonable accuracy. There is still a vast amount of noise in the series, and growth is often above or below the average for three years out of four. Like index returns, GDP growth is a noisy variable with a large random component.

Momentum is the opposite of mean reversion, and is the tendency for a variable to keep moving in the same direction. At some level, GDP growth also has momentum, as a very low value is very unlikely to be followed by

a very high value. Momentum and mean reversion are not mutually exclusive, so long as they exist in different time frames.

Market commentators and analysts use terms such as mean reversion and momentum to describe stock prices, but there are specific mathematical definitions that can be applied to the 80-plus years of available stock market data. At this point, neither mean reversion nor momentum has been conclusively found in the broad stock market index by any leading academic researcher.

This doesn't necessarily suggest that the effect doesn't exist. Mean reversion could certainly be active across multiple sectors, and perhaps there are target P/E ratios for each industry and for the overall market that help push stock prices down after a rise, and momentum effects that tend to keep them higher in the same conditions. But when all of the effects are added together, they are undetectable, or at least have been up to this point.

> *As Ronald Balvers, Yangru Wu, and Erik Gilliland commented in their 2000 study of mean reversion in stock index prices in 18 countries, a serious obstacle in detecting mean reversion is the absence of reliable long-term series, especially because mean reversion, if it exists, is thought to be slow and can only be picked up over long horizons.*

The result is that there is no way to tie either mean reversion, momentum, or even valuation to a long-term timing model regarding the stock market that tells an investor to get in and out at certain points. Analysts or commentators that suggest that we should avoid investing in the market because it has either risen sharply recently, or fallen sharply recently, are likely making emotional decisions based upon recent volatility, because academically there's very little basis for any conclusion of that sort.

People often see patterns in data that simply aren't there. When stock prices rise, they see momentum, and when prices fall, they see mean reversion. The assumption seems to be that, based upon prior behavior, conclusions can be drawn regarding the future direction of prices. However, that line of thought has been discredited for more than one hundred years.

Clearly, there are stretches where the market goes up or down for a long period of time, and we'll take a closer look at one shortly. The question is whether these cycles are predictable and/or persistent. Identifying a market as a bull or bear is of little value if we don't know how long the present conditions will last.

Still, we should mention that the index does have a few patterns that have been identified. These patterns aren't enough to change our long-term

view, but may suggest altering an investment strategy slightly at certain points.

The first is that the S&P 500 does have a tendency to rebound after a large decline. According to a study by M. Bremer and R. Sweeny, after a daily decline of more than 10 percent, the index will recover 1.78 percent in the first market day, and 2.64 percent over the three-day period. This is simply an average, however, and may be skewed by the 1987 crash and large rebound.

There is also a seasonal affect to stock market returns. Henk A. Marquering studied U.S. stock market returns from 1973 to 2002, and found that monthly returns in the winter months (defined as December to May) are about three times higher than returns in the summer months. This effect was also found in other European markets. It could be considered a superset of the January effect, in which stock market returns are consistently higher in that month.

And, stock market returns are significantly lower on Mondays. Why? Nobody knows, but the effect has been documented in academic studies going back to 1973, including one by Ken French in 1980.

Cycles and Regime Change

Think the markets are unpredictable now? Take a look at this classic quote from *Business Week*:

> *The masses long ago switched from stocks to investments having higher yields and more protection from inflation. Now the pension funds—the market's last hope—have won permission to quit stocks and bonds for real estate, futures, gold, and even diamonds. The death of equities looks like an almost permanent condition—reversible someday, but not soon.*
>
> *At least 7 million shareholders have defected from the stock market since 1970, leaving equities more than ever the province of giant institutional investors. And now the institutions have been given the go-ahead to shift more of their money from stocks—and bonds—into other investments. If the institutions, who control the bulk of the nation's wealth, now withdraw billions from both the stock and bond markets, the implications for the U.S. economy could not be worse.*
>
> *Before inflation took hold in the late 1960s, the total return on stocks had averaged 9% a year for more than 40 years, while AAA bonds—infinitely safer—rarely paid more than 4%. Today the situation has reversed, with bonds yielding up to 11% and stocks averaging a return of less than 3% throughout the decade.*
>
> (From "The Death of Equities," *Business Week*, August 13, 1979)

As this issue of *Business Week* went to publication, the Dow Jones Industrial Average was trading at 887 and had been in decline for three years, and pension funds, cited as the only hope left for the market, had just been given approval to diversify into alternative investments. Inflation, energy, and commodity prices were at all-time highs. Never before and never again would the publication be so pessimistic.

