BANYAN HILL

Smarter Investing in Any Economy!

The Definitive Guide to Relative Strength Investing

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Welcome to the Banyan Hill Publishing edition of *Smarter Investing in Any Economy!*

I'm excited to give you a "behind the scenes" look at the key behind many of my successful trading systems — my relative strength (RS) indicator.

I want you to know that while *Smarter Investing* took about three months to write — it took about 18 years to research.

It was a few decades ago, in 1990, when I first came across the idea of RS — and I immediately knew it made sense. For those unfamiliar with relative-strength trading, I'll just say now that the idea is simply to buy stocks that are going up and avoid stocks that are going down.

It really is as straightforward as that.

However, in 1990, there wasn't a lot of information about RS available. Access to the indicator required an expensive subscription. To top it off, I couldn't find any formulas for RS. So I started working on my own.

After a few months, I had an idea that seemed like it would work, but the formula needed to be refined.

Then, in October of that year, I read that the Royal Swedish Academy of Sciences awarded the Nobel Memorial Prize in Economic Sciences to three economists who had studied the stock market. One of the economists was Dr. William Sharpe.

As I read about his research, I realized the formula I was working on was something known as "beta," one of the concepts the Nobel Prize recognized. Beta is found with a linear regression that compares the stock's price moves with the changes in the S&P 500. I cover the calculations in detail later in this book.

This news didn't discourage me. It actually opened up a whole new world, which you'll read all about in this book.

That's because I now knew there was academic research that could help me discover how to beat the market.

Remember, this was the early 1990s, before the internet, so progress was slow to say the least. I had to work through libraries to access academic papers and journals. It could take months to get individual papers! And sometimes I got my hands on research that didn't help me an iota. But finally, in 1999, I uncovered a paper that had been published in 1993 proving RS worked.

And it provided a simple formula. From there, I found other papers, some dating back to the 1940s. But I realized there was a clear problem in all this research…

There was nothing explaining how to use RS to the average, individual investor.

That's why I decided to write this book.

This book was released in May 2008, as the stock market was beginning the worst bear market since the Great Depression. Test results shown in the book run through December 31, 2007, and I have to say the results shown in the book are impressive.

For example, this table is the same one you will see in Part 3. All of the rules are described in the book, by the way.

RS Techniques	Annualized Return	Maximum Drawdown
Normalized rate of change	20.10%	-52.26%
Back-weighted ROC	21.77%	-47.21%
Front-weighted ROC	19.83%	-53.06%
Price/Moving average ratios	18.87%	-55.42%
Ratios of multiple moving averages	21.94%	-42.41%
Averaging different time periods	21.10%	-50.15%
Alpha	20.94%	-53.53%
S&P 500	**8.70%**	**-50.03%**

These tests use different definitions of RS, and each definition beat the market (the S&P 500), based on the annualized return. As you can see, though, the results show that an RS strategy can suffer steep losses. The Maximum Drawdown column shows the largest loss in the portfolio over the 17-year test period.

Yes, the maximum drawdown is high — and this is a problem with RS. But there are ways around that problem as I explain in Part 4 of the book.

Of course, these results don't include the bear market, which was already underway when the book appeared. So every reader should ask an important question before they get to the first page of the text: What happened in the bear market?

I wanted to provide you with that information, so — to see if these RS strategies have worked since the 2007 publication — I ran new tests. These tests were all run the same way the original tests were run, except for the dates.

The start date is January 1, 2008, and the end date is January 15, 2018, which allowed for the longest test period while meeting this new publication deadline.

Results are in the table at right.

RS Techniques	Annualized Return	Maximum Drawdown
Normalized rate of change	9.10%	-53.20%
Back-weighted ROC	9.40%	-58.50%
Front-weighted ROC	11.00%	-45.50%
Price/Moving average ratios	13.10%	-42.40%
Ratios of multiple moving averages	7.60%	-50.10%
Averaging different time periods	8.80%	-51.60%
Alpha	10.50%	-44.30%
S&P 500	**7.00%**	**-56.00%**

The results show that RS still works in the long run — even throughout a bear market. All of the formulas still beat the market. Of course, all of the results continued to endure large drawdowns. So risk management is central to implementing an RS strategy, and that's why I have spent years working on that.

In the time since it's been published, my research has continued. It's not surprising that if I wrote this book today, it would include information I didn't know a decade ago. After all, I do use the most up-to-date research in my current work and share that research whenever possible.

But the main point remains this — relative strength works, and it works well. And if you understand it, you can use it to beat the market. That's why I wanted to present this book to you. It has everything you need to get a good grasp of the strategy.

I hope you enjoy it and benefit from the details you're about to learn.

To the best of trades,

Michael Carr, CMT
Banyan Hill Publishing
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CHAPTER 1

Defining Relative Strength

To understand and profitably implement relative strength, it helps to look back at the popularity of momentum investing; an idea which drove stock markets around the globe to irrationally exuberant levels in the first few months of the twenty-first century. There was nothing inherently wrong with the ideas of day trading, or rapid fire momentum investing. The problems arose because many traders had never considered momentum as part of a complete investment philosophy. There was little thought given to the fact that it might not work someday, and many portfolios suffered for this lack of forethought. A complete philosophy includes plans for managing losses, reinvestment alternatives in declining markets, and recognizing that the trader's system has stopped working.

The most notable problem with momentum investing is that it required stocks to keep going up, making new highs every day. When one stock ran out of steam, another one would pick up the slack, and traders would pile into that one, abandoning yesterday's darling in favor of the next and always on the lookout for tomorrow's rising star. No one ever seemed to consider the possibility that one day, everything might just go down. And, to survive over the long-term in the markets, this possibility needs to be planned for. While momentum traders were in constant pursuit of something going up, relative strength investors, armed with a plan, were able to prosper even as a bear market rivaling the legendary one that heralded the Great Depression took hold.

Momentum investing captured the imagination of the public in the 1990s as some individual investors placed their life savings and dreams of early retirement with top performing mutual funds that

delivered phenomenal returns. Funds run by Janus and other large growth fund families advertised during prime time television shows, making sure everyone knew they represented the new era of stock investing.

Nothing like it had been seen on Wall Street before . . . at least not since the Go-Go years of the 1960s, when great rewards accrued to investors in the hottest mutual funds, which usually held the hottest stocks of the day, the Nifty Fifty. This was when investing was easy as managers bought "one decision stocks." This meant they never needed to decide when to sell because these stocks would never stop going up. And they didn't, until they went down in the worst bear market since the Great Depression in the early 1970s.

But, other than that, nothing like the internet boom had ever been seen on Wall Street before . . . except for that time in the 1920s when stock prices rose for nearly seven years before falling by more than 80 percent in less than three years.

But the 1990s were a different time for the markets. Many traders realized they didn't need professional help and took charge of their own destinies in the late 1990s. They began trading for themselves. The press was filled with stories of day trading. Rapid fire momentum trading was made possible by the internet, and companies which existed solely because of the internet were the best choices for these traders. AOL, Yahoo, and anything with dot.com in its name was going up, and traders were making money faster than they could spend it.

Buying what went up and selling stocks when they started going down was the key to an early retirement. Unfortunately, there are no simple paths to riches on Wall Street and the dreams of many were lost, along with their money, in the internet crash which followed the brief boom. Deep in despair, many took what they had left and turned to value managers to help them get rich slowly. They often believed that momentum investing was a fad. Yet, in the hands of prudent investors, momentum investing remains a powerful tool for profiting from the markets.

One problem momentum investors faced was determining when to sell. Most investors in that era set stop losses for each position

they entered. It was often a rigid rule, such as selling if the price dropped more than 8 percent from the purchase price. One problem with this approach is that the market doesn't care what an investor paid and 8 percent below the purchase price may just be a normal retracement in the stock price. Routine price action shook many investors out of what should have been winning positions.

Momentum investors also faced the problem of knowing when to take profits in a winning position. One key to achieving long-term wealth in the investment community is to let winners run as long as possible. But, nothing goes up forever and when the stock starts going down, the investor is giving back hard gained profits. Selling a winner too early means the investor failed to fully profit from their correct stock selection; selling too late means they gave back too much in profits.

A final problem that momentum investors face is what to do with their investment capital after they sell. Without a clear idea of what to buy next, they can end up chasing the latest stock tip or buying that great stock that was just mentioned by an analyst on television. Another risk is not reinvesting profits in a bull market. Sitting on cash in a bull market carries an opportunity cost, which can be just as damaging to an investor's account as trading losses since both lead to lower equity.

Relative strength (RS) is the idea that allows us to incorporate momentum investing into a complete investment strategy. RS makes it possible to develop clearly defined buy rules, establish criteria in advance for selling when the buy decision was wrong, and know in advance how to handle winning trades. These strategies require the investor to develop a list of stocks to buy from, eliminating the problem of what to buy next. Collectively, these processes take emotion out of the investment process and help to prevent the bane of most small investors who buy tops and sell bottoms.

Concepts Behind the Idea of Relative Strength

Everyone understands the idea of momentum. Almost 400 years ago, Isaac Newton summed it up in his First Law of Motion, "An object in motion tends to stay in motion unless an external force

acts on it." In the stock market this means that stocks go up until they stop going up. This idea is captured by the old Wall Street adage, "the trend is your friend."

Turning to Newton's law for an example, we can think of the game of baseball. The essence of the game is the duel between the pitcher and the batter. The baseball is subject to a series of external forces, beginning when the pitcher throws the ball towards the batter. The ball remains in motion until acted upon by an external force — either the bat or the catcher's glove stops the forward motion of the ball. If the bat connects with the ball, it applies an opposite force, and the ball is propelled back towards the pitcher by the force of the bat.

The same rules apply in the stock market. Stocks spend most of their time in trading ranges, waiting for an external force to move the stock in one direction or the other. A trading range occurs when a stock remains within a narrow price channel, for example it may trade between 45 and 50 for several weeks. Most studies have shown that stocks are typically within trading ranges up to 70 percent of the time. To make money in the stock market, traders and investors need to own the stocks which are not in trading ranges. Successful investors need to find stocks shortly after the outside force has caused it to leave the trading range. In theory, investors can profit without knowing why a stock is moving.

In the markets, an external force that acts on a stock in motion may cause it to rise or fall. Sometimes the external force is news about the company, perhaps an announcement that the company, or even a competitor, will have lower than expected earnings. It is important to remember that stocks and the company which issued the stock are two different things. Stock movement can become disconnected from the underlying company fundamentals, which is what makes investing so challenging.

The external force that reverses a trend may be something completely unrelated to the company, such as something like a tightening of the money supply initiated by the Federal Reserve Board or an economic downturn. Likewise, a stock will continue falling until something significant occurs to reverse the decline,

maybe a new product, restructuring of senior management or changes in the overall economy.

When the external force is applied, the stock takes off in one direction or another. Unfortunately there are no hard and fast rules in the stock market, and there is no predictability as to which way the stock will move in response to an event. A good earnings report will usually drive a stock higher, and a negative earnings surprise can knock the value of a stock down by half. But sometimes what seems like a good earnings report leads to a large decline in a stock because reported earnings miss the rumored number that traders had been expecting. The goal of RS investors is to ignore the rumors and the news, looking only to find stocks shortly after they have broken out of the trading range. In theory, RS investors don't even need to know what the stock is, they simply need to know it's going up and has been for some time.

That's all RS investors are trying to do - buy stocks that are going up and sell them when they start to go down. The large number of people trying to do this can lead to sharply rising prices, rewarding traders who spotted the opportunity in the earliest stages. As more and more traders see the rising price trend, they bid the shares higher and higher. RS investing is a real world application of what economists would call the "Greater Fool Theory."

Economists would say that when a trader is acting under the greater fool theory, they buy questionable securities without any regard to their quality, but with the hope of quickly selling them off to another investor (the greater fool), who is also hoping to profit by selling it quickly. While it sounds irrational to believe that this theory explains market action, it does apply to any speculative bubble. Unfortunately, speculative bubbles always burst, and what goes up quickly comes down even quicker with prices falling rapidly when the supply of fools dries up.

Speculative bubbles have a long history in the financial markets, and even Isaac Newton was caught up in one. Newton is believed to have lost a £20,000 fortune speculating in the South Seas Bubble, which occurred in England during the early eighteenth century. The South Seas represented the trade route between Europe and the newly discovered colonies of the New World. And just like

the internet, the South Seas held the promise of a brave new world for business. As the internet would 300 years later, the colonies created dreams of riches in the common man. Momentum investing ruled the stock market in England in the early 1700s, as traders bid on shares in companies that had business plans only slightly more ludicrous than an internet startup. Charles MacKay documented some of the business ideas in his 1841 book, *Extraordinary Popular Delusions and the Madness of Crowds*. He found companies that sold stock to the public so they could engage in businesses such as trading in hair, insuring and increasing children's fortunes, manufacturing a wheel for perpetual motion, and in what remains an all-time classic for a publicly traded company, one company sold shares to finance "an undertaking of great advantage; but nobody to know what it is."[1] Investors read these business plans and were undeterred; after all it was a new era in business. In the end, prices came down to reflect the reality of these businesses, and losers vastly outnumbered winners.

Manias such as this illustrate the danger of momentum investing. While we generally think of bubbles as impacting entire markets, micro-bubbles can occur in sectors or even individual stocks. It's possible for traders in individual stocks to drive prices insanely high in that stock in the midst of a bear market. This is what makes momentum investing successful, sometimes.

Buying on the greater fool theory certainly works for a time. It stops working when there are no fools left to buy, and the timing of the fool shortage is unpredictable. Human nature has been unchanged for centuries, so we can be certain that another mania will arrive. Starting with the idea of momentum investment, we can create a complete investment methodology that will allow us to profit from the next mania. More importantly, a disciplined strategy which includes selling and risk management criteria will allow us to keep most of our profits from that mania. The strategies developed will also yield profits during more rational times, the times that mark most of market history.

From Momentum to Relative Strength

Another law that always applies in the stock market is the law of supply and demand. This is the most basic law of economics and

states that the price for any product or service will move towards the level where supply and demand for that product or service are equal. As the number of buyers increases, demand exceeds supply and producers can charge more, meaning prices move higher. If the number of buyers decreases, supply exceeds demand and prices will drop. Higher prices convince suppliers to produce more, while lower prices lead producers to shift their efforts to alternative products, decreasing the supply of the original product or service. The constant changes in supply and demand impact the price, driving it towards the point where the forces of supply and demand are equal.

In the stock market, buying represents demand and selling creates supply. Buying increases the price and as prices rise, sellers enter the market seeking to profit from their holdings. As the available supply of stock gradually increases because sellers are entering the market, prices start to stabilize. At some point, high prices convince enough people to sell while scaring away additional buyers and the supply of available stock then exceeds the demand for the stock. When supply exceeds demand, the price declines to entice buyers. These simple ideas create the movements we can so readily spot on stock charts.

Economists make the assumption that the law of supply and demand works because consumers, or in our case investors, are rational. Demand exists because the buyer needs the product being offered, and supply exists because suppliers have identified a need and are seeking to maximize their profits by meeting that need. These assumptions work in most markets, with products such as bread and services such as hair styling. Consumers need these staples and if prices seem too high, they will substitute other choices (like buying generic bread instead of gourmet varieties) or limit their consumption (for example by getting their hair done every six weeks instead of every four weeks, or switching to a less expensive stylist). So consumer demand is regulated by price and if prices get too high, demand will decrease, forcing suppliers to lower prices to stimulate demand. At some price, consumer demand and supplier profits are maximized.

The problem with applying the law of supply and demand to stocks is that investment markets are not always rational. Most

investors don't truly have a need for the stock they are buying — they are making a choice of what to buy in order to achieve a goal of maximizing gains. Rationally, they should be looking for the best available investment based upon quantitative criteria. But often a stock is bought without any supporting financial logic to support the purchase, For example, an investor may buy the stock of a retailer because as a consumer, they like that store, even though the company is losing money.

All too often emotions become involved in the buy and sell decisions. Greed can lead to buying speculative penny stocks or hanging on to a loser far too long in the hope that the investor will eventually break even. Fear can cause an investor to sell a winning stock too early, or to become paralyzed and unable to act in the face of a broad market decline.

Irrationality and emotion are partly responsible for the success and failure of the momentum investment style. In part, the emotions of investors will always drive stocks higher or lower than then the underlying fundamental value of the market. A bull market feeds on itself as some investors hear about the success of others, decide they are smarter than many making fortunes in stocks, and buy into the hot stocks of the day. As others pile into the game, prices move higher and higher. Newspapers and business news on television begin covering the top movers, and soon everyone knows that a certain stock is going to $1,000 a share. The momentum investors continue piling in, and large paper profits build up.

The problem is converting those paper profits to taxable gains. As smart investors start selling to the latecomers, the supply of the stock increases and prices stop going up. Soon, investors accustomed to incredible gains on a daily basis begin looking at other stocks which have continued going up and think that their money would be better invested in the next stock that everyone knows is going to $1,000 per share. In order to buy the next winner, they need to sell the stocks they own. As everyone tries to sell at once, there is no one left to buy and prices decline very quickly. Usually the declines seem even sharper than the preceding price rise, which leads to fear among those who bought this stock for the long-term, and they too enter sell orders. The

result is the type of decline that was painfully common at the end of the internet bubble.

Examples of this behavior are found throughout the history of trading. In the internet bubble, solid companies as large and as profitable as Sun Microsystems and Cisco rose beyond any rational expectation along with companies less deserving of rich multiples such as pets.com, whose sole asset was a sock puppet used in expensive television commercials. One company that led the bubble on the way up and was one of the first signs of the over-inflating bubble was MicroStrategy (MSTR), whose chart is shown in Figure 1-1. This company perfectly illustrates the large price gains commonly seen in momentum stocks along with the dramatic declines also commonly seen in this type of stock. We can see in the chart that momentum traders piled into the stock on the way up, but all tried to get out at the same time when bad news hit. An effective momentum strategy would need to take part in most of the upside, while limiting the downside to prevent giving back most of the hard fought gains.

The principle underlying momentum strategies is the concept of RS. Returning to the example of the baseball pitcher and batter, when the bat hits the ball, the force transferred to the ball

FIGURE 1-1

Weekly chart of MSTR illustrating the rewards and risks of momentum investing.

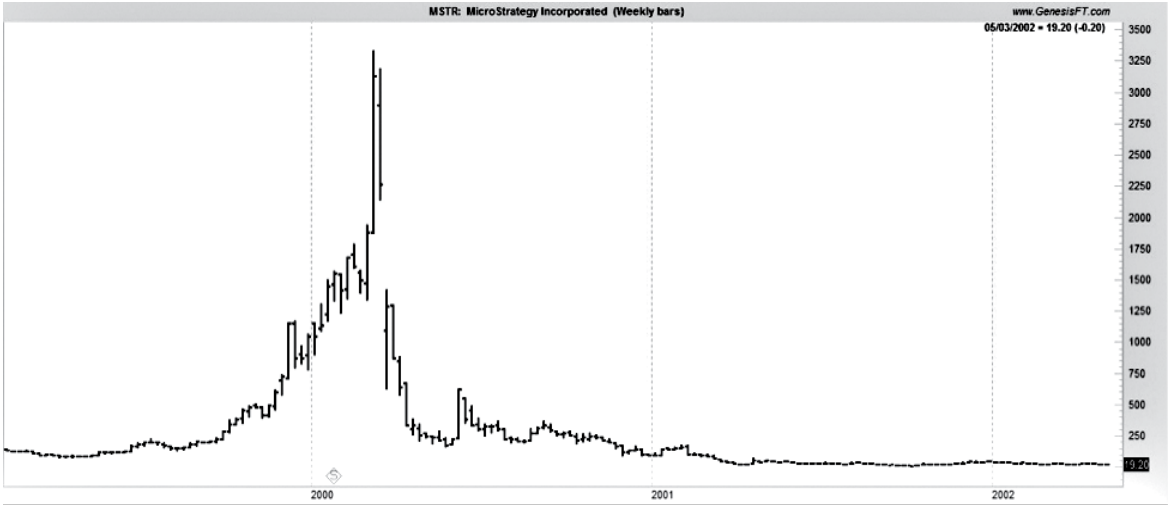


Chart courtesy of Trade Navigator www.GenesisFT.com.

by the swing is, at first, stronger than the force applied by the pitcher. We see the ball take off, and for the first half of its journey, the ball is reflecting the stronger relative strength we provided. As the impact of that swing weakens, the ever present forces of gravity become relatively stronger than the force we provided. With the relative strength of gravity exceeding the relative strength of our swing, the ball returns to earth and eventually comes to a stop.

The same principle can be applied in the stock market. Looking at the chart of MSTR, the stock remained in a very narrow trading range for several years. During the fourth quarter of 1999, an external force acted upon the stock, powering it upward out of the trading range. The external force may have been that company earnings increased dramatically, or the company signed a large contract with another internet company, but most likely the greed of investors combined with the hype about the internet drove the stock higher. The reason this database company began to move is long forgotten, but the RS investor isn't concerned with the reason behind the move.

MSTR continued higher for six months, increasing from $225 a share to a peak near $3,300 a share, a move which now seems to be impossible but at that time was considered commonplace. RS, on a weekly basis, spiked higher in December 1999, two months into the move, offering a buy signal near $1,100 a share. The disciplined investor would have exited the trade in March 2000 after the stock, and RS, broke down. This disciplined RS investor would have doubled their money in only three months. The chart shows that most investors sold long after the decline was confirmed, at much lower prices.

The RS investor just wants to capture a part of the large move which follows the breakout, take profits before the entire upward move is retraced and reinvest in the next high flier. The task of the RS investor is to identify when external forces have powered stocks out of trading ranges. To determine which stocks to buy, you need to determine which ones are strongest on a relative basis, in other words we want to find the strongest compared to all other stocks. To determine when to sell, risk management strategies must be incorporated into a trading plan. There are

several ways to select high RS stocks to buy, and that will be covered in Chapter 2. Building a complete investment strategy from this concept will also be the subject of a later chapter.

Why RS works - Supporting Economic Theory

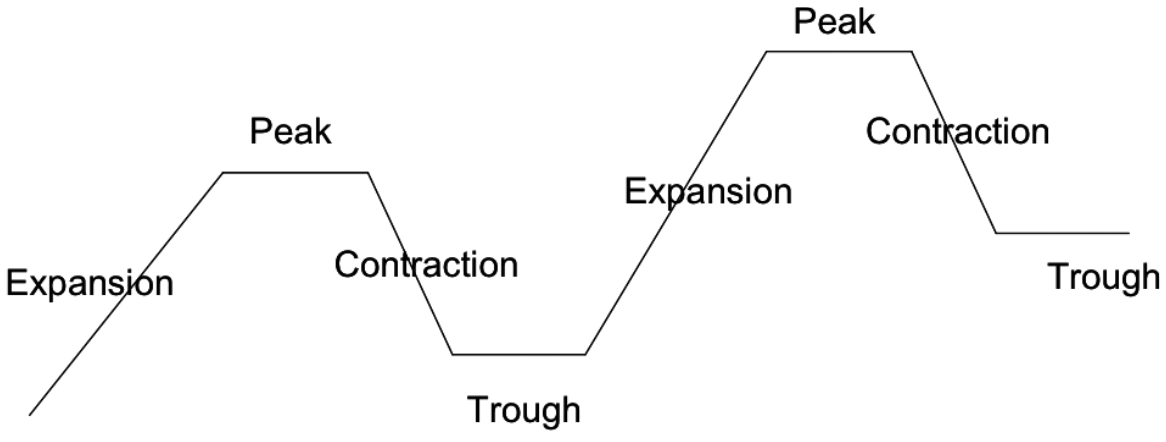
Successful investment strategies are based on logic. To see if RS has any underlying logic, we will start with a look at the economic theories that make markets move.

RS strategies take advantage of the business cycle. For hundreds of years, economies around the world have shown a repetitive pattern of growth and decline, or expansion and recession. These cycles are seen in a nation's output, and are usually measured by changes in the gross domestic product (GDP). Other economic indicators, like unemployment rates and inflation, also show this cyclical pattern. The reasons behind these cycles are the subject of debate among economists, but there is near universal agreement that the cycles exist and that is all that matters to the RS investor. In simple terms, the business cycle can be thought of as shown in Figure 1-2.

This represents the general trend of most world economies, where activity fluctuates above and below the nation's long term growth trend. The business cycle involves shifts over time between a period of relatively rapid growth of output (expansion), a short

FIGURE 1-2

an idealized business cycle model.

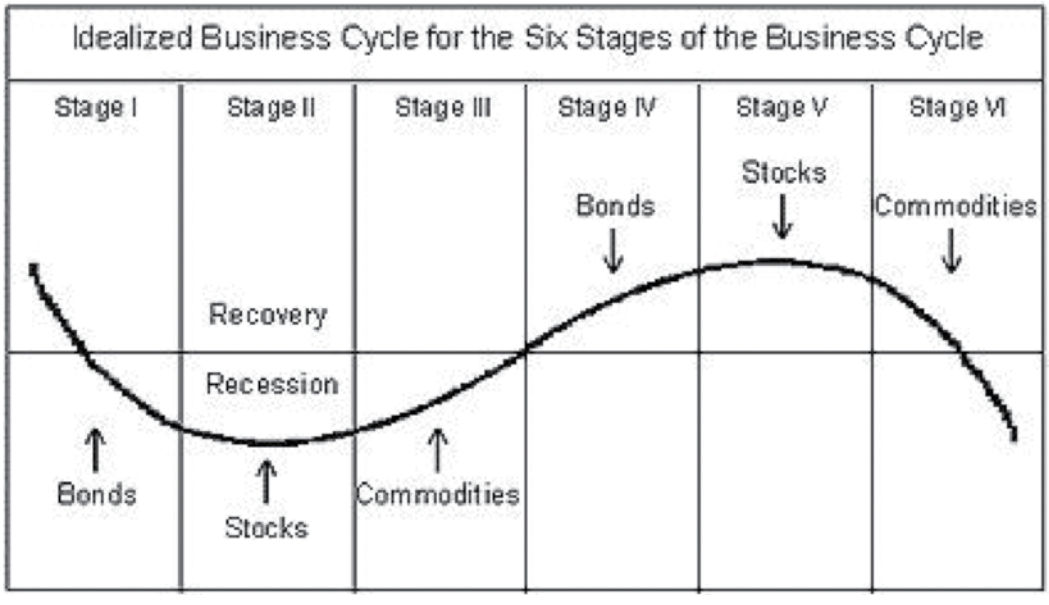


time when supply and demand are near equilibrium (peak), followed by a period of relative decline (contraction), and economic stagnation (trough). While we expect cycles, like the phases of the moon or the changing of the seasons, to occur on a regular, predictable schedule, fluctuations in economic growth and decline do not follow a purely mechanical or predictable periodic pattern. Since the underlying causes of the cycle are unknown, the timing of the peaks and troughs can not be determined beforehand. That creates an investment opportunity for prepared investors.

At different phases of the cycle, different investment vehicles have been observed to perform better than other investments. As a broad example of this concept, market analyst Martin Pring has developed an expanded version of the business cycle which shows how stocks, bonds and commodities each perform during different phases (Figure 1-3). Pring has refined the business cycle into six stages, breaking expansion and contraction into two separate stages. As the level of economic activity changes during the cycle, it makes sense that different investment strategies will do well at some times, and not so well at others. Bond prices increase as interest rates decrease, so bonds should do well

FIGURE 1-3

Pring's refinement of the idealized business cycle



Source: http://pring.com/articles/article8.htm, used with permission of the author

when the Federal Reserve is lowering interest rates to stimulate a contracting economy. This is shown as Stage I in Figure 1-3. Stocks anticipate the economic recovery and do well as the economy bottoms, which is Pring's Stage II. Economic output increases and the demand for industrial inputs (commodities) increases, driving the prices of commodities higher (Stage III).

As the business cycle moves towards its peak, economic growth accelerates and the Federal Reserve gets nervous and starts raising interest rates, hoping to gradually cool off the economy to prevent excessive inflation. Rising interest rates cause bond prices to decline (Stage IV). Eventually the higher rates make bonds more attractive and lower their risk compared to stocks. This causes investors to begin shifting some money out of stocks towards the higher yielding bonds. The stock market then begins to decline (Stage V) as the economy peaks and investors anticipate the slower economy. Finally, industrial output declines, taking commodity prices lower (Stage VI) as demand for industrial input decreases.

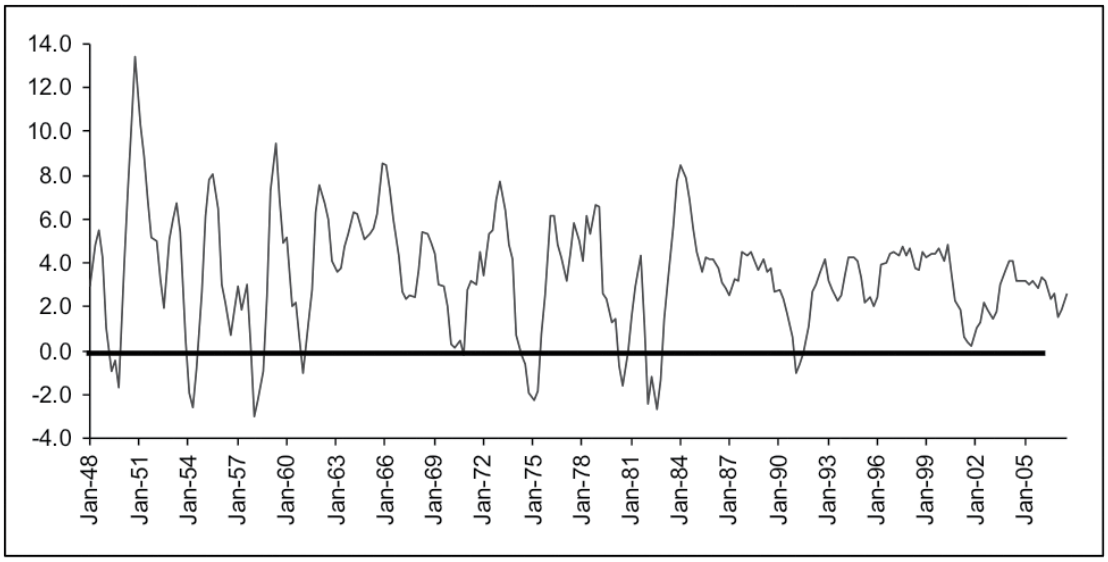
The real world is usually a lot messier and doesn't follow idealized models very closely. A nation's economy is incredibly complex, with billions of individual transactions impacting each other in ways that no one can fully understand. In addition to the complexity of the present moment, there are cycles of different lengths for different industries acting at any given time, which makes it impossible to accurately predict the length of the overall business cycle. These real world interactions, as measured by GDP, are shown in Figure 1-4.

Economic growth is far from idealized; in fact it is difficult to see any order within the data. But, what is visible is that the data series goes up and then down in a pattern that repeats over and over again. While the timing of the top and the bottom is impossible to predict, it is relatively easy to predict that there will at some point be a top, followed by a decline and then a bottom. And, that is all the RS investor needs to know to begin thinking about a profitable investment strategy.

Figure 1-4 demonstrates what most people already know - that predicting the future of the economy is impossible. Fortunately

FIGURE 1-4

Year-over-year percentage change in US GDP



data source: Federal Reserve Bank of St Louis, http://research.stlouisfed.org/fred2/series/GDPC1/downloaddata?cid=106

investors can profit from the business cycle without knowing precisely where we are in the cycle or where we will be next month. As the nation's economy grows or contracts, different businesses will do better or worse than others. It is relatively easy to expand this concept to the stock market (Figure 1-5). This model is not precise, and just as we saw in Figure 1-4 no two cycles will behave exactly the same. But a model will allow us to take the idea of the business cycle from a theory to a practical investment application. The value of having a model is that it will allow us to develop an investment strategy based on the business cycle and we can then rotate our holdings to take advantage of the ever changing economic conditions.

Combining the ideas illustrated in Figures 1-2 and 1-3, we have created an idealized model of sector rotation in Figure 1-5. As the economic expansion begins, bonds are doing well as interest rates are declining. Lower interest rates will also help banks (shown as number 1 in Figure 1-5), which will see increased profits as consumer demand for loans increases in response to the lower rates. As the expansion continues, businesses expand and that requires investments in technology. Computer and other high tech companies become the market leaders (shown as 2 in Figure

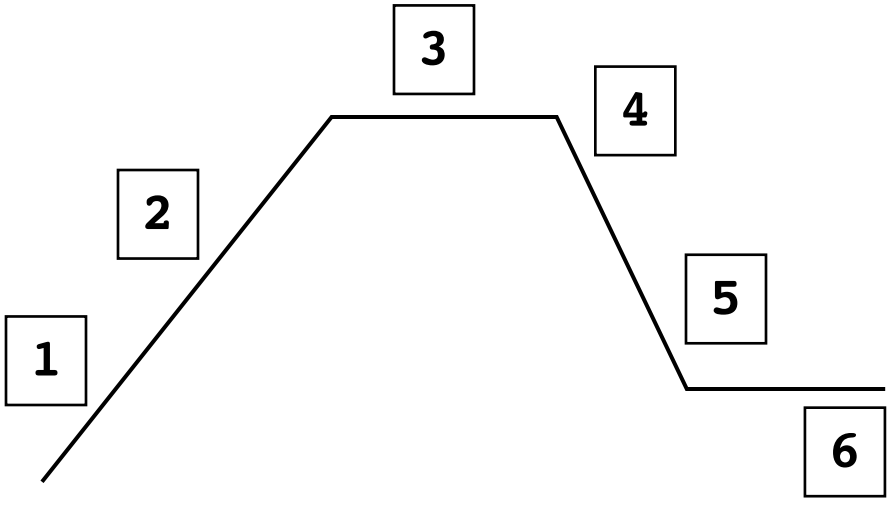
1-5). As economic activity reaches a peak, the demand for energy to power factories and take consumers on vacations has increased dramatically, and energy companies take their turn leading the market (shown as 3).