As predicted, things did get worse. By October the Dow Jones Industrial Average (DJIA) was trading at 815, and by March 1980, it was 785. Then the market improved, and finally got above 1,000 again in March 1981 before enjoying an incredible bull market in the mid-1980s.

But was the market clearly in a down cycle? The arithmetic average monthly return from January 1975 to December 1979 is 0.38 percent with a 4.23 percent standard deviation. There are nine months with a greater than 5 percent return, including a 14.4 percent return in January 1976, and a 10.6 percent return in April 1978. In some months the index was trading in the 900s, and in other months the Dow was back down below 750 (see Table 1.3).

By assigning a singular direction to the Dow and by labeling that period, or any period, as simply a bear market, we risk overlooking important details, such as the positive average monthly return and the occasional high

TABLE 1.3 Monthly DJIA Returns during the 1976 to 1979 Bear Market

	1976	1977	1978	1979
Jan.	14.4%	−5.0%	−7.4%	4.2%
Feb.	−0.3%	−1.9%	−3.6%	−3.6%
Mar.	2.8%	−1.8%	2.1%	6.6%
Apr.	−0.3%	0.8%	10.6%	−0.8%
May	−2.2%	−3.0%	0.4%	−3.8%
June	2.8%	2.0%	−2.6%	2.4%
July	−1.8%	−2.9%	5.3%	0.5%
Aug.	−1.1%	−3.2%	1.7%	4.9%
Sep.	1.7%	−1.7%	−1.3%	−1.0%
Oct.	−2.6%	−3.4%	−8.5%	−7.2%
Nov.	−1.8%	1.4%	0.8%	0.8%
Dec.	6.1%	0.2%	0.7%	2.0%
Monthly Avg.	1.48%	−1.55%	−0.14%	0.42%
Range	850 to 1,000	800 to 1,000	740 to 875	800 to 890

All Four Years

Monthly Average	0.05%
Monthly Standard Deviation	4.21%

returns. These two details, when combined with the appropriate strategy, are enough to generate profits, as we'll show in one of our early strategy chapters.

The best, or at least most cited, evidence for market cycles comes from the recent NASDAQ boom and bust in the late 1990s and early 2000s. However, by that point the NASDAQ had become largely a tech sector index, and its huge market cap had distorted even the larger S&P 500, sharply reducing the industry diversification benefits of index investing.

For example, near the NASDAQ peak, in a column written by Jeremy Siegel for the *Wall Street Journal*, called "Big Stocks Are a Sucker Bet," he explained that of the 33 largest U.S. stocks by market capitalization, 18 were technology stocks, and that their market-weighted PE was 125.9. Half of the assets in S&P 500 index funds were invested in "story stocks" with no earnings.

During the last half of the 1990s, as the composition of the S&P 500 changed, so did the volatility. The S&P 500 had traditionally been a very low-risk index, but the VIX jumped from an average of 12 to 15 to the mid-20s and sometimes even the low 30s. (The VIX and volatility is covered in more detail in the next section.)

The lesson is that traditional bull and bear market classifications are not nearly enough to base investment decisions on. Trying to jump into and out of different markets virtually guarantees buying before corrections and selling well before a bull market ends.

Still, indexes do change fundamentally at times, and it's important to recognize what that shift is and when it occurs, particularly with regard to the expected return distributions. Academics often refer to these types of shifts as a "regime change" in order to avoid other market labels with different connotations.