Rational investors realize that markets can't continue going up forever, and they start thinking defensively. In the coming economic downturn, they reason, people will continue to get sick and need to see doctors, so they bid up the shares of pharmaceutical companies (shown as 4). As the contraction accelerates, interest rates are declining and utilities with high dividends become the investment of choice for income seeking investors (shown as 5). Finally, the economy looks to have bottomed and investors begin the cycle again by buying financial stocks (shown as 6), which will benefit in the expansion that smart investors see on the horizon.

While no business cycle will exactly mirror the sequence shown in Figure 1-5, we can be certain that market leadership will rotate among various business sectors. RS strategies are based upon this insight that certain sectors will outperform others at various stages of the business cycle and the stock market will reward those sectors doing the best as we advance through the business cycle. By measuring which sector is doing best, traders

FIGURE 1-5

Stock market sector rotation during the business cycle



can get an idea of where we are in the cycle, and profit from that knowledge by owning the most desirable stocks for that phase. As the economy moves to the next phase, RS rankings will change and investors will switch into the strongest stocks for that phase. An effective RS strategy will react to the changing dynamics of the economy and the stock market, rather than expecting to forecast the shifts.

As with any investment strategy, there are two sides to RS investing — getting in and getting out of a position. The business cycle dictates the importance of getting in at the right time. Another economic concept, creative destruction, demonstrates why getting out of an investment at the right time is critical to the success of RS strategies. First described by the economist Joseph Schumpeter shortly after the end of the Great Depression, creative destruction, describes the process of change that accompanies economic progress. In Schumpeter's view of the world, entrepreneurs are constantly coming up with new ideas and this process sustains long-term economic growth, even as it destroys the value of older, established companies that often enjoyed some degree of monopoly power. In simplest terms, this idea is illustrated by thinking about how the eight-track tape replaced the vinyl record and was itself replaced by cassette tapes, which were replaced by CDs, which are now being replaced by MP3s.[2] Creative destruction is good for the overall economy since research and development and new products create more jobs than are lost by the older industries they displace. The individual consumer also benefits from creative destruction, since modern music lovers can listen to the song of their choice without being physically constrained by access to a record player.

To apply the ideas behind this economic theory to companies we can consider the case of the software company Microsoft. This now colossal company created the market for personal computer software by providing operating systems, first DOS and then Windows, and productivity software including Word, Excel and PowerPoint. Microsoft helped to set software standards which enabled the Internet to grow, and these standards played a significant role in the explosion in usage of the Internet which occurred in the late 1990s. In opening up new software markets, Microsoft revolutionized the world we live in and destroyed the old order of

mainframe computers. But their success has sown the seeds of their possible destruction — and we now see Linux, OpenOffice, Google and even Apple making significant gains within the markets created and currently dominated by Microsoft.

Looking at Microsoft's stock, we can see the impact of creative destruction on the stock price. As products were introduced the stock moved up slowly, but steadily for most of the 1980s and early 1990s. Once the dominance of its product line was ensured, by the mid-1990s, Microsoft's stock raced ahead to unsustainably high levels. The bubble that drove so many stocks down in 2000 also alerted the investment community to the fact that Microsoft now had competitors, and the stock has since stabilized at a price nearly half of its historical high price.

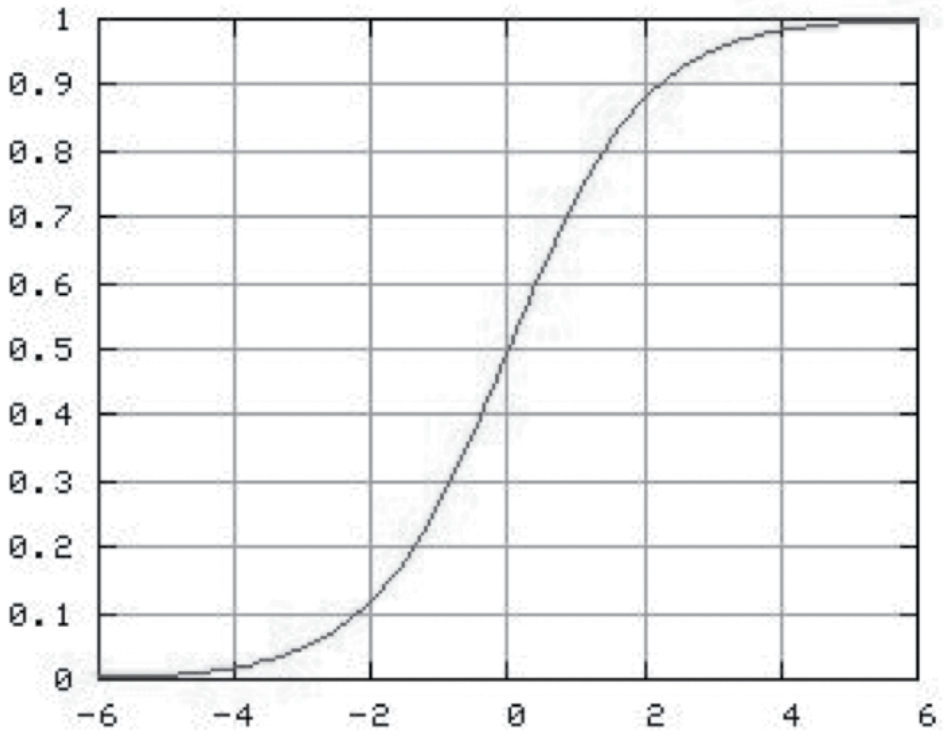
The idea of creative destruction demonstrates the importance of developing sound exit criteria in order to have a successful RS strategy. No company, not even one as respected as Microsoft, will forever dominate a market, and no stock will forever lead the stock market higher. It is important to identify winners as early as possible, and to be alert to the fact that competition is always attempting to unseat the winners. As the idea of creative destruction highlights, recognizing when to sell is probably more important than knowing when to buy.

The idea behind RS is also supported by what we see around us in our everyday lives as new products are introduced, become must have items, and then become obsolete. Businesses often need to create a model to illustrate the adoption rate of a new product or service so that they can develop manufacturing and business plans. There are several approaches, but a common one, and the easiest to understand, is the s-curve. The s-curve (Figure 1-6) illustrates the consumer acceptance rates within the typical product life cycle.

In the beginning, adoption is slow, possibly due to high prices or a lack of consumer acceptance. Eventually, successful products catch on with consumers, and a period of rapid growth occurs. Finally, the market becomes saturated, and growth slows. Thinking back to our discussion of creative destruction, after growth slows, a new product is often introduced which completely replaces the original one.

FIGURE 1-6

Product acceptance life cycle as illustrated by the S-curve



As a concrete example, consider the cell phone. When first introduced, in 1983, it seemed like a novelty, not the indispensible part of everyday life it is now. Several years after it was introduced, less than 10 percent of the population used the bulky, expensive devices. As size and prices came down in the years after it was introduced, consumer acceptance underwent exponential growth, and today more than 90 percent of consumers carry cell phones. And, in the spirit of creative destruction, something will eventually replace the cell phone, just as the cell phone has partially replaced the landline telephones that were the predominant from of communications for nearly 100 years.

Looking at Figure 1-6, we can see similarities with a high momentum stock, which breaks out of a base and experiences exponential growth for a time. Technology stocks, in particular, seem to go through the same life cycle, except in a shorter timeframe than the cell phone. We tend to see long base building periods followed by explosive growth and then explosive declining growth as the market becomes saturated. The chart of MSTR (Figure

1-1) demonstrates that the decline is rapid, and recovery is slow in the best case and unlikely to occur for most stocks.

Comparative Performance

Relative strength means we want to identify stocks that are doing well compared to other stocks. For example, we might be impressed with a stock that has moved up 10 percent in three months, unless we learned that the average stock had increased by 15 percent in that time and the market, as measured by the S&P 500, was up by 12 percent. In this case, the stock that was up 10 percent in three months, a stock moving at an annualized rate of return in excess of 40 percent, would actually be a disappointment. Looking at the comparative performance of the stock, instead of looking at absolute performance, would allow us to easily note that this particular stock had underperformed.

In the previous example, we noted that the average stock had significantly outperformed the market, and we defined the market as the S&P 500. These ideas may require a little clarification. Newscasts tell us what the market did by referencing an index, such as the S&P 500 or Dow Jones Industrial Average. The average person often assumes that all investors make money when the Dow is up, or lose money on the days it declines. For active investors, few portfolios exactly mirror the large, well known indexes. In these cases, indexes represent benchmarks to compare their performance against. There are hundreds of indexes available for benchmarking, and the investor's objective needs to be defined before deciding on which one to use.

The second idea in our example that might need clarification is that the average stock may not move in line with the well-known indexes. With more than 8,000 stocks traded on US markets, the narrowly defined indexes may or may not be representative of what is actually occurring among the majority of stocks. While the major indexes, especially the NASDAQ Composite, moved higher into the market top of 2000, the average stock was doing relatively poorly. The advance-decline line measures the difference between the number of stocks moving higher and lower on a given day. This indicator of market strength peaked in 1998, almost two years before the ultimate top in the major indexes. The indexes were led

higher by a few internet-related stocks, while about 80 percent of stocks trading at that time were not keeping up with these leaders. When markets are ruled by speculative sentiment, it is not uncommon for 10 percent or less of the stocks in an index to account for all of its movement.

The fact that some stocks will beat the market creates profitable investment opportunities for the RS investor. But, it also creates a problem for RS investors in that they must clearly define the universe of stocks they will use for their comparison, considering the potential rewards along with the risks of their selection.

Professional investors usually follow a written investment policy which defines the benchmark they are trying to outperform. For these investors, they can simply use that benchmark and apply their strategy within that universe of stocks. For example, a large pension fund manager may seek to beat the S&P 500. Large investors need active stocks to buy and sell, otherwise their orders will create too much movement in the stock and they will suffer severe losses when closing their position. This type of manager could easily trade in the large stocks of the S&P 500, and needs to calculate RS only for those 500 stocks.

Smaller investors have an advantage over these institutional investors in that they can trade much smaller stocks. In a pension fund with $1 billion or more in assets (a relatively small fund in today's market), traders might need to restrict their activity to stocks which trade at least five million shares a day in order to provide them with enough liquidity to get in and out of a position. Only about 20 percent of listed stocks have enough trading volume to interest these investors. A small investor might be comfortable trading stocks with an average trading volume of only 20,000 shares, which represent nearly two-thirds of the available securities. The larger pool of potential trading stocks should allow small investors to identify the bigger winners early. Comparing the performance of 2,000 stocks is not that difficult, especially since software is available to do much of the work.

In later sections, we will cover the ideas behind selecting which stocks to trade and which benchmarks to consider based upon investment objectives.

Rank Ordering and Percentiles

RS is a comparative term, meaning that we need to compare it to other values. By itself, an RS score really doesn't mean anything and won't help us to make trading decisions. The concepts of rank ordering and percentiles are often applied to the RS scores in order to incorporate RS into an investment strategy.

The various ways to calculate RS are detailed in Chapter 2. For this section, we can assume that we have applied one of those methods to a universe of stocks, such as the one hundred stocks which make up the NASDAQ 100 Index. If we simply looked at their percentage change over the past twelve months, we'd get one hundred values of that change. Rank ordering means that we sort those one hundred values from the highest value to the lowest. If we assign the highest percentage change a value of 100, the second highest is assigned a value of 99 and so on down to the lowest value which will be assigned a value of 1. In this way, we have rank ordered our universe.

If we were to look at a larger index, such as the Russell 2000, we would have 2,000 values. Rather than use the actual numeric rank order, it would be easier to break them into percentiles. In simple terms, the percentile is a value ranging from 1 to 100 (so that it looks like a percentage) that indicates the percent of the sample size that lies below it. Standardized test scores, commonly used in schools, are usually scored within a percentile, for example, "This student's math score is at the 95th percentile." That value represents the percent of students that scored lower in the math test than our example student. With the Russell 2000, the stock which had a rank order of 100 in percent change, in other words the stock which had a percentage change greater than 1,900 other stocks would be in the 95th percentile. Each percentile for the Russell 2000 would include twenty stocks since there are only one hundred possible values that can be assigned to the list.

Investor's Business Daily represents RS as a single number between 1 and 99. The idea is the same as with percentiles. All stocks are assigned an RS rank, with 99 representing the strongest group of stocks in the market. If 8,000 stocks are ranked, then there would be eighty-one stocks in each ranking.

Value Line is another well known investment advisory service that reports RS rankings. Known as the Value Line Timeliness Rank, this is actually just a measure of a stock's relative strength, but it is reported in a less precise manner than *Investor's Business Daily's*. Value Line divides all stocks into five groups, and shows stocks rated as 1 as being the highest rank, with 5 being the lowest. In a universe of 1,800 stocks, each bin contains 360 stocks with each rating. This stock advisory service recommends investors buy highly rated stocks and sell them when timeliness is below average.

The similarities in both methods are obvious. Both methods make a proprietary calculation for each stock in their universe — *Investor's Business Daily* for all listed stocks and Value Line for the 1,800 stocks that they report on. They then rank order the stocks from highest to lowest. Finally, they break the stocks into groups based on their scoring method. *Investor's Business Daily* uses ninety-nine bins and rates the top group of stocks as 99, the second highest ranking group as 98, and so on down to the bottom group of stocks which is rated a 1. Value Line sorts their groups into quintiles, and the highest scoring 20 percent of stocks are rated a 1, the next 20 percent are rated a 2, continuing downward until the bottom 20 percent are assigned a score of 5.

This is the basic methodology common to all RS scoring systems. The differences lie in the calculation methods, a subject we will take up in later chapters.

Applying RS

Economic theory provides strong support to the idea behind RS investing. That is important to providing investor confidence as they apply real money to the theory in the markets. Too many investment strategies are based upon data mining — sifting through the mountains of market data available to discover what worked in the past and thinking that it will work in the future. This leads to trading strategies like buy the Dow if gold is down, bonds close lower and the Mexican Peso was up six days ago. With so many variables and no underlying logic to support the strategy, it's unlikely that these types of strategies can hold up in real time. RS is different than data mining in that economic theory explains why it should work.

History and academic research also support the ideas behind RS investing. There is a long history of practical application in the markets of these ideas. And, there are detailed, peer reviewed studies published in academic journals that demonstrate its long term success. But, history and academic studies also document the problem with RS strategies. Investors must endure deep drawdowns.

Drawdown is the amount of money a trader gives back to the market from their previous winnings. Trading involves winning and losing — winnings add to the trader's equity and losses take away equity. All strategies have streaks where winnings pile up and other times when losses occur with alarming frequency. RS is no different. After a new high in equity is reached, losses will occur and the account will suffer a temporary decline. Because you won't know in advance when the decline will end, it can be difficult to stick with the strategy. This is why it is important to understand the logic behind the strategy, and why we spent so much time looking at the economic principles that support RS. And, it's why we're about to spend so much time looking to history and academia to develop a deeper understand of the theory. In later sections of this book, we will identify several techniques to minimize drawdowns, but no trading strategy will ever be able to eliminate them.

Long before there was a name for it, smart investors knew about the idea of RS. One of the most entertaining books ever written about trading is the fictionalized biography of Jesse Livermore, Edwin Lefevre's 1923 classic *Reminiscences of a Stock Operator*. Livermore made, and lost, several great fortunes while trading in the first decades of the twentieth century. In the unregulated markets of the time, he watched the ticker tape and bought whatever was going up, and sold whatever was going down. He is quoted as saying ""Remember that stocks are never too high for you to begin buying or too low to begin selling."[3] In other words, stocks showing high RS will rise, and it is better, from Livermore's perspective, to buy those stocks than to buy stocks which have been falling.

Livermore traded in the era before computers. His trading was based upon intuition, rather than quantification of market action. Since he observed that momentum works in the markets, there have been countless efforts to quantify that idea. It's actually a simple mathematical problem. All the investor needs to do is define

a way to calculate when prices are high, on a relative basis, and when they are low.

The earliest quantitative approach to calculating RS seems to have been published in 1945. H. M. Gartley, known more as a chartist than a quantitative analyst, introduced the world to velocity statistics as an investing tool. Gartley's work was so ahead of its time that it is worthwhile to review his exact words on how to calculate velocity statistics:

> "First it is necessary to select some average or index to represent the broad market, such as the Standard & Poor's 90-stock Index, the Dow-Jones 65-stock Composite, or a more comprehensive measure . . .
>
> By tracing back the fluctuation pattern of the general average, the larger swings are selected (by inspection) and the successive high and low points are then used to compute percentage advances and declines. Although the general market trend may make the choice of smaller movements feasible, usually the swings selected are those of 10 percent or more . . .
>
> The next step is to compute the comparable percentage advance or decline of the individual stock in the swing . . . .And finally, the percentage rise or decline in the individual stock is divided by the corresponding move in the base index, and multiplied by 100, to give the "velocity rating" of the stock."[4]

Gartley identified major bull and bear trends within the overall market. He compared the movement of each individual stock to the movement of the overall market during each timeframe, and calculated the velocity of each stock. This was a major step forward, a rules-based approach to Livermore's idea of buying high and selling higher.

Velocity ratings are very similar to what we now call beta. Nearly two decades after Gartley published his paper, the great economist William Sharpe developed the Capital Asset Pricing Model (CAPM) and introduced the concepts of alpha and beta. In his

work, he identified several components of risk in any investment. One type of risk is systemic, which cannot be eliminated, and is related to being invested in the market. The second type of risk is related to the individual investment. In sum, the CAPM helps assess the risk of a stock, and allows investors to gain an understanding of the risk they hold within their overall portfolio. These powerful concepts will be more fully explored in Chapter 2.

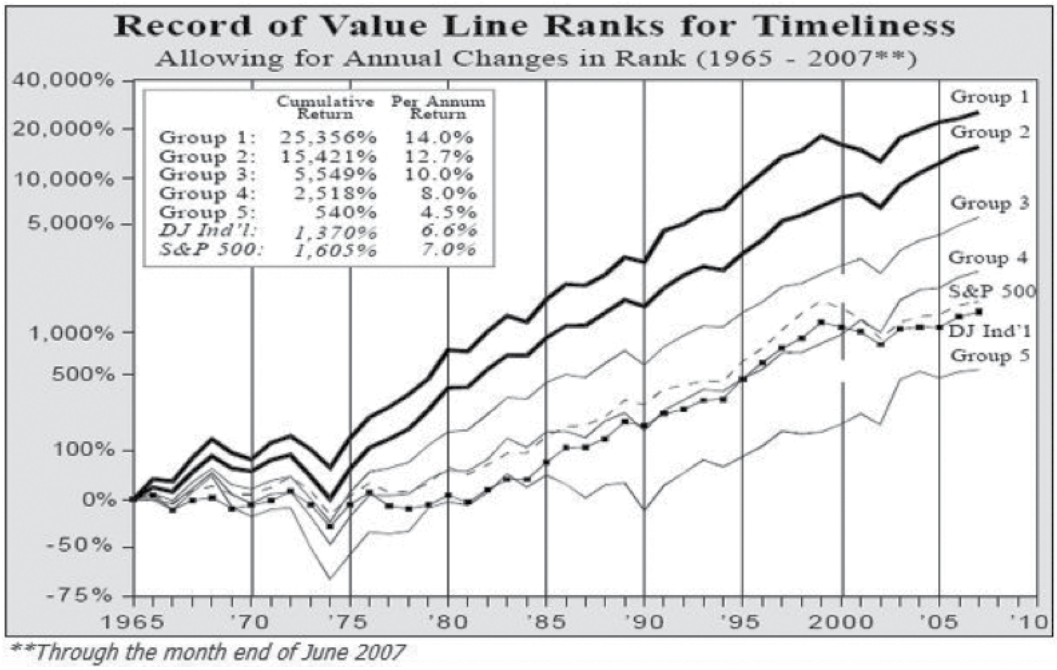
The theory underlying CAPM is worthy of a Nobel Prize, and in fact Sharpe shared the Nobel Memorial Prize in Economic Sciences in 1990 with his mentor, Harry Markowitz and Merton Miller, an economist at the University of Chicago. Fortunately, traders don't need to fully understand the theory to benefit from this work. If they are looking to find the strongest stocks, the formulas are relatively easy to apply without understanding the full concepts behind them. Along with these methods, there are other, simpler, ways to find the strongest stocks.

Although it makes sense to buy stocks that go up and sell them when they go down, most investors want proof that a strategy will work before putting actual money to work in the markets. James O'Shaughnessy provided quantitative evidence that RS works in *What Works on Wall Street*.[5] He conducted exhaustive tests of various fundamental and technical variables to identify which, if any, were predictive of future performance. His research demonstrated that RS is the only growth variable that consistently beats the market. In his test, buying the 50 stocks with the highest RS, defined as the biggest gainers in terms of the previous year's price appreciation, significantly outperformed the market. O'Shaughnessy also demonstrated that the 50 worst performing stocks in the previous year continued to underperform the market over the next year.

Value Line, as noted, also includes a measure of RS in their stock reports. Over a very long history, their methodology has proven to be successful. Stocks rated 1 perform the best, while stocks which receive a rating of 5 are the weakest performers. As seen in Figure 1-7, their method demonstrates the effectiveness of making RS a part of any stock selection strategy. Stocks with a Timeliness Rank of 1 have more than doubled the return of the

FIGURE 1-7

Performance of stocks by Value Line Timeliness Ranking



Source: http://valueline.com/pdf/modelperf1.pdf

S&P 500 since 1965, while those with a Timeliness Rank of 5 have significantly lagged the general market averages.

Although the calculations used by Value Line are proprietary, there are widely known methods available to individual investors that should lead to similar results. Calculations, ranging from simple to complex, will be explored in Chapter 2 and put to the test in Chapter 3. These techniques will be used to build complete investment strategies in later sections.

CHAPTER 2

Calculating Relative Strength

RS is a comparative strategy, meaning we need to find a way to compare stocks to each other. That means the first step in developing an RS strategy is to identify a group of stocks that will be compared to each other. This group is called the investment universe. For each stock within that universe, the investor will regularly calculate RS and rank the universe from the highest to the lowest values. They will buy and hold the strongest stocks within their universe, selling each position when the RS ranking declines below a predefined cutoff value.

Selecting a universe of stocks to invest in is a relatively easy process. Components of broad market indexes, such as the S&P 500 or Russell 2000, can be used. Investors may also choose to use a group of exchange traded funds (ETFs) which buy groups of stocks based upon sectors or strategies, or a group of sector or style mutual funds. The investment universe can even be as small as the choices available to an investor through their 401(k) retirement plan options.

Implementation of an RS investment strategy requires a regular calculation of RS. This calculation may be performed on a daily or weekly basis, depending upon investor preference. In the simplest mathematical terms, which are not necessarily simple English terms, RS compares the normalized change in value of one price to the normalized change of another over the same timeframe. When we normalize a value, we mathematically process it in some way that makes it possible to compare that value with other values that are calculated in the same way the first value was calculated. Admittedly, these concepts seem like they are difficult to explain,

and while normalization may be tough to define with words, an example is fairly easy to understand.

Many investors use screens to identify a short list of purchase candidates. As a first step, we can identify stocks with low valuation ratios and a certain size market capitalization. After running this screen, we might be trying to decide whether to buy one of two stocks which are equally compelling investments. To make the final decision, we decide we want the one which has been the strongest and we want to know which stock has gained more in value over the past week, stock A or stock B. The first stock, A, has increased in value from a price of $10 per share to a price of $12. Over the same timeframe, B has increased from an initial price of $100 per share to $112. Looking at just the overall gains, we might say that B was the stronger performer since it gained $12 while A only gained $2 per share.

However, most analysts discuss investment gains in terms of percentage change. This example demonstrates why that is a better approach. To calculate the percentage change, we divide the total change by the initial price and multiply the final result by 100. The final step of multiplying by 100 is needed to convert the decimal to a percentage. Comparing percentages rather than absolute changes normalizes the returns of each stock, and provides a common basis of comparison. Regardless of the initial price, all returns are directly comparable to each other. As an example, if a stock doubles in value, that represents a gain of 100 percent. It doesn't matter if the stock went up 5 points, from 5 to 10, or if it went up 100 points, from 100 to 200. In both cases, the stock increased 100 percent in value. All other price changes are proportionally related to this fact — a stock moving from 50 to 75 would represent a 50 percent gain, the same percentage gain as a stock that moved from 10 to 15.

In the example of A and B, looking at percentage gains instead of absolute gains tells a different story. On a percentage basis, A shows a gain of 20 percent, significantly more than the gain of only 12 percent for B. Had we invested $1,000 in each stock, our initial investment in A would now be worth $1,200 while the investment in B would only be worth $1,120. Once the results are normalized, we see that A was the bigger gainer, and the stronger stock.

The security with the greater normalized change is said to be relatively stronger than the others. Turning again to the world of sports for an analogy, in any contest, the individual or team with the stronger RS is the winner. Looking at a marathon race, the average runner finishes in the middle of the pack; athletes with stronger RS finish above average, while those with weaker RS finish towards the bottom.

To expand beyond a universe of just two stocks it is helpful to reconsider the idea of percentiles. Percentiles, as a sorting technique, were defined in Chapter 1. A useful characteristic of percentiles is that they limit the number of possible values to a defined range. For RS, this range usually begins at 1 and runs through 99. For example, a stock may have risen 30 percent in the past year, which initially sounds good, unless the overall market has gone up by 35 percent in that same timeframe. By comparing that 30 percent gain to all the other stocks that traded in the past year, we will be able to see that the seemingly spectacular gain has been merely average in that market environment, and the RS of that stock would probably be near 50 when scored as a percentile.

Limiting the possible values of RS makes it easier to define sell rules within the portfolio. Without boundaries, we could be working with stocks showing returns ranging from a low of -99 percent to as high as several thousand percent. By normalizing these values into percentiles, we no longer have to work with complex numbers since everything is bounded. Sell rules can then be as simple as 'sell when RS drops below the top half of all stocks.' Using a scale of 1 to 99, with 99 being the strongest stocks, we would then sell if RS fell below 50. Using a scale of 1 to 5, with 1 being the strongest stocks, we would sell when RS fell to 3 or more.

Just as defining normalization proved to be easier to illustrate than to describe, it might be best to begin the discussion of the methods of calculating RS with an illustration. Always seeking an edge, traders have examined many different ways of calculating RS. There are at least a dozen different methods currently being employed by professionals in the stock market. In this chapter, we will discuss some of the different methods. In the next chapter, we

will develop a complete trading strategy to implement the concepts and test the different methods using the same buy and sell rules in an effort to identify the best methods for investors to attain long-term success in the markets.

While each of the different techniques we'll look at ultimately measures RS in a different way, all methods begin by examining the change in prices over a defined period. The time period can vary with the investor's objectives and the calculation method chosen. A full description of time period selection will be included in the next chapter when we develop a complete strategy. At that time, we will review test results to identify if an optimal period exists. For the purpose of understanding the different RS calculation methods, all we need to know is that a time period must be selected.

Commonly used periods are one month, three months, six months, and one year. Most investors would find the one month measurement period to be impractical to employ in trading strategies. Using such a short time period will result in very high portfolio turnover, increasing the costs associated with increased commissions and slippage. While this is not a problem for institutions managing multibillion dollar portfolios, minimizing transaction costs is an important consideration for the individual investor.

Another problem with short timeframes, such as one month, is that stock prices often exhibit a tendency to revert to the mean, which is the basis of successful countertrend trading strategies that are often employed in nontrending markets[6]. This phenomenon, known as "reversion to the mean" is another mathematical concept that can be thought of in easy to understand terms. What we are really saying is that stocks tend to spend a great deal of time basically going nowhere. They fluctuate above and below a price, staying within the boundaries of what is called a trading range. Most market professionals insist that stocks are range-bound 60-70 percent of the time, although formal studies proving this have not been published.

This reversion to the mean phenomenon would be most easily identifiable in the short term. Looking at a typical trading day,

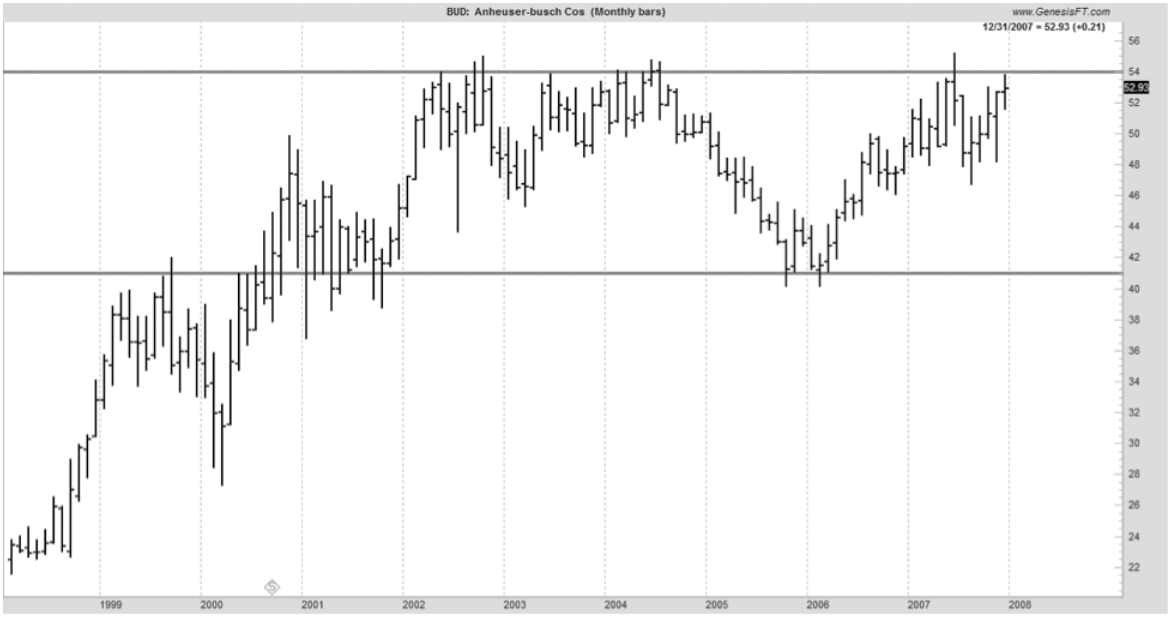
you'll often see stocks move a little bit above and below a certain price level with very little overall progress in either direction.

However, in the markets, nothing can ever be counted on as absolute rule; the truth is that these trading ranges are not purely a short-term occurrence and can last for years. We can see in Figure 2-1 that the stock of Budweiser (BUD) traded within a 20 percent range for more than seven years. Most investors would prefer to avoid holding stocks like this because they represent nothing more than dead money for months or years. One advantage of an RS strategy is it would give a sell signal as other stocks offered better potential returns and taking that sell signal would allow the investor to buy something offering a better return on investment.

In order to avoid holding a stock in an extended trading range, the RS investor would monitor their portfolio and would have sold the stock when it stopped going up. Portfolio monitoring means consistently calculating RS in one of the various ways.

FIGURE 2-1

Monthly chart of BUD shows that the stock has traded within a 12 point price range from — the middle of 2000 through the end of 2007.



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Calculating RS as Differences

The easiest approach to determining which stock from a group of stocks went up the most would be to calculate how much their prices have changed over the time period being studied. For stock A, if its current price is 50 a share and it started the month at 25, we can see it went up twenty-five points. If stock B went from 25 to 35 in the same time, then it shows a ten point gain. With these numbers, we would say that A is the stronger stock.

Throughout this chapter, we will provide formula for the different calculation methods. The formula for this version of RS is:

FORMULA 2.1

$$RS = P_{today} - P_{1\ month\ ago}$$

where RS represents relative strength
P_{today} represents the current price
$P_{1\ month}$ ago represents the price 1 month ago

In Formula 2.1, and all subsequent formulas in the chapter, the time periods used are only an example. For this calculation, there is no need to use one month. We could just have easily chosen one week, three months, one year, or any other time period. The important thing to remember is that in order to compare RS within the investment universe and implement it as an investment strategy, the timeframe must be the same for all calculations. We cannot use one month for stock A and three months for stock B.

The simple method shown in Formula 2.1 should not actually be used by any investor. It would only work if all stocks started at the same price. If one stock begins the time period trading at a higher or lower value than another stock, the results would not be comparable. We can consider the example of a third stock, C, which changed in price from 1,000 per share at the start of the month and finished the month at a price of 1,100. The one hundred point gain dwarfs the gains of the other two stocks, but C is

actually the worst performer of the three stocks. Since stocks do in fact trade at different price levels, this simple approach is impractical to apply as a trading strategy.

From Differences to Ratios (Calculating RS as a Normalized Rate of Change)

Investors measure their performance with tools like return on investment, which is used to determine a percentage gain for their returns. In this case, we can take the total change in each stock and divide it by the original price to figure out our return. To turn these numbers into percentages, we multiply by 100. This step isn't necessary, but it done for convenience since most people are more comfortable thinking in terms of percentages than of decimals.

We will ignore the costs of commissions in this example, and throughout this chapter. We will also ignore dividends. Some stocks, and many mutual funds, make regular payments to shareholders. To properly calculate the return on investment, these payments would not to be added to the price change in the stock or fund. These often represent a sizable amount of an investor's total return. However, to develop an RS strategy, we will ignore these payments which will understate potential gains in the models we will be working with.