Volatility-related regime changes are, according to studies, somewhat related to changes in macroeconomic variables, financial leverage, and trading volume. At the extremes, such as the period after the 1929 depression when stock prices were moving 10 percent a month, increased volatility may be due to legitimate uncertainty about whether the economic system will survive.

Understanding Volatility

Volatility is a measure of the downside risk of a security. As a rule, volatile securities are expensive to own because they are expensive to hedge. As risk increases and prices become more unstable, option prices climb, and more capital is required to hold a position.

Typically, volatility is quoted as an average based upon annualized historical thirty-day volatility, which is actually the standard deviation of

twenty-two days of market returns. We can divide by 3.4 to convert the annualized number to a monthly figure, or 7.2 to find the weekly result.

For example, if the annualized volatility of the S&P 500 was 12 percent, which is a typical value, that means that prices moved by an average of 3.5 percent a month, or 1.7 percent a week. Sixty-six percent of daily, weekly, and monthly returns are expected to be within one standard deviation, and 95 percent within two standard deviations.

As time gets shorter, the expected range of returns decreases, but only at the square root. The square root of 12 is 3.4, the number of months in a year, and 7.2 is the square root of 52 weeks, the number of weeks in a year. This nonlinear relationship between time and the expected movement of a security is critical for understanding options strategies, forecasting expected returns, and managing risk, and will be covered in more detail later.

We've shown the annualized volatility for selected indexes, calculated using weekly returns. Volatility for an index of 10 or less is considered very low, 15 to 20 is about average, and in the 30s or 40s is considered very high. Consider that a security with a volatility of 40 has a 33 percent chance of gaining or losing more than 40 percent in a year and would also be expected to gain or lose about 10 percent in the coming month (see Table 1.4).

Low or high volatility does not change the average return for the index. Academic theories such as the Capital Asset Pricing Model (CAPM) say that investors avoid assets with high volatility and expect a premium for them, but experience with any hot asset class shows that volatility on the upside can often attract investors rather than dissuade them.

Table 1.5 shows the relationship between annualized volatility, also known as IV, and monthly price change expectations. When the IV for an investment hits 35 or 40, 10 percent monthly movements become commonplace.

Implied volatility, also known as IV, is the option market's future estimates of volatility, as opposed to historic volatility, or HV, which are calculations from actual daily returns. IV affects option prices, and can be backed out of the price of an option if interest rates and dividends are known.

There are several interesting characteristics related to implied volatility that have been widely studied, but are still not well explained. For example, IV for puts is often higher than IV for calls on the same security, IV for in-the-money options is higher than IV for out-of-the-money options, and IV for longer-term options is higher than IV for shorter-term options. Intuitively, IV should be identical for all of the options on a single security, but this is clearly not the case.

IV is also higher than historic volatility in most cases for most time periods. The reasons for this gap are not well understood, and may be related to downside volatility crash protection. We'll later show a volatility arbitrage

TABLE 1.4 Selected Index Returns and Volatility

	Oct 1987 to Sep 2007				Jan 2002 to Dec 2006			
	Monthly Return		Annualized		Monthly Return		Annualized	
Index	**Avg. Return**	**Avg. Volatility**	**Avg. Return**	**Avg. Volatility**	**Avg. Return**	**Avg. Volatility**	**Avg. Return**	**Avg. Volatility**
Dow Jones Industrial Average	0.90%	4.02%	11.31%	13.93%	0.55%	3.54%	6.80%	12.26%
S&P 100	0.82%	4.13%	10.30%	14.31%	0.44%	3.58%	5.41%	12.40%
S&P 500	0.84%	3.95%	10.56%	13.68%	0.57%	3.46%	7.06%	11.99%
Russell 2000	0.94%	5.08%	11.88%	17.60%	0.97%	4.77%	12.28%	16.52%
NASDAQ 100	1.40%	7.65%	18.16%	26.50%	0.86%	5.77%	10.82%	19.99%

TABLE 1.5 Converting Actual or Implied Volatility (IV) to Monthly Change

Volatility	% Change 1 STD (66%)	% Change 2 STD (95%)
10	2.9%	5.8%
15	4.3%	8.7%
20	5.8%	11.5%
25	7.2%	14.4%
30	8.7%	17.3%
35	10.1%	20.2%
40	11.5%	23.1%

(often referred to as "vol arb") strategy that exploits this difference, but it is not risk-free, as volatility can rise sharply and unexpectedly.