The concept of return on investment forms the basis of the next technique that we can use to calculate RS. Although a little more complex than the simple difference shown in Formula 2.1, it is still a very simple calculation, among the easiest quantitative approaches to developing an RS investment strategy. In mathematical terms, it is often called the normalized rate of change. Investors commonly refer to this idea momentum, or rate of change. It is often shortened to ROC in charting software packages.

ROC can be found by simply dividing the current price by the earlier price, or it can be found by dividing the difference in those prices by the original price. The formula for this calculation is:

FORMULA 2.2

$$RS = 100 * \frac{P_{today} - P_{12\ months\ ago}}{P_{12\ months\ ago}}$$

where RS represents relative strength
P_{today} represents the current price
$P_{12\ month}$ represents the price 12 months ago

Multiplying by 100 means this calculation will express the price change as a percentage. Although any timeframe can be used in the calculations, most practitioners find six months or one year to be the timeframe that reduces portfolio turnover and transaction costs while delivering market-beating performance. The strongest stock is defined as the one which has gone up the most during the calculated time period.

Returning to the example from the previous section, the price changes are summarized in Table 2-1. Applying formula 4.2 and doing the math, we find an investor would have made 100 percent investing in stock A; 20 percent investing in B; and only 10 percent investing in C.

TABLE 2-1

	Initial price	Ending price	Point change
A	25	50	25
B	25	35	10
C	1,000	1,100	100

An example of price changes for RS calculation.

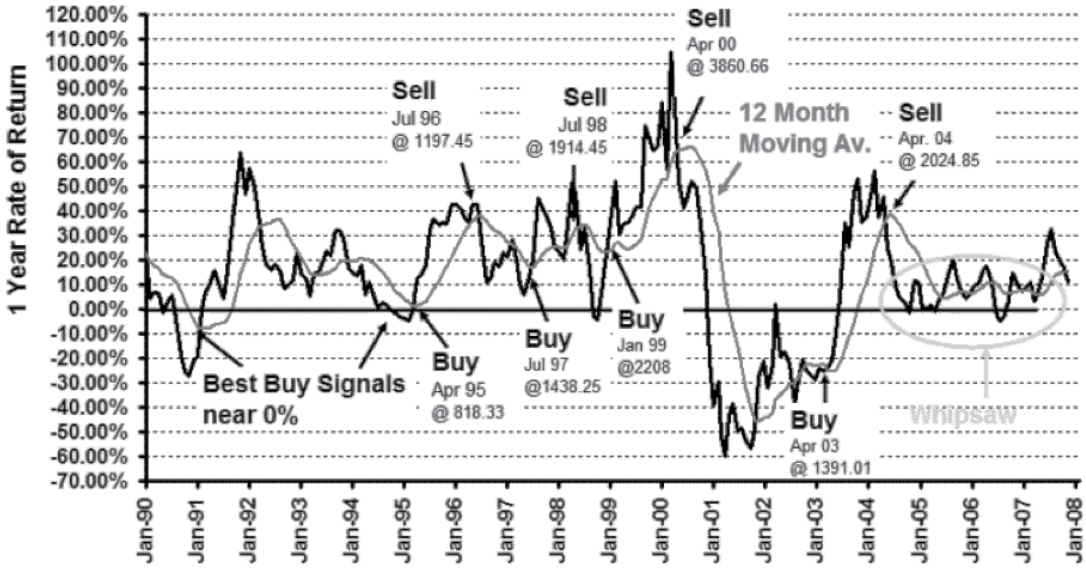
When the calculation is done over time on a single stock, the normalized ROC can be graphed as an oscillator, fluctuating above and below zero. The oscillator can then be used to generate trading signals. One way to do this is to take signals based upon crossings of the zero-line, buying when the oscillator crosses above zero and selling when the normalized rate of change turns negative. Under this set of rules, the investor holds the stock when it is increasing in price faster than it was one year ago.

Alternatively, we can plot the ROC oscillator along with a moving average of the rate of change on a chart and take crossovers of the two lines as trade signals. A moving average is a continuously updated average of the most current data points. For this example, we are looking at a twelve period moving average, computing the average of the last twelve ROC calculations. The next month, we will repeat the calculation using the newest data point and dropping the oldest, so that we are constantly updating our moving average with only the twelve most recent pieces of data. Analysts use moving averages to smooth the data, eliminating erratic points and making it easier to spot the underlying trend in the data. Although usually applied to price, this technique can be applied to any indicator, including RS.

As a demonstration of the moving average analysis method, we can apply the idea to the NASDAQ Composite Index. Investors can use an Exchange Traded Fund (ETF) as a low cost way to buy almost index, so this example can be readily applied in any sized investment account. The popular QQQQ ETF tracks the NASDAQ 100 index, which is different but would provide similar results to

FIGURE 2-2: NASDAQ RATE OF CHANGE

Using the ROC for the NASDAQ Composite Index along with its twelve month moving average correctly identifies every major turning point. Unfortunately, it is also subject to a large number of whipsaw trades



http://fintrend.com/ftf/images/charts/ROC/NASDAQ_Rate_of_Change.htm

those shown. Figure 2-2 presents an example of this technique and clearly shows that this idea correctly identifies all major trends. To reproduce this chart, an investor would need to collect market data only once a month and calculate the twelve month ROC of the index. That data is then charted onto a graph, along with the average of the last twelve month's worth of data. Whenever the ROC crosses its moving average, a trading signal is generated. When the ROC crosses above the moving average from a value below the moving average, it is a buy signal since the ROC is now considered to be above its trend. When the ROC falls below the moving average, it is considered to be a sell signal.

While this nearly effortless system is profitable over the long run, the problem with this and any other moving average system is that these strategies are prone to a large number of small, whipsaw trades when the market isn't trending. Overall, it is a profitable strategy since the small number of winning trades that catch the major trends lead to large profits which usually more than offset the poor results from the larger number of whipsaw trades. But it requires faith on the part of the investor that a sustained trend will emerge from what can be a very long series of whipsaw trades. Without faith in their system, many traders abandon their rules during these periods, suffering only the losses and never benefitting from the gains which would have developed in time.

Looking beyond a single stock or ETF, normalized ROC can be used to manage a portfolio of any number of stocks. Calculation of ROC would need to be done on each stock in the investment universe, and then those values need to be sorted from the highest value to the lowest. Those stocks at the top of the list are the strongest and those at the bottom the weakest. This converts the calculation from an oscillating, chart-based tool to a quantitative approach to investing.

Using Microsoft Excel, the investor can automate the downloading of quotes for a fairly short list of stocks[8]. If more than one hundred quotes are required, a more efficient software solution would need to be explored. Calculating ROC in Excel requires only a single formula, and the values can then be sorted with only a few clicks to have the highest ranked ROC on top.

It would be easy to see what to buy, which would be the stock at the top of the list. Current holdings would then need to be individually evaluated against the predefined sell rules based upon where they rank on the sorted list. While RS investing is possible in Excel, the investor would have to be willing to invest time and effort into setting up and maintaining this approach.

RS Ratios

No matter which method we choose to analyze RS, in the end we are actually looking for the stocks which have gained the most compared with to the performance of the stock market. Applying this idea will let us find a different way to calculate RS.

If we represent the market as one of the major stock market indexes, such as the Dow Jones Industrial Average or Standard and Poor's 500 (S&P 500), we can divide the price change of a stock over a specified time by the change in the index over the same timeframe to determine the stock's performance relative to the market.

The formula is very similar to the normalized rate of change calculation:

FORMULA 2.3

$$\mathbf{RS = 100 * \frac{P_{today} - P_{12\ months\ ago}}{IndexP_{today} - IndexP_{12\ months\ ago}}}$$

where ROC represents rate of change
P_{today} represents the current price of stock
$P_{12\ months}$ represents the stock price 12 months ago
$IndexP_{today}$ represents the current price of the index
$IndexP_{12\ months\ ago}$ represents the index price 12 months ago

Selection of the appropriate index requires some thought, but is not critical to the success of this approach. Most major markets indexes tend to behave similarly, rising or declining together. While there will be directional differences on some days,

the general trend in each index is usually the same. The S&P 500 would normally work as well as the Dow. The NASDAQ Composite Index might be more appropriate for very aggressive investors since it is more volatile and will find the stocks which are having larger moves. But, all of these indexes topped at the end of an eighteen year bull market in early-2000 and declined for more than two years, sharing the same upward and downward trends over those two decades. RS calculations based upon any one of them would have yielded very similar results to the investor.

Formula 4.3 can also be thought of as dividing the percentage changes of the stock and the index. When discussing RS on television or in the newspapers, analysts will generally refer it to as comparing percentage gains. Their approach is no different than we showed in Formula 4.3 and the results would be the same, however the formula would appear a little more confusing:

FORMULA 2.4

$$RS = 100 * \frac{(P_{today} - P_{12\ months\ ago})/P_{12\ months\ ago}}{(IndexP_{today} - IndexP_{12\ months\ ago})/IndexP_{12\ months\ ago}}$$

Either ratio calculation can be developed into a quantitative investment strategy by applying the ranking and percentile techniques described in previous sections. Those techniques from the cornerstone of applying RS as an investment strategy. The only variables in any strategy will be the calculation method and timeframes used for RS itself.

A straightforward approach to analyzing the ratio of RS is to visually examine the price strength as depicted by the ratio of a stock, such as BUD which was shown in Figure 2-1. For this example, we will calculate the ratio using the S&P 500 as the denominator in Formula 4.4. Every day, we would divide the percentage price change of the stock by the percentage price change in the market average, and we can then plot a line of that ratio on the chart. When the line is rising, the stock is outperforming the market; if the line is falling, the stock is underperforming the market.

If we are analyzing more than one stock, it is important to use percentage changes in this calculation. Because stocks trade at different values, the calculations need to be normalized. As shown earlier, a one point change in a stock priced at 10 is more significant than a one dollar change in a one hundred dollar stock. Failing to normalize price changes in RS calculations would favor the selection of higher priced stocks which will normally show larger price gains when measured by point changes.

The RS ratio technique, applied to the chart of BUD, would have identified profitable long-term buy and sell signals in that stock, allowing investors to hold the stock only when it was going up. Trend lines are often drawn on charts to indicate the trend. When prices, or in this case an indicator, is rising, the analyst draws a straight line to connect the low points that punctuate the upward progression of the line. By connecting the lows, the analyst defines an uptrend, and when this line is broken, a trend reversal is expected. The analyst then draws a line connecting the lower high points to define a downtrend.

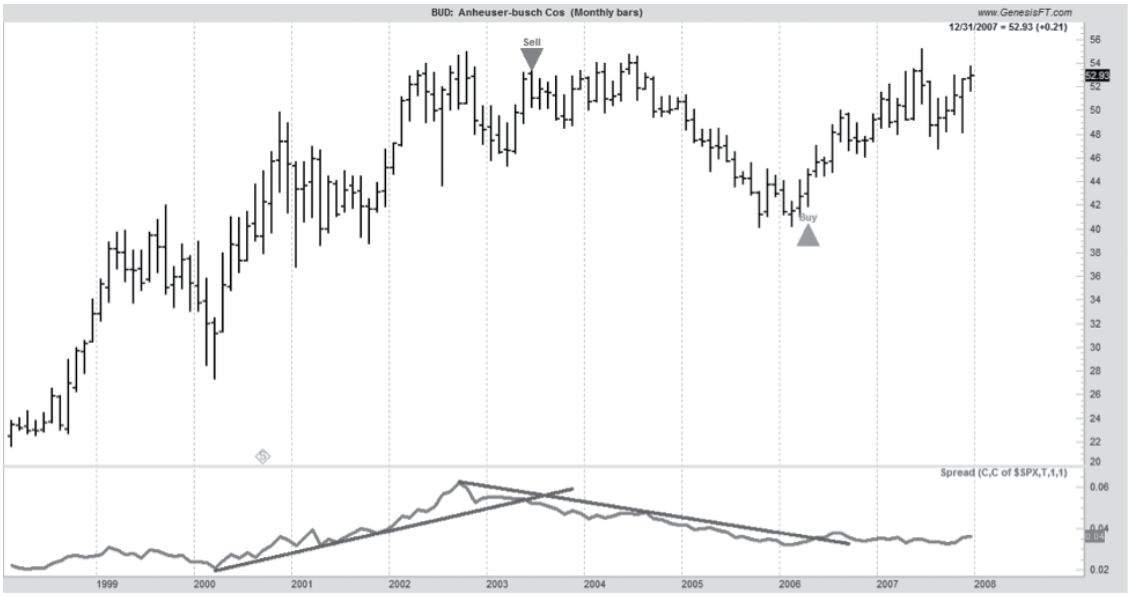
In Figure 2-3, a sell signal is generated towards the left side of the chart when the RS ratio breaks its long-term uptrend line. The buy signal occurs when the RS ratio crosses above the downward sloping trend line. Both signals proved to be timely, and occurred very close to tops and bottoms. This chart uses monthly price changes and offers a long-term perspective of RS. By employing a weekly or daily calculation, the investor would generate more frequent buy and sell signals.

Quantifying the results, this simple, but effective trading tool would have generated a sell signal in early 2003, after having owned BUD for more than three years and gaining a little more than 64 percent. The buy signal in BUD occurred in the same month the S&P topped at the end of the internet bubble. This compares with a loss of about 35 percent in the S&P 500 over the same time period. After the sell signal, BUD lost 16 percent over three years before RS signaled it was time to buy again in March 2006.

While trend line analysis of this ratio would help long-term investors time their entries and exits into single stocks, RS ratio analysis cannot serve as the cornerstone of a complete

FIGURE 2-3

This monthly price chart of BUD includes an RS ratio in the lower panel. With the trend in the RS ratio, the stock can be bought or sold. The buy and sell signals shown in this chart result solely from looking at the RS ratio rather than interpreting the price and guessing whether it will go higher or lower.



investment strategy. It is subjective in nature because trend lines can be drawn along various points depending upon who is drawing the line. Even the starting point of the trend line can be defined differently by different investors based upon their individual perceptions of when a top or bottom is formed. Furthermore, signals based upon trend line breaks can be early or late relative to the stock price and signals will be dependent upon the slope of the preceding RS. A rapidly accelerating stock will take on a parabolic RS line, and the uptrend won't be broken until the stock has fallen a great deal from its peak. Stocks in tight, well-defined trading ranges may have a nearly flat RS ratio, making it difficult to spot trend line breaks. In short, while useful, RS ratio analysis is only a starting point in applying RS.

To overcome the weaknesses of RS ratio analysis, a quantitative ranking method needs to be used. This will enable the method to be applied to all stocks within the investment universe. The procedure to accomplish this is the same as the steps required to evaluate the investment universe outlined in the ROC section. Calculate

the ratio for each stock within the universe, than rank them into percentiles. This is the same approach that will be used in all quantitative approaches to RS investing.

Applying Point & Figure Analysis to RS

One other RS visual means that can help long-term investors identify low risk buy and sell levels while also helping short-term traders identify profit taking opportunities is to apply point & figure charting techniques to an RS calculation. Portfolio manager Clay Allen, CFA, details a novel approach to chart relative strength in his book, *Winning The Performance Game*[9]. Allen developed software to create point-and-figure (P&F) charts of a stock's relative strength. While charting RS instead of price, he uses traditional P&F chart patterns to clearly define buy and sell rules for any individual security.

P&F charts have been a valuable addition to the technician's toolbox since at least the nineteenth century. These charts were used by traders on the floors of the stock exchanges, including Charles Dow, in the late 1800s. Victor deVilliers published the first detailed explanation of this technique in 1933.[10] P&F charts are different from traditional stock charts in that they track only price changes and ignore time. Proponents of this technique believe that focusing solely on significant price changes eliminates the day-to-day market noise. Without being distracted by the smaller price movements that make up most of a stock's trading activity, P&F analysts think that it should be easier to identify significant support and resistance levels.

The basic P&F chart shows columns of Xs and Os. A column of Xs means the price of the security is rising; Os means it is falling in price. Only Xs or Os are placed in a single column. The analyst switches columns when price reverses by a predetermined amount. To construct a P&F chart, you have to first decide what box size to use; box size will represent the amount of price movement represented by a single X or O. For example, with a box size equal to one, each X or O would represent a one point price change, anything less than that would be disregarded. The other variable in a P&F chart is the reversal criteria, which is the number of boxes required for a reversal from Xs to Os or vice versa.

Price reversals which do not meet the minimum reversal criteria are disregarded. Often, a price reversal value of at least three points will be used. A box size of one and a three box reversal are the most common measurements used in P&F charting.