In academic theory, implied volatility is the market's best guess of future volatility, and should utilize all available information and be at least somewhat predictive. In reality, it is both predictive and reactive and is heavily correlated to recent negative returns. High volatility can emerge and dissipate quickly, often spiking and then fading after a few weeks.

At the same time, there is a background level of volatility for every index that is related to long-term trends. An argument can likely be made that this is the "true" volatility, or expected return distribution at a weekly or monthly level, and the short-term spike represents only the expected volatility at a daily level. Still, a temporary market drop will often affect IVs on options months or years into the future.

In order to help measure volatility, the CBOE calculates and distributes the VIX, a volatility index derived from a weighted average of a range of options on the S&P 500 index, with the goal of measuring the implied volatility of a 30-day at-the-money option on that index. Other similar indexes are being created for the NASDAQ and the Russell 2000.

Using the VIX and the above divisors for monthly return distributions, we can estimate the market's expected downside risk for the current period. For example, if the VIX is 18, then we can assume that the market believes that the one standard deviation gain or loss for the S&P 500 over the next 30 days is 5.3 percent, or 18 percent divided by 3.6.

Also, by using historical VIX quotes, it is often possible to estimate previous option prices for the S&P 500 or highly correlated indexes. This can be useful for backtesting various options strategies.

Note that the VIX can move very quickly in a matter of days or hours, whereas 30-day historic volatility is a moving average and thus has some inherent smoothing and takes a little longer to rise and fall. Ideally, we would like to know the "instant" volatility, in other words what the return distribution is at that exact moment, but unfortunately that's impossible and can only be estimated later from the future analysis of returns.

HIGH PERFORMANCE INDEXES

Different indexes have very different performance characteristics. For example, the OEX and the S&P 500 have extremely low volatility, and the Russell 2000 has higher volatility but higher performance. This diversity is a direct result of how the index is constructed and the types of stocks it contains.

The S&P 500 has made a tremendous contribution to index investing and to the wider economy—it is even one of the leading economic indicators. Still, it would be fair to say that its construction is more of a product of the 1950s than the twenty-first century. At this point, we know much more about individual stock returns and volatility and portfolio management than we did sixty-five years ago.

The S&P 500 was and still is designed with stability in mind. Companies are selected primarily for size, but also on the basis of financial strength, and the overall composition of the index is carefully managed to provide broad industry representation. Once a company is included in the index, it rarely gets removed except under the worst of circumstances. This creates an extremely stable portfolio with low turnover and low volatility. Note that it is not necessarily the portfolio with the lowest possible volatility—it is very likely that there are still stocks in the S&P 500 that have too much volatility and don't provide enough return in compensation.

The CAPM states that every investment has a beta, or correlation, to the broad market, and the higher this beta, the more return investors should demand from the investment. However, CAPM is much more a theory than an actual observation. In the marketplace there are many highly volatile stocks that have provided low historic returns and that still have high betas, and thus low risk-adjusted returns. The S&P makes no effort to remove these stocks.

Two other "old-school" indexes also seem antiquated given today's knowledge. The Dow Jones Industrial Average consists of only thirty U.S. stocks, selected by hand and price-weighted, and thus is neither a broad measure of the economy nor an academically defensible weighting. The NASDAQ-100, also known as the NDX or QQQQ, is a list of the top 100 companies that happen to be listed on that exchange rather than the NYSE and meet other minimal requirements. It is neither diversified by sector nor broadly representative.

A better approach for index construction would be to mine the CSRP data and find out which types of stocks performed better than others, and build a high-performance portfolio around just those stocks. This was done more than forty years ago, almost immediately after the data set mentioned at the beginning of this chapter was first created.

Small Cap and Value Premium

In 1964, Eugene Fama and Kenneth French studied thirty-eight years of market returns, trying to determine if certain stocks performed better than others. They were originally looking for evidence of CAPM, the model that assumes that beta and volatility drive stock price performance. Instead, they found that the influence of beta on stock returns was very weak.

However, they found that two other factors, size and book-to-market, explained more than 90 percent of stock market returns. Since that time, additional factors have been shown to have additional explanatory value; we'll discuss those shortly.

Book-to-Market is a valuation metric that is closely correlated to other similar metrics such as Price-to-Earnings or Price-to-Cash-Flow. It's a way of measuring whether a company is cheap or expensive relative to its peers. Size is simply smaller market capitalization versus large market capitalization. Small stocks and value stocks have significantly better returns.

Size and Value have been defined in the model as SMB (Small minus Big) and HML (High Book-to-Market minus Low Book-to-Market). These values are the premium that a small-cap or value portfolio delivers over its polar opposite. These values have been tracked for more than forty years and updates are posted monthly on Ken French's web page (see Table 1.6).

For example, in one study, Fama and French created 25 stock portfolios based on five divisions of size and five divisions of Book-to-Market. The small-cap value portfolio has a nine point advantage over Large Growth, and isn't significantly more volatile (see Table 1.7).

The three-factor model has been well examined, and the paper in which it was introduced is the most widely cited in financial academia. The results have been duplicated repeatedly across many different data sets, including later market returns, financial companies (originally excluded from the sample), and international stocks.

Of course this research has profound implications for the broader traditional indexes such as the S&P 500, the NASDAQ-100, and the Dow Jones Industrial Average. All of these indexes are heavily biased toward large-cap and growth stocks. That has led to suggestions that the indexing industry should move away from market-cap weighting to either equal-weight or weights based on some fundamental factor, such as revenue or dividends and the creation of products such as the WisdomTree Index ETFs.

HML and SMB can be viewed as additional investments that are included with the purchase of a value and/or a small-cap stock. Both HML and SMB have positive expected returns for every period, but also wide standard deviations. As is true with the index return, defined in the study as Rm-Rf (Market return minus Risk-free return, such as the rate on a U.S.

TABLE 1.6 Fama & French Factors

	Jan 1950 to Dec 2006					Jan 2002 to Dec 2006				
Factor	**Avg. Monthly Return**	**Volatility**	**Annualized Return**	**Volatility**	**Rm-Rf Correlation**	**Avg. Monthly Return**	**Volatility**	**Annualized Return**	**Volatility**	**Rm-Rf Correlation**
Rm-Rf	0.64%	4.19%	7.94%	14.53%		0.46%	3.62%	5.69%	12.55%	
SMB	0.19%	2.81%	2.26%	9.72%	0.27	0.54%	2.60%	6.63%	8.99%	0.33
HML	0.36%	2.92%	4.46%	10.10%	−0.26	0.70%	2.18%	8.78%	7.55%	0.38

Source: Kenneth R. French Data Library.

TABLE 1.7 25 5×5 Size and Book-to-Market Portfolios

	Annualized Return Book-to-Market						Annualized Volatility Book-to-Market				
Size	**Low**		**Mid**		**High**	**Size**	**Low**		**Mid**		**High**
Small	9.2%	16.0%	16.5%	19.4%	21.2%	Small	26.8%	22.6%	19.3%	18.1%	19.3%
	11.2%	15.1%	17.6%	18.2%	20.0%		23.5%	19.3%	17.2%	16.9%	18.9%
Medium	12.3%	15.6%	15.8%	17.5%	19.1%	Medium	21.5%	17.4%	15.9%	15.8%	18.0%
	13.1%	13.5%	16.6%	17.0%	17.8%		19.2%	16.4%	15.7%	15.6%	17.9%
Large	12.0%	12.8%	14.1%	14.2%	15.0%	Large	15.7%	14.7%	14.1%	14.5%	16.6%

Source: Kenneth R. French Data Library.

government bond), the longer the horizon, the more the return matters and the less effect the noise has.