To clarify this idea, if price is moving lower, it is being recorded as a column of Os. As the price drops from 15 to 14, an O is added to the chart. The next day, price declines by another half point, and the analyst would not do anything on his chart, since price did not move by a full point. On the day after that, price rises by two points to 16 ½. Again, there would be nothing to do on the chart since the price would need to move three points higher before the reversal criteria is met and a new column is started. After price reverses by at least three points, to 17 in this example, a new column of Xs will be created. Similarly, if price is going up, the analyst is tracking price changes with a column of Xs and a three point reversal to the downside will result in a new column of Os.

One of the most important features of this charting technique is that day-to-day market noise is filtered out, making it easier to spot the long-term trend. By ignoring moves of less than three points, smaller price wiggles are ignored, allowing the investor to focus on the longer term trend rather than being concerned with small, insignificant changes. It is these small changes that cause many investors to panic and react to the market, rather than sticking with their long-term plan.

Buy and sell signals on P&F charts range from simple to complex. The simplest buy and sells are double top buy signals and double bottom sells (Figure 2-4). A double top buy signal occurs when a column of X’s exceeds the top of the previous X column, indicating that prices have broken through a short-term resistance level. A double bottom sell signal is given when a column of O’s falls one box below the previous O column, indicating a break of short-term support levels.

A slightly more complex buy signal is the triple top, which means a column of X’s has risen above two previous X columns. The triple bottom sell signal results from a column of O’s falling below two previous columns of O’s. These are shown in Figure 2-5.

There are many other P&F signals that investors can study and use in trading, but they are not used in RS analysis.

FIGURE 2-4

The simplest P&F chart patterns are the double top (shown on the left), which is a buy signal, and the double bottom sell signal (shown above on the right). These patterns indicate breaks of short-term resistance (double top) and support (double bottom).

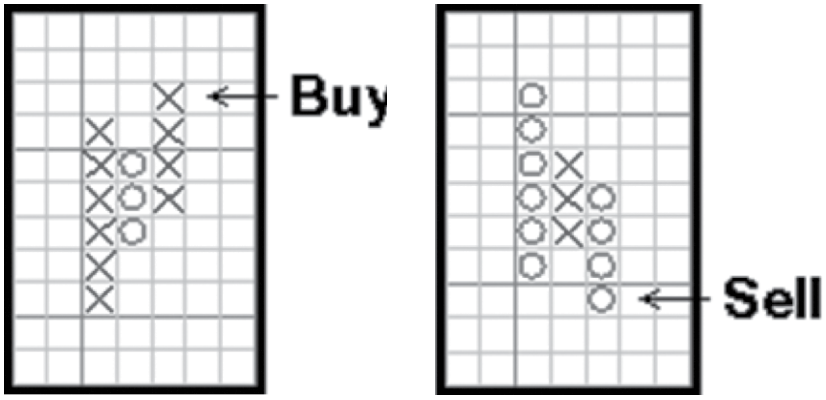
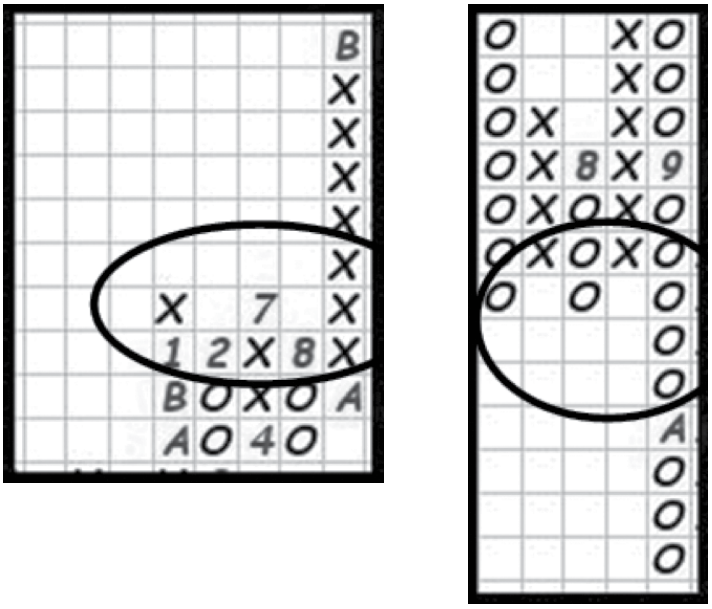


FIGURE 2-5

The P&F triple top buy signal, shown on the left side of this figure, occurs when Xs break out from a short-term consolidation pattern. The triple bottom sell signal on the right side is a signal that prices have broken down through short-term support levels and are likely to continue falling.



Another significant difference between P&F charts and traditional bar charts is that trend lines are always drawn at 45-degree angles on P&F charts. Rather than finding two or three highs or lows to connect, as is done on a traditional bar chart, on a P&F chart, a 45-degree line is drawn downward from the highest high or upward from the lowest low on the chart. Some analysts prefer the clarity of P&F charts because signals are never ambiguous. Trend lines are indisputable and all analysts agree on how they would be drawn on a chart. The stock is always on a buy or sell signal, and again there is no possibility of disagreement arising from objective interpretation. Additionally, trading ranges are easy to spot on P&F charts.

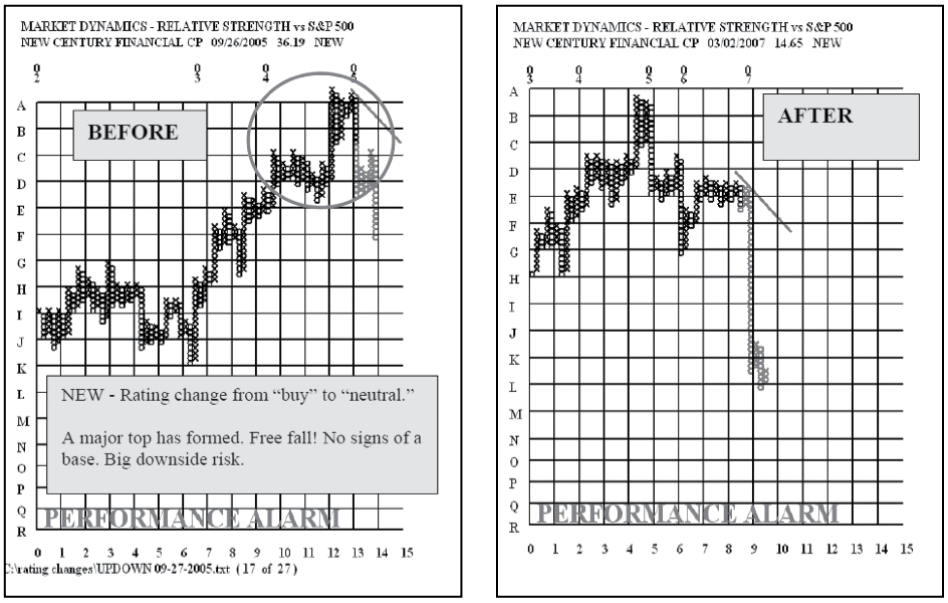
Instead of price, Allen charts relative strength in a P&F format, applying the same P&F principles described above. By doing this, he believes that the charts allow the investor to focus strictly on the long-term trend of the security being traded, factoring out the distraction of the erratic price movements. The chart is always on a clear buy or sell signal, based upon whether a triple top buy signal or triple bottom sell signal occurred more recently. He uses 45-degree angle trend lines to highlight stocks which need to be sold because they are in a downtrend and a triple bottom was the most recent signal.

An example of this technique is shown in Figure 2-6. New Century Financial Corp (NEW) was a subprime mortgage lender, which experienced significant problems with its loan portfolio beginning in the second half of 2006. A crisis in the subprime mortgage market in 2007 decimated the stocks of companies in this industry, and NEW was among the worst hit. Within months, its stock was worthless and delisted.

Applying RS P&F analysis provided a sell signal nearly two years before the market recognized the depth of this problem. RS analysis, as practiced by Allen, gave a clear sell signal on March 10, 2005, when NEW was trending at a closing price of 47.16. On the weekly chart, NEW would never reach that price level again. Its price trended lower for two years. Its RS chart never gave another triple top buy signal. It is the textbook example of why this technique works well as a sell signal.

FIGURE 2-6

This is an example of a P&F chart of RS. Rather than plotting prices, only the RS is shown in this chart. The sell signal in this chart came nearly two years before shares of New Century Mortgage were worthless, and would have allowed investors to exit within weeks of the stock's all-time high.



Source: http://www.clayallen.com/NEW%20case%20study%2003-05-2007.pdf

The example of NEW highlights the important contribution that RS makes to investor facing the often dreaded sell decision, and vividly illustrates the problem of buying or holding stocks which show declining RS. After the RS P&F sell signal was recorded, investors who held onto their positions in NEW hoping for a rebound, or those who bought into the stock thinking that a bottom had been reached were disappointed. RS can help investors overcome their reluctance to sell by pointing them towards better opportunities.

An advantage of the RS P&F method compared to the RS ratio technique described earlier is its objectivity. All analysts familiar with the rules of this method will arrive at the same conclusion, the stock is either on a buy or sell signal. Allen advocates this method as a vital component of the investment sell decision. While it can be used to time buys, it is best used along with other buy criteria to avoid stocks which are in extended trading ranges. It can be used as a stand-alone sell signal. While

not a complete RS trading strategy, it is an improvement over visual RS ratio analysis.

Weighted RS Calculations

To calculate RS so far, we have given equal weighting to all data points. It is possible to overweight or underweight certain data points relative to other data. This process is commonly done to calculate grades in high school classes. Not all work is equally important, so different weights are assigned to different parts of the curriculum. Final grades are often computed using a weighted average.

It is possible that in a history class, homework could account for 10 percent of the grade, quizzes 20 percent, and tests 70 percent. If a student completed the course with a homework grade of 92 percent, a quiz grade of 68 percent, and a test grade of 81 percent, then the overall final grade would be calculated as:

Final grade = (0.10) (92) + (0.20) (68) + (0.70) (81) = 79.5

This same idea can be applied to RS. While all price data seems to fit into the same category, there is actually older data and newer data. The question the investor faces is whether price data from a year ago means as much as more recent market activity. Applying the same idea as with the calculation of a grade in history class, the investor may decide that the prices from a year ago should account for 10 percent of the RS calculation, from six months ago 20 percent, and from the last month 70 percent. This can be reduced to a formula and applied to the investment universe.

This general idea of weighted RS calculations can be divided into two types of calculations, front-weighted and back-weighted RS. We will place more emphasis on the most recent price action with the front-weighted process and we will deemphasize recent action in favor of older data in the back-weighted calculation. Both of these concepts will be discussed in detail in the next two sections.

Back-Weighted Rate of Change

As mentioned earlier, stock prices often show a tendency to revert to the mean, characterized as extended periods of time when prices move within a narrow trading range. This behavior can also be identified on price charts when the price moves above and below a simple moving average. This was illustrated in Figure 2-2 where we saw an extended series of whipsaw trades in the NASDAQ Composite Index as the ROC repeatedly moved above and below its twelve-month moving average.

While usually associated with short-term, losing trades, reversion to the mean is also visibly at work in successful trades based upon moving average rules. When prices (or ROC as shown in Figure 2-2) exceeds a moving average by too much, it eventually snaps back and finally drops below the average during that reaction. The opposite behavior, a sudden and sharp rise in price, is usually seen when prices get too far below the moving average. Given this tendency to return to the price level of the moving average, some investors choose to calculate RS using a back-weighted momentum calculation, which means they give greater importance to older data in their calculations. This calculation method can be referred to as back-weighted ROC since it is very similar to the ROC calculations explained earlier.

Since prices show a tendency to revert to their previous levels, these investors are expecting prices to reverse their short-term performance and move towards their longer-term average price. They believe that it makes sense to overweight the earliest price data since prices are being drawn to that level. This minimizes the impact of the most recent price action, and rewards stocks which have shown steadier growth.

To clarify the rationale behind this technique, think of a stock which reported great earnings and had a very quick price spike, moving up 50 percent in the past month. It is unlikely that this stock will be able to continue advancing with this much momentum. Giving more weight to earlier price action should give a more accurate representation of its potential gains going forward.

As an example of the calculation, to find the back-weighted rate of change over the past twelve months, you can calculate the change in price over the last 12 months, excluding the change of the past month. The formula for this calculation would be a little more complex than the simple rate of change calculation:

FORMULA 2.5

$$RS = 100 * \frac{(P_{today} - P_{12\ months\ ago}) - (P_{today} - (P_{1\ month\ ago})}{P_{12\ months\ ago}}$$

where RS represents RS, calculated as the back-weighted rate of change
P_{today} represents the current price
$P_{12\ months\ ago}$ represents the price 12 months ago
$P_{1\ month\ ago}$ represents the price 1 month ago

In numbers, we can find the back-weighted ROC for a stock which traded at 50 twelve months ago, 60 a month ago, and 75 today. Putting these values into the formula, we would get:

$$RS = 100 * \frac{(75 - 50) - (75 - 60)}{50}$$

This formula gives a value of 20 percent. The normalized ROC for the past twelve months would be 50 percent. However, by subtracting out the 25 percent gain in the most recent month, the stock is ranked significantly lower by this method. Many investors would be timid about buying a stock that had run up so much in the past month, and this technique minimizes the chance of buying stocks with outsized one month gains. There is a psychological appeal to this method for those concerned about buying stocks breaking out to new highs.

Formula 2.5 is only one example of the back-weighted calculation. Investors can use a six month lookback period instead of twelve, or any other time period. Instead of subtracting out the last month, the investor can subtract the last two months performance. Alternatively, the formula can subtract only a

fraction of the recent performance. To subtract only half of the recent performance over a one year lookback period, the formula would be:

$$RS = 100 * \frac{(Price_{today} - Price_{12\ months\ ago}) - (0.5*(Price_{today} - Price_{1\ month\ ago}))}{Price_{12\ months\ ago}}$$

Alternatively, we can develop a formula with different weights applied to each month:

$$RS = 100 * \frac{(Price_{today} - Price_{12\ months\ ago}) - (0.75*(Price_{today} - Price_{1\ month\ ago})) - (0.5*(Price_{today} - Price_{1\ month\ ago}))}{Price_{12\ months\ ago}}$$

Obviously, the possibilities are unlimited. Any combination of time periods can be combined with any weighting scheme the investor chooses. And, in testing, some combination will give superior returns. However, as variables are added to the equation, the problem of curve fitting arises. Curve fitting occurs when an analyst tries multiple combinations of variables in an effort to maximize returns. We've all heard the government mandated disclaimer that past performance in any investment vehicle does not guarantee future results. One of the only certainties in the investment world is that the future will never be exactly like the past. When we introduce too many variables into the equation seeking the best combination from the past, we are virtually guaranteed that future performance will be less than the results seen in the past. This can even be statistically demonstrated. For this reason, it is usually best to minimize the number of variables in an investment strategy, an approach we will take in this book.

While an advantage of the back-weighted ROC approach is that it might make sense to avoid stocks which have recently experienced sharp gains, a disadvantage of the back-weighted method is that it will also avoid stocks which have recently suffered sharp declines. A stock that has fallen by 50 percent in the last month is unlikely to continue falling at this rate. But, it is also unlikely to recover quickly, and when using the

back-weighted calculation method, the investor risks buying stocks that have suffered steep declines in the recent past. These stocks are unlikely to perform well in the near future and would normally be avoided by prudent investors seeking steady long-term gains.

Calculating RS as a Front-Weighted Rate of Change

Alternatively, traders can define RS by using front-weighted momentum. The opposite of back-weighted ROC, front-weighting places greater value on the most recent returns and reduces the impact of older data. The rationale for this adjustment to ROC is summed up in the old market adage, "the trend is your friend." Providing more weight to more recent market action means the investor thinks it is likely that a stock's future performance will be very close to its current performance.

The formula for this calculation is:

FORMULA 2.6

$$RS = 100 * \frac{(P_{today} - P_{12\ months\ ago}) + (P_{today} - (P_{1\ month\ ago})}{P_{12\ months\ ago}}$$

where RS represents the relative strength
P_{today} represents the current price
$P_{12\ months\ ago}$ represents the price 12 months ago
$P_{1\ month\ ago}$ represents the price 1 month ago

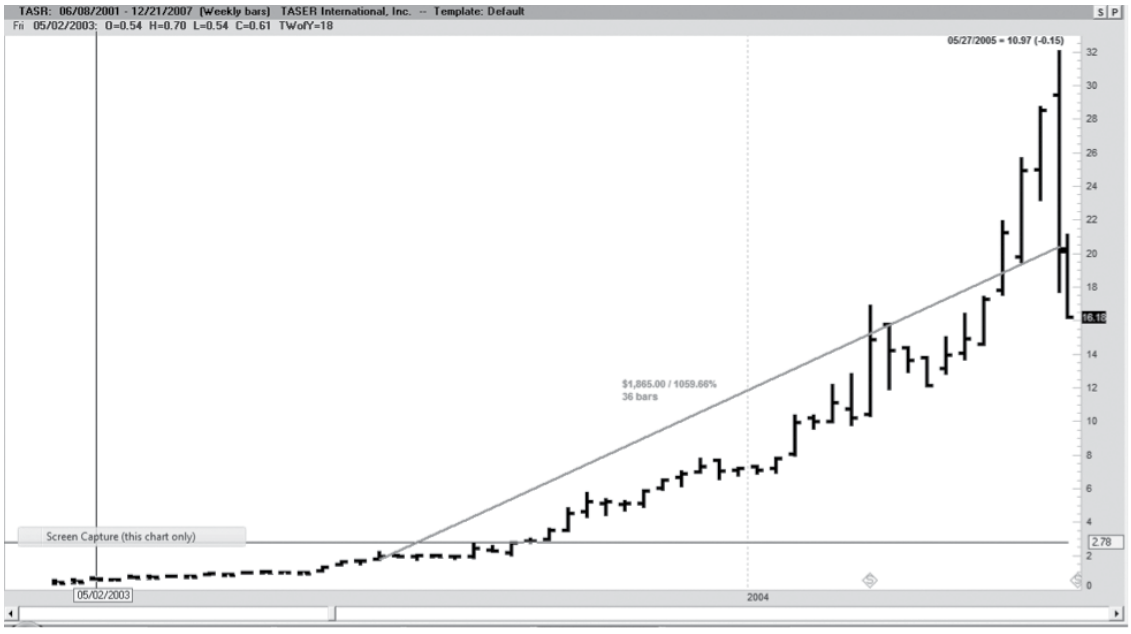
The formula is obviously very similar to the back-weighted calculation. The only difference is that the price change from the last month is added to the one year price change in the numerator, instead of being subtracted. By overweighting the most recent price data, the investor is hoping to find stocks which are just starting to trend. If a stock is going to deliver triple-digit returns over the next year, it will probably break out explosively with large gains of the first month of what will become a twelve month trend.

The logic seems sound, but potentially great returns must be related to potentially great risks. Many stocks will not follow through on these breakouts, consolidating in trading ranges rather than continuing higher. Other stocks will be in the final stages of a speculative run up where price has actually become parabolic. The chart of MSTR in Chapter 1 illustrated the idea of parabolic rises, and starkly demonstrated the danger of buying near the end of that rise.

The appeal of catching a stock at the beginning of a run-up is obvious. As seen in Figure 2-7, this can be very profitable. When TASER International (TASR) broke out of its extended trading range, the move up was rapid and profitable. TASR increased more than 1,000 percent in only nine months. The top was well above this level, offering investors the opportunity to exit with even greater profits. Front-weighting the ROC would result in the earliest possible entry, and should help accelerate exits if a stock starts falling rapidly, as TASR did after that amazing run up.

FIGURE 2-7

This chart of TASER International (TASR) demonstrates the importance of catching a trend as early as possible. After the breakout from an extended trading range, TASR gained 1,060 percent in nine months. At the top, the gain totaled more than 1,700 percent.



All of the variations described for back-weighted RS calculations can be done with front-weighted. Additional terms can be added to the equation, and percentages can be used to vary the weightings. As with the back-weighted calculation, the variations are limitless, and the same cautions expressed there are applicable in this case. Curve fitting to develop an investment strategy is never a good idea.

Based solely upon their descriptions, the front-weighted RS calculations seem to have overwhelming logic in their favor. Overweighting the most recent price action will help investors catch the biggest winners as early as possible. That same math will help them keep most of their gains by getting out of the stock at the first hint of a problem.

The case that can be made for this approach supports the need to independently test any trading strategy. Another old Wall Street adage reminds us that if something sounds too good to be true, it probably isn't going to work as advertised. Only through thorough testing can we determine if the front-weighted average offers all these advantages without any disadvantages. This testing will be undertaken in the next chapter.

Price-to-Moving-Average Ratios

Probably the first RS technique to be thoroughly tested was the method which calculates the ratio of a stock's current price to a moving average of the stock price. This technique is not commonly used by practitioners today, but test results using this approach were first published in the mid-1960s, as computerized testing of investment strategies was beginning to be explored.[11]

At the time, the Efficient Markey Hypothesis (EMH) was widely accepted in the financial community. The EMH states that all financial markets are "informationally efficient", which means that the price of a stock already reflects everything that is known about that stock. The price incorporates the collective hopes and fears of all investors about the future prospects of the stock. When new information becomes available, the EMH says

that it is instantly priced into the stock and that explains the large price changes we see related to news events.

Since prices already include everything that is known about a stock, the EMH implies that it is not possible to consistently beat the market, except through luck. This theory contends that day-to-day price changes in a stock are completely independent of each other, in other words, every day prices in the market move randomly.

The colorful analogy of a drunken sailor has been used to help explain the nature of price movements. As a drunken sailor staggers home from the bar, his next step is said to be completely random in direction, unrelated to the direction he took in his previous step.

This is undoubtedly a flawed analogy. There are limits to where the next step can be. If the next step is truly random, after stepping in a direction with his right foot, the sailor's left foot could fall anywhere within 360 degrees of the original step. Physically, this is impossible. We can argue that his next step cannot be backwards without turning from his original direction, which he cannot do without picking up his right foot. Physically, his next step is limited to a radius of 270 degrees. While the drunken sailor may stagger randomly, his walk from the bar is not truly directionless.

This classical explanation of the EMH has a flaw. And, current research indicates that the EMH itself is flawed[12]. If stocks truly moved in a random walk, individual stocks should not experience trends since that would indicate that current prices were related to past prices along a straight line. But at the time Levy was doing his work, academia almost universally embraced the EMH.

Closely examining the studies into stock price movement available to him, Levy noticed that the tests supporting the random walk conclusion all relied on the same techniques and he astutely observed that the studies did not account for the fact that stocks tend to move together. What Levy noticed was that most stocks tend to go up at the same time, and most stocks

fall at the same time. This cross-correlation, or co-movement of stock prices, could be hiding the fact that the movement of individual stocks depended upon the price movement and the size of the moves of other stocks. Intuitively, Levy understood that this dependency existed. To prove it, he set out to show that the rankings of relative price changes within a portfolio were consistent over time — in other words, he was supplying a mathematical rationale for RS. He wanted to demonstrate that the strongest stocks continued to perform well, while the weakest stocks continued to underperform the market.

To conduct his studies, Levy began with the idea that performance would be persistent over time. To determine whether or not this was true, he needed to look at the correlation of performance rankings over time to identify a possible relationship between past price behavior and future price behavior.

Correlation is the mathematical measurement of how closely two things influence each other. Given two sets of data, a linear regression can be completed to determine how much the movement in one set of data influence movements in the second set. A correlation coefficient is obtained from the linear regression process. The values of these coefficients range from -1.0 to +1.0. A correlation coefficient of +1.0 indicates that a perfect relationship exists between the two sets of data and whatever causes one set of data to move causes exactly proportional changes in the second set. Foe example, looking at price changes in two stocks, if one went up by 2 percent, the other would also rise by 2 percent. At the other extreme, a value of -1.0 means that a perfectly inverse relationship exists between the two sets of data. For stocks with a perfectly negative correlation, if one increased by 2 percent, the other would show a decrease in value of 2 percent. Most correlation coefficients lie between these two extremes. The math is understandable by anyone, but not critical to understanding what Levy did, so will not be explained any further.

In his study, what Levy expected to find was that the strongest stocks, on a relative basis, would remain strong; and over time he assumed that relatively weaker stocks would remain

weak. To test this idea, he needed to isolate the performance of each individual stock and filter out the effects of the overall market on stock prices. For the sake of comparing stocks within the investment universe, he needed to capture the relative performance of the stock, which he did by comparing the current price to a twenty-six week moving average of price.

The formula for Levy's calculation of RS is:

FORMULA 2.7

$$RS = \frac{P_{today}}{MA_{26\ weeks}}$$

where RS represents the Relative Strength
P_{today} represents the current price
$MA_{26\ weeks}$ represents the twenty-six week moving average of the weekly closing prices

This formula is similar to Formula 4.2, which took a ratio of the differences of price and also ignored the effects of the market on an individual stock. In reality, the market effect is captured in these equations if Levy's assumption that the movement of a stock is dependent upon the movement of other stocks is correct

Levy completed this calculation for all stocks in the investment universe and ranked the results each week. Performance for the next twenty-six week period was then measured and ranked, with the rankings of past RS being compared to the rankings of future performance. The final step was to measure the correlation coefficient between the two sets of data.

His test results confirmed his intuition. Levy reported that the stocks with the highest RS over the previous twenty-six weeks, on average, enjoyed the best performance over the subsequent twenty-six week period. Interestingly, he also found that when he used a four week moving average to calculate RS, there was no predictive value as to the price performance over the next four weeks. Over such a short timeframe, he hypothesized

that reversion to the mean must be the predominant factor impacting a stock's performance.

Levy's work has been shown to work in real time over more than two decades by Charles Kirkpatrick, CMT. Combining Levy's RS calculations with fundamental screens, Kirkpatrick published a weekly stock selection list for institutional and individual investors. The results are documented in a 2002 paper and reveal market beating portfolios in all but four years from 1982 through 2006.[13] This technique will be discussed more in later sections.

As with the other techniques examined so far, the calculation variables can be changed to suit the needs, or imagination, of the investor. This calculation can be back-weighted or front-weighted by modifying the formula to include the desired change. To increase the emphasis on more recent data, the formula could be:

$$RS = \frac{P_{today}}{MA_{26\ weeks}} * 1.05 * \frac{P_{today} - P_{4\ weeks\ ago}}{MA_{26\ weeks}}$$

This change overweights the price change in the most recent month by 5 percent, and would be similar to the front-weighted ROC concept. When test results are examined, the investor would be in a position to decide if this additional step is warranted.

Ratios of Multiple Moving Averages of RS

A more straightforward approach to back-weighting or front-weighting some of the price data is to use a ratio of moving averages to calculate RS. By using a ratio of shorter-term price data to a longer-term series of price data, more recent price movements are emphasized, similar to the front-weighted ROC. Inverting the ratio, placing the longer-term series in the numerator and the shorter series in the denominator has the same effect as a back-weighted ROC calculation, where the most recent data is less important than the older data.

Looking at a formula should clear up any confusion created by the description. For example, we can emphasize the short-term price momentum by starting with a ten week moving average of the closing prices and dividing that by a twenty-six week average of

the stock's closing prices. The formula for this method resembles the formula used by Levy (Formula 4.7), substituting a short-term moving average of price for the price itself:

FORMULA 2.8

$$RS = \frac{MA_{10\ weeks}}{MA_{26\ weeks}}$$

where RS represents the Relative Strength
$MA_{10\ weeks}$ represents the ten week moving average of the weekly closing prices
$MA_{26\ weeks}$ represents the twenty-six week moving average of the weekly closing prices

To increase the weight given to older data, we can invert the ratio:

FORMULA 2.9

$$RS = \frac{MA_{26\ weeks}}{MA_{10\ weeks}}$$

Instead of using the moving average of closing prices, an average of the percentage gains each week can also be used. In practice, this added calculation would not be employed by most investors, but we will use it here to illustrate this idea because percentage changes will be easier to follow than price changes. Table 2-2 shows sample price changes for a stock over the past ten weeks and over a twenty-six week period that includes those ten weeks as its most recent data. We assume that each stock started at a price of 100 per share. Relative strength ratio calculations are shown in Table 2-3.

TABLE 2-2

	Stock A	Stock B	Stock C
Ten week percentage change	100%	50%	-10%
Twenty-six week percentage change	50%	100%	100%
Ending price	150	200	200

Sample data to illustrate the calculation of RS ratios

TABLE 2-3

	Stock A	Stock B	Stock C
Ten week/twenty-six week Ratio	2.0	0.5	-0.1
Twenty-six week/ ten week Ratio	0.5	2.0	-10.0

Results of RS ratio calculations using the data in Table 2-1.

In our example, two stocks doubled in price and one appreciated by 50 percent over the twenty-six week holding period. Raking RS based upon the total change would show that stocks B and C were the strongest. The results in Table 2-3 show the variability of rankings based upon the ratio calculation methods. When the calculation period includes a negative return, the answer will always be negative, and in this example Stock C seems to be a strong stock undergoing a much needed correction, yet ranks lowest because of that pullback.

When overweighting the most recent performance, Stock A, the weakest performer over the twenty-six weeks, is rated highest. The RS investor employing this calculation methodology is expecting the short-term trend to continue. When we reverse the calculation, Stock B, which enjoyed steady growth, but is likely to have become overextended, becomes the top ranked performer. As this example illustrates, there are potential problems associated with any calculation method. These problems will be addressed when we develop a complete trading strategy in later sections.

While this example used percentage changes to ensure it was easy to understand, in practice, we would not use the

percentage changes but would use a moving average of the price. The reason for this is that using a short-term moving average of price instead of the current price smoothes out the day-to-day price fluctuations of the stock, which can be erratic. Since RS calculations are, in essence, just a snapshot of strength at a particular time, this smoothing should result in less volatile rankings, leading to lower turnover within the portfolio. Lower turnover improves overall performance for the investor by decreasing transaction costs.

Another advantage of using smoothed price data is that it should allow investors to hold onto stocks that are experiencing normal short-term consolidations in an overall rising trend. Other than that difference, using this method to calculate RS would result in the same advantages and disadvantages previously cited for front-weighted and back-weighted ROC.

Calculating RS as an Average of Different Time Periods

Using ratios of different time periods compares short-term to long-term RS in an effort to identify stocks which are experiencing an acceleration of RS. A different method of combining RS for different timeframes is to multiply the moving average of price over different timeframes and then taking the average of the product. The formula for this approach, using ten weeks and twenty-six weeks is:

FORMULA 2.10

$$RS = \frac{MA_{10\ weeks} * MA_{26\ weeks}}{2}$$

where RS represents the Relative Strength
$MA_{10\ weeks}$ represents the ten week moving average of the weekly closing prices
$MA_{26\ weeks}$ represents the twenty-six week moving average of the weekly closing prices

An advantage of this approach, compared with the ratio analysis, is that we are not limited to two time periods. It is

possible, though impractical, to use an unlimited number of time periods. This technique, using absolute changes instead of moving averages, is attributed to Tom McClellan and Roger Kliminski[14].

They calculate the five-day, fifteen-day, twenty-five day, and thirty-five day percentage changes of their investment universe, average the products by dividing by four and rank them. In a simple application, they demonstrated that it is possible to beat the market averages by doing this calculation only on the S&P 500 and NASDAQ Composite Index. They invested in stocks when the RS value for the NASDAQ Composite was higher than the RS of the S&P 500 and switching to cash when the S&P 500 was the leader. From 1971 to 2003, they reported that this simple approach outperformed the annualized return of the market by more than 30 percent. Their research identified other strategies to improve this performance.

This approach is promising as a quick technique suitable for market timing. Market timing is often considered to be a losing proposition. Studies often show that if a market timer misses the ten best days, they are likely to significantly underperform the buy and hold investor. What these studies fail to address is that market timing is designed to avoid the ten worst days. The timer will miss some of the best days, but will also reduce risk, and increase returns, by being out of the market when the risk is too high. Investors can profit by market timing since it will help them avoid large losses in the market.

The work of McClellan and Kliminski has a great deal of logical support. They are simply taking advantage of the fact that market gains are more likely when investors are optimistic about the future and buying more speculative stocks. When the investing public is more cautious, the larger, established companies in the S&P 500 are expected to outperform the tech-heavy NASDAQ Composite and this system offers a warning sign that investor sentiment has shifted. It is an interesting application of RS worth considering for the time-pressed investor looking at improving the performance of their retirement account.

A modification of this technique can be used to manage a portfolio.[15] For a group of Exchange Traded Funds, the investor could calculate RS over thirteen-weeks, twenty-six weeks, and

fifty-two weeks. To overweight the more recent performance, the values for the two shorter periods are doubled and then the three values are added together. The formula for this approach would be:

FORMULA 2.11

$$RS = \frac{(2 * (Price_{today} - Price_{13\ weeks\ ago})) * (2*(Price_{today} - Price_{26\ weeks\ ago})) * (Price_{today} - Price_{52\ weeks\ ago}))}{3}$$

The final RS values are then ranked, and the strongest performers are bought. With the addition of sell rules, this can become a complete investment strategy.

Alpha & Beta

Modern portfolio theory (MPT) attempts to explain how rational investors create a portfolio of diversified investments to obtain the maximum possible return consistent with their tolerance for risk. Investors with a greater appetite for risk expect greater than average returns for holding riskier assets. Among the basic concepts of the theory are ways to measure the riskiness of an asset, defined as the alpha and beta coefficients.

Under MPT, the value of an asset can be found by the Capital Asset Pricing Model (CAPM). Using the CAPM, a stock's expected return based upon its riskiness is calculated, and then the theoretically correct value for the stock can be calculated. The stock's price in actual trading should be near its calculated value, under this theory. Alpha and beta, both measures of a stock's risk, can also be used as measures of a stock's RS. First, we will address beta since it is a little easier to understand.