This suggests that over long periods of time, that is, five or more years, a small-cap and/or value portfolio is virtually guaranteed to beat a large-cap or growth portfolio, even with its additional risk (see Table 1.8). And this also means that on a daily basis, the statistics favor the outperformance of these securities, if only by a slight amount.

In the following, we've compared the returns from the S&P 500, the Russell 2000, and the Russell 1000 value for various periods. As shown previously in Table 1.6, SMB is positively correlated with the Rm-Rf, which means that in bull markets, SMB will generate higher returns, but in weaker markets, it will punish a portfolio. This is why many investors avoid small stocks regardless of the premium, although the additional return appears to more than compensate for the risk over long periods of time.

On the other hand, HML, the value premium, is negatively correlated with Rm-Rf, which means that these stocks can provide a cushion in a down market, but will lag in up markets. Still, it should be noted that both of these correlations are relatively weak and may not hold for shorter periods of time.

Holding both premiums, the small-cap and the value, combines the relative outperformance, but allows the correlations to cancel each other out, becoming roughly zero. That creates an asset with a beta of 1, but with almost double the equity premium.

However, it should be mentioned that there is a momentum effect to small cap and value returns, and there will always be periods where small

TABLE 1.8 $1 from 1950 Invested in . . .

	Large Caps			Small Caps		
	Growth	**Neutral**	**Value**	**Growth**	**Neutral**	**Value**
1955	2.53	2.77	3.63	2.39	2.70	2.90
1960	4.61	5.24	7.02	4.83	5.45	6.05
1965	8.00	10.35	14.10	6.01	8.92	11.82
1970	9.95	10.53	19.50	12.81	18.70	25.85
1975	9.44	12.04	27.43	6.21	14.90	26.67
1980	15.90	28.62	70.65	24.92	57.72	116.82
1985	28.93	57.44	172.42	44.35	167.70	380.74
1990	60.88	120.64	384.73	54.92	303.80	699.01
1995	106.95	198.10	674.10	80.59	586.36	1,418.64
2000	388.61	502.66	1,488.86	183.20	1,392.03	3,418.68
2005	311.42	752.28	2,110.27	158.72	3,007.44	9,036.47

Source: Kenneth R. French Data Library.

cap and value underperform the broader market. The outperformance is only a tendency over longer periods of time.

Stock Migration

The size and value premiums are well known, but not widely exploited. The overwhelming majority of assets, and especially indexed assets, are in large-cap portfolios that are tilted toward growth. The issue preventing more widespread adoption may be that both factors take time to deliver returns in excess of their volatility and may be incompatible with a mutual fund industry that's focused on next quarter's performance.

There is also one other key difference between index portfolios constructed around small-cap and/or value stocks and the more traditional index portfolios such as the S&P 500. The portfolios are much more dynamic.

Fama and French revisited their research in 2007 and started tracking the movements of stocks in and out of the size and value portfolios. They divided the stock universe into three value categories and two size categories, and assigned each stock to a portfolio in June of every year, based on its book-to-market ratio and market capitalization.

What they found is that stocks moved in and out of the value category very frequently. Almost thirty percent of value stocks moved to core, the center category, and almost thirty percent of the stocks in core moved to value. As these stocks migrated from value to growth and back, they were bought and sold by the virtual portfolio, generating returns in the process (see Table 1.9).

Value stocks also had a better chance of being acquired, and when they were, the premiums were higher. This positive migration (from value to core) and the opportunity to benefit from an acquisition is the explanation

TABLE 1.9 Migrations between Growth, Neutral, and Value Portfolios (by percentage of stocks, annual average)

From	To	Percent
Big Neutral (BN)	Big Growth (BG)	12.5%
	Big Value (BV)	9.2%
Big Growth (BG)	Big Neutral or Value (BN/BV)	13.3%
Big Value (BV)	Big Neutral or Growth (BN/BG)	20.3%
Small Neutral (BN)	Small Growth (SG)	10.9%
	Small Value (SV)	20.1%
Small Growth (SG)	Small Neutral or Value (SN/SV)	27.0%
Small Value (SV)	Small Neutral or Growth (SN/SG)	16.5%

Source: Fama & French, "Migration" (CRSP Working Paper No. 614, 2007).

for the value premium. Small-cap stocks also migrate—a few grow and become large stocks, creating huge premiums in the process. An individual small-cap stock is a lottery ticket with an expected payoff higher than its cost, but with an extremely high volatility. Individually, small-cap stocks and value stocks are more risky than large-cap and growth stocks, in that they have a higher chance of failure. In the study, each year on average, 2.5 percent of small-cap value stocks were removed from the portfolio due to failure, compared to 2.2 percent for small-growth and 0.2 percent for large stocks. In absolute terms the percentages are still very low and don't affect the premium significantly.

The phenomenon of migration makes us question what it really means to be an index. The Dow Jones Industrial Average and S&P 500 are relatively stable collections of companies. Of course, mergers and acquisitions take place, and new firms are added to the list, but the average turnover is relatively low, about 5 percent for the S&P 500.

But the Fama and French value portfolio changes every year. It could change every month or every day. It buys stocks when they are relative values and then sells them when prices rise. Similarly, the small-cap Fama and French portfolio buys small stocks and sells them when they get big. And when these two strategies are combined, the portfolio outperforms the market by eight points a year, on average. Did Fama and French develop a factor model, or did they in fact create two rule-based trading systems that have delivered higher returns than the broad market for more than eighty years?

The pair is modest when discussing their achievements. Their explanation is that markets are efficient, and that there is no market outperformance without additional risk, which means that small-cap and value stocks have to carry more risk. That may be true of the small-cap index, due to the positive correlation between Rm-Rf and SMB, but value stocks have the opposite effect—they deliver higher returns but reduce some of the risk associated with equities. Many others believe that behavioral factors are involved.

There have been many studies that show that investors chase outperformance. Most are naturally attracted to securities that have risen lately and mentally screen out those that have performed poorly from their investment choices. Behavioral finance could certainly account for the effect.

Another explanation may simply be that small-cap and value stocks are more risky individually, but this risk is reduced dramatically when hundreds of stocks are held in a portfolio. The pricing then is rational at the individual level, because it takes into account the risk of total loss, but not at the aggregate index level when diversification is applied.

Additional Factors

Another argument for the behavioral explanation comes from the momentum factor. There are two studies that are the cornerstone of momentum theory. The first, by Narasimhan Jegadeesh and Sheridan Titman (1993), shows that stocks that have done well over the past six months outperform "losers" by 1 percent a month on average for the next six to twelve months. This is sometimes known as the "smart money" effect, as it's assumed that the dumb money follows the smart money and contributes to their total return. However, Werner F. M. DeBondt and Richard Thaler (1985) show that loser stocks in the past three to five years outperform winners by 25 percent over the next three years. This implies long-term reversals are an important phenomenon in the market, and that many investments left for dead can come roaring back to life—for example, telecom or energy in recent years. Models that use momentum as a fourth factor (see Table 1.10) in explaining stocks returns refer to it as UMD, or Up minus Down, or alternately, WML (Winner minus Loser), or MOM (Momentum); however, not all use the same time or portfolio definition.

Ken French calculates the factor using 2 to 12 month returns, and averaging the difference between the momentum effect on a large-cap and small-cap portfolio. The results from 1950 through 2006 are 0.84 percent a month with a 3.65 percent standard deviation, making it definitely a significant, if somewhat unpredictable, factor. MOM is not correlated with the broader market, which is somewhat unexpected.

While no indexes have been constructed around the momentum factor, there is some industry discussion that mutual funds often use stock momentum in their selection process. It follows that it could also be used to select broad portfolios full of stocks with high momentum factors, such as countries, industries, or even styles.

While momentum is commonly accepted as a fourth factor, even by Fama and French, there is no real agreement on a fifth factor. One approach that has been used is to identify a new market beta and use this variable as both a systematic risk indicator and a factor explaining individual stock market returns.

For example, Lubos Pastor of the University of Chicago found that returns were greater for less liquid stocks. Ten portfolios were created based upon liquidity, and the top decile, that is, the least liquid stocks, had 9 percent higher returns than the lowest liquidity, even after controlling for size, value, and momentum.

In another study, researchers created a volatility beta for the total stock market that measured an individual stock's sensitivity to market volatility, that is, the VIX. Stocks that had more sensitivity delivered better returns.

TABLE 1.10 Momentum Factors

	Jan 1950 to Dec 2006					Jan 2002 to Dec 2006				
Factor	Avg. Monthly Return	Volatility	Annualized Return	Volatility	Rm-Rf Correlation	Average Monthly Return	Volatility	Annualized Return	Volatility	Rm-Rf Correlation
Mom	0.84%	3.66%	10.54%	12.67%	−0.06	0.31%	4.34%	3.74%	15.02%	−0.58

Source: Kenneth R. French Data Library.

Regardless, given that at this point there is no momentum-based index fund or other investable asset in the marketplace, even if a fifth factor were conclusively found, it could be a long time before index funds were constructed around it.

FORECASTING INDEX RETURNS

Modeling stock returns has always been difficult for academics and researchers, primarily for three reasons:

1. Volatility varies across at least two dimensions. There is a long-term volatility that changes slowly, and shorter-term volatility that spikes upward when the market declines.
2. Prices jump between trading periods. An index may close at 1,550 and then open at 1,540 the next day because of negative news or events before the open.
3. Return distributions are not normal distributions. It is not exactly clear what they are, but usually they are modeled as log normal. Log normal variables are the multiplicative product of many small independent factors, such as the daily rates of return on a stock.

The models in use in academia and on Wall Street are random walks with generalized autoregressive conditional heteroskedasticity, or GARCH, which are then modified for discontinuities (that is, jumps), fatter tails, and other variable distributions such as a student-T. For example, one model, EGARCH, is an exponential model that provides for both positive and negative shocks.

Thankfully, in this book we can use much simpler models because the objective is to calculate a reasonable set of monthly or annual price changes, rather than the continuous stream of price ticks that traders use. Still, as we progress, we will apply some of the techniques listed above to generate prices with higher frequencies or more complex volatilities.

SUMMARY

The practice of indexing owes its existence to several key events, including research into portfolio diversification, a data analysis project for the University of Chicago, and the Vanguard fund, the first index fund for retail investors. Today, indexing is firmly established in the investing marketplace, and new products are being introduced constantly.

Indexing strategies work because the market is at least somewhat efficient, meaning that in the aggregate and over long periods of time, the market price of a set of securities should trade in line with its fair value. However, the success of indexing does not preclude active investing strategies from working, and, in fact, indexers need active investors to continuously adjust the market prices of securities through their trading activity.

While many investors believe the pricing trends of the indexes are influenced by previous prices and thus exhibit either momentum or mean reversion, and market analysts often cite these two reasons for either market rallies or declines, the research in this area has found no significant relationship between past pricing trends and future prices. The index can best be described as a small amount of upward drift with a large amount of random noise.

As a short-term investment, the index is wildly unpredictable, as the high level of noise makes the price changes over periods of weeks or months essentially random. But over longer periods of time the index delivers. For holding periods of four years, gains average 40 percent or more and losses are scarce. This creates an opportunity for long-term leveraged investments to benefit through the investment and compounding of additional capital.

The S&P 500 has long been used as a proxy for the market-cap weighted U.S. stock market index, because from its inception it has contained a cross-section of the largest listed firms. But analysis from Fama and French in the 1960s revealed that shares of larger firms tend to underperform smaller firms, and that shares of firms with a higher book-to-market ratio underperform those of other firms. The publication of the three-factor model has led to both the creation of new high-performance indexes, and an ongoing search for additional factors.