One part of a stock's risk comes from the fact that it is a stock. The stock market is defined as a risky investment since there is no guarantee of profits or even of return of capital. In academic terms, this is known as "systematic risk," or the market risk, which is a risk that cannot be diversified away. Another

component of risk is the “idiosyncratic risk”, which is the risk specific to an individual stock.

If we think of the stock of General Motors (GM), we can more readily understand these risk components. GM trades on the New York Stock Exchange, and is a member of the Dow Jones Industrial Average and Standard & Poor’s 500 Index, among other indexes. Index investors, including many large mutual funds and ETFs, buy and sell baskets of stocks to duplicate the performance of the actual index. As these trades are executed throughout the day, the price of GM moves up and down with the indexes. This is an example of systemic risk, which is risk associated solely with the stock market and having nothing to do with the underlying business of GM.

While the performance of the stock market as a whole represents a risk to all stocks, the systematic risk is not the same for all securities. Different companies respond differently to economic conditions such as a recession or a growing economy. The automobile industry will suffer more in a recession than the pharmaceutical industry. Both industries will suffer during the recession, but drug companies will not see earnings drop as much as companies like GM in the automobile industry, because many people will defer buying a new car but cannot stop taking prescribed medications. Likewise, in a growing economy, GM will see a greater increase in earnings than a pharmaceutical company since the pent up demand for new automobiles will be unleashed. Economic conditions are another component of systemic risk, but the degree of risk will vary across industries. These different responses to systemic risk are quantitatively defined with the calculation of beta.

The idiosyncratic risk, or nonsystemic risk, is derived from the fundamentals of GM itself. This is a company whose performance can be affected by foreign competition, consumer rejection of new models, and employee union relations among thousands of other factors. These risk factors are unique to the performance of General Motors as a business, and are not measured by beta, but are captured by alpha.

Alpha and beta are both calculated using linear regression analysis. To find beta, the performance of the individual stock is compared to the performance of the market as a whole, defined by

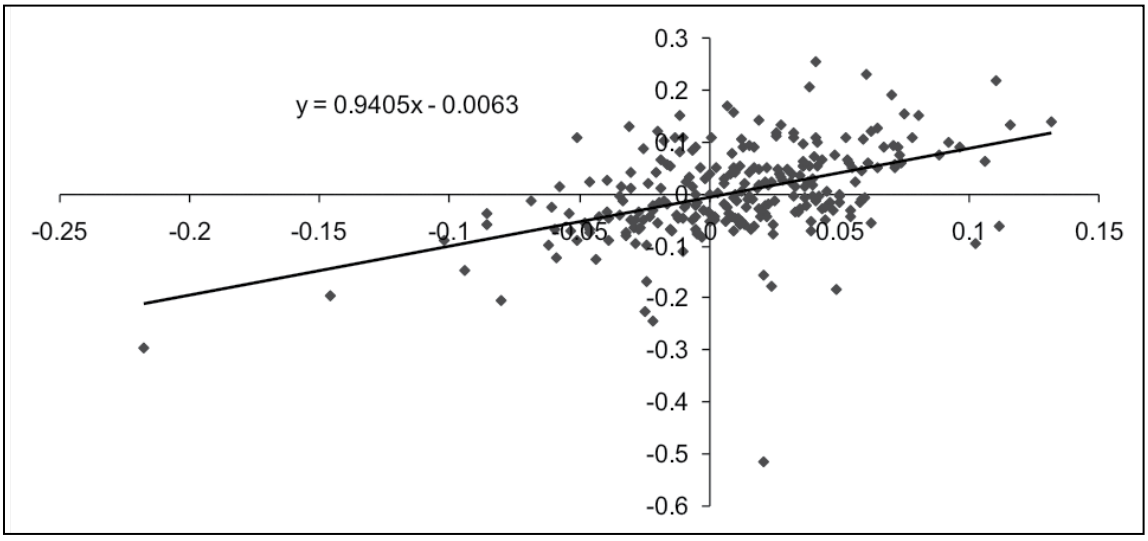
an index, over the same timeframe. Both sets of data are plotted on a single graph, and the straight line which best fits the data is found through a series of steps that are difficult to explain, but easy to do using Microsoft Excel or any statistical support software package. After drawing the line, the slope of the line is determined, and that represents the beta of the stock.

As an example, we will look at the data for GM compared to the S&P 500. To calculate the beta, monthly prices from January 1980 through 2000 were used. Annual data could be used, and longer or shorter timeframes could be used. In Figure 2-8, the annual returns for GM and the S&P 500 are plotted with the linear regression line and regression formula shown.

The type of graph shown in Figure 2-8 is known as a scatter diagram. GM's monthly percentage returns are shown on the y-axis (the vertical line) with market returns on the x-axis (horizontal line). Using the point in the lower right corner to describe how points are plotted, the S&P 500 declined 21.76 percent in

FIGURE 2-8

Linear regression is used to calculate the alpha and beta of a stock. In this example, the market returns of GM are plotted as dots along the y-axis (vertical line), while the returns for the S&P 500 are plotted along the x-axis (horizontal line). Microsoft Excel is used to plot the line which best fits the data, and the formula for this line is shown in the figure. The slope of the line, in this case 0.9405, is the beta of GM. The y-intercept, 0.0063, is the alpha of GM.



the month of October 1987, and GM declined 29.52 percent that month. The point corresponding with the S&P decline is found on the x-axis, and a dot is plotted at -0.2952 on the y-axis to correspond with the return of GM's stock price for that month. This process was repeated for each month.

Then, Excel calculates the straight line which best describes the data. In this case, that straight line is described by the formula y = 0.9405x – 0.0063. From algebra, we know that the equation of any straight line can be written as: y = mx + b, where m is the slope of the line and b is the y-intercept. Slope measures how quickly the line changes over time, the y-intercept describes the value of y when x = 0.

For GM, the slope is 0.9405 and the y-intercept is -0.0063. Switching from algebra back to finance theory and the CAPM, beta is defined as the slope and alpha as the y-intercept. This means that GM has a beta of 0.9405 and an alpha of -0.0063.

With a beta of 1.0, we expect to see a stock match the performance of the market. Betas under 1.0 indicate that the stock will usually lag the market and stocks with betas exceeding 1.0 should see returns which exceed the returns of the market index. To think in percentage terms, we can multiply the beta times one hundred. So a beta of 0.94 means the stock should move 94 percent as much as the overall market. A beta of 1.20 would indicate an expected return equal to 120 percent of the market's return. Given the beta calculated for GM, if the market averages increase by 10 percent, we'd expect to see GM increase by 9.4 percent. The same principle applies in a market decline. If the market average decreases by 10 percent, GM decline by only 9.4 percent.

Alpha provides the expected return of the stock if the overall market is flat for the time period. This means that alpha provides a theoretical measure of how much of a stock's return is derived solely from factors unique to the company. Again, alphas can be converted to percentages by multiplying the alpha by one hundred. In this example, if the market returned zero percent in a given month, we would expect GM to show a slight loss of 0.6 percent.

A more rigorous mathematical explanation of alpha and beta can

be undertaken, but is not necessary to see that both can be used to measure a stock's performance relative to the market. As an indicator of RS, beta, although based upon historical calculations gives traders some idea of what to expect in the future, assuming the market behaves close to the way it did in the past. Referring to Figure 2-8, we see that market usually does behave close to the way it did in the past. Most of the time, the price change of GM is less than 10 percent in any given month, meaning that the majority of the data points lie between values of -10 and +10 on the y-axis. The change in the S&P 500 is usually less than 5 percent per month. Given this stability of returns, beta offers a fair guide to future performance.

Many financial analysts associate beta with risk. They reason that higher beta stocks will decline more than the overall market if the market falls and therefore bring more risk to an investor's portfolio than stocks will decline less than the overall market. This is true for any calculated measure of RS; higher RS stocks will be more volatile and carry more risk. This concept is easily illustrated with beta. For a stock with a beat of 1.2, the expected price movement is 20 percent more than the overall market. If the market goes up 10 percent, the stock should move 12 percent. Investors are comfortable with risk like this on the upside. But, sometimes the market goes down, and if the market declines by 10 percent, our stock with a beta of 1.2 would be expected to decline by 12 percent. The expected result would be the same for any other measure of RS.

Conventional thinking associates potential declines with risk. In reality, beta is not an adequate measure of risk. High beta does imply that the stock will be more volatile than the overall market. However, most investors are striving to achieve gains greater than those possible by buying an index fund that seeks to match market performance and do not consider outperforming the index to be risky. When considering volatility and risk, investors must distinguish between upside volatility and downside volatility. These issues will be addressed in developing an RS investment strategy.

In an interesting practical application of these concepts, Robert Pierce addresses the issue of volatility from a unique

perspective[16]. He identifies alpha conceptually as volatility adjusted RS. His work shows that stocks with higher RS will usually have higher volatility, higher betas, and higher alphas. To begin selecting stocks, he calculates the RS of all stocks in his universe using a ninety-nine week moving average of price changes. The next step is to calculate beta. He defines beta using the percentage change between the lowest price in a time period and the highest price in that same period. This eliminates the use of signs in the calculation, and a stock with a large decline would be considered as having a high beta, equal to the beta of a stock which had an equal percentage gain in that time. In this way, beta is reduced to a measure of volatility.

Having defined alpha as volatility adjusted RS, Pierce now calculates alpha as the ratio of RS to beta. He then sorts the alphas for the stocks within his universe from highest to lowest and assigns them to percentiles. This captures the idea of alpha, which is to measure a stock's strength independent of the influence of the stock market, while ignoring the academic derivation. He is identifying stocks which have a strong tendency to move more than the market (high beta), and stocks that are doing that while adjusting for their increased volatility (high alpha).

In doing so, Pierce demonstrates the most important aspect of RS investing, which is to find something that works and to use it consistently. He buys the strongest RS stocks, and sells when the alpha for a stock within the portfolio falls below the fiftieth percentile. Pierce has published a study showing his real-time performance applying his rules. He more than doubles the market performance with this relatively simple approach.

Alpha represents a historical measure of a stock's return independent of the market, making it a pure measurement of historical RS. This may mean it is the best possible measure of RS, or it may mean the theory is flawed. Detailed testing will be undertaken to assess if either of these ideas is true.

However, beta will not be tested separately. Despite all of the theory and elegant math supporting the calculation of beta, the results obtained for beta are equivalent to the results of the much simpler normalized rate of change. Under the CAPM, the market

itself is defined to have a beta of 1.0, since the market can neither outperform nor underperform itself. Individual stocks are assigned betas based upon the degree that their returns differ from the returns of the market. A stock that outperforms the market has a beta greater than 1.0 and if a stock fails to perform as well as the market, the stock's beta will be less than 1.0.

More specifically, a stock that has a beta of 1.2 moves 20 percent as much as the market; meaning when the market has an overall decline of 10 percent, a stock with a beta of 1.2 will fall 12 percent. Likewise a 10 percent rise in the market should result in a 12 percent gain for a stock with a beta of 1.2. Extending this example, we can come up with the series of stocks shown in Table 2-4. We assume that each stock has a starting value of 100 to simplify the calculations.

TABLE 2-4

Stock	Beta	Expected gain if market gains 10 percent	Normalized Rate of change at expected gain for stocks selling at 100 per share
A	0.8	8%	8%
B	0.9	9%	9%
C	1.0	10%	10%
D	1.1	11%	11%
E	1.2	12%	12%

Sample data of stock price changes used to compare beta with the normalized rate of change calculation.

For stock A, with a beta equal to 0.8, if the market gains 10 percent, the stock is expected to gain 80 percent of that amount, or 8 percent. Staring at a price of 100, the stock would reach a price of 108 in that rise. From Formula 2.2, the rate of change would also be 8 percent. Since beta and rate of change are both being calculated with the same historical data, they will always provide the same results.

As Table 2-4 illustrates, the relative rankings would be the same if we calculated beta for each stock or the much simpler normalized rate of change. Given that the added complexity adds nothing to the stock selection strategy, there is no need to test beta. All other calculations from the formulas presented in this

chapter result in different values, and will therefore be tested.

Careful readers will notice a similarity between beta and Gartley's velocity statistics described in Chapter 1. Although beta is mathematically more complex than Gartley's approach, which was published in 1945, the end result is similar. In some ways, velocity statistics offer a more sophisticated look at the expected performance of a stock. Gartley prepared two sets of velocity statistics, one for bull markets and one for bear markets. The CAPM assumes that over a long enough time, the differences will not be material to the calculation. Individual investors can make their own decision, and use a suitable lookback period for alpha and beta or follow Gartley's approach.

The bottom line is that any of these methods will provide a measure of how a stock has moved in comparison to the market in the past. That information will serve as a useful guide as to how the stock can be expected to move in relation to future market swings. But it is only a guide; the future is never exactly like the past. An investment philosophy is needed to prevent disaster for those all too frequent times when the future varies from the past.

Combining RS and Other Technical Indicators

Technical analysts have spent decades creating formulas designed to give them an edge in trading. Many are based upon the principle that changes in momentum will occur before changes in price trend occur, in other words technicians are saying that RS in a stock's past performance is a good indicator of future price appreciation. Examples of technical indicators include stochastics, the moving average convergence-divergence indicator (MACD), and the poorly named Relative Strength Index (RSI) which doesn't really measure relative strength.

RSI was introduced to the world by Welles Wilder in 1978.[17] It is among the most popular momentum oscillators used by technicians, and is a very useful component in many trading strategies. The RSI compares the strength of a stock's recent upside movement to the magnitude of its recent losses and provides that information as a single value that ranges from 0 to 100. It is not a measure of comparative RS as we have been discussing in

this book because it does not take into account the performance of other stocks or the market itself. The theory behind the RSI is that it will identify those times when a stock has moved too far, too fast and is due to exhibit mean reverting behavior causing a reversal of the current trend. It is intended to spot tops and bottoms rather than find stocks that are starting to move higher for an extended period of time, as RS seeks to do.

MACD measures the difference between a short-term and long-term moving average of closing prices. The longer moving average is subtracted from the shorter moving average. The theory behind this indicator is that this calculation of a stock's momentum will show when prices are changing directions. A positive value of MACD indicates that the short-term MA is trading above the long-term MA. A negative MACD indicates the opposite. If MACD is positive and rising, then the gap between the two MAs is widening, which means the rate of change of the short-term MA is higher than the rate of change for the long-term MA. This should lead to higher prices for the stock. If MACD is negative and declining further, then downward momentum is accelerating, and lower prices are to be expected

The MACD indicator has been adapted as a measure of RS by Christopher Hendrix, CMT.[18] Hendrix substitutes an RS calculation for price into the traditional MACD formula and creates a Momentum of Comparative Strength (MoCS) formula:

FORMULA 2.12

$$\text{MoCS} = \begin{array}{c}\text{(12-period EMA of (Stock/S\&P 500))} - \\ \text{(26-period EMA (Stock/S\&P 500))}\end{array}$$

where EMA represents an exponential moving average
Stock represents the closing price of the stock being evaluated
S&P 500 represents the close of the S&P 500 Index

An exponential moving average (EMA) is used by some market technicians to reduce the time lag introduced with simple moving averages. When using a moving average to smooth the data and help identify the trend, some delay is introduced into the price series.

EMA's reduce the lag by overweighting the importance of more recent prices, with the amount of overweighting determined by the specified period of the EMA. Shorter period EMAs overweight the most recent price more than longer period EMAs. In the MoCS formula, the most recent close accounts for 15 percent of the value of the 12-period EMA, and the 26-period EMA derives about 7.5 percent of its value from the most current price. Because it puts more weight on recent prices, an EMA will react quicker to recent price changes than a simple moving average which equally weights all data points..

At first glance, this formula appears to be similar to ratio RS method. The difference is that trading signals are generated when a 9-period EMA of the MoCS crosses above or below the current value of the MoCS. An example is shown in Figure 2-9. Buys are signified when the solid line is above the dotted line, sell signals are the reverse. The advantage of MoCS is that it compares the movement of a stock to the overall market but allows the investor to apply

FIGURE 2-9

Modifying the formula of the well-known MACD technical indicator to measure RS allows an investor to see clear buy and sell signals for an individual security. The momentum of Comparative Strength (MoCS) indicator is shown in the bottom panel of this figure. In this case, a buy signal occurs when the solid line crosses above the dashed line, and a sell occurs when the solid line falls below the dashed line.

an RS strategy to a single security, rather than requiring that an investment universe be rank ordered and sorted into percentiles. The chart shows that there are clear buy and sell signals based only upon the behavior of this stock compared to the market.

This technique can be applied to any technical indicator by adapting the formula to use an RS ratio instead of the stock's closing price. It is a highly adaptable strategy which can employ RSI, or stochastics, for example, instead of using MACD. Alternatively, investors can change the time periods for MACD to generate a greater or lesser number of signals.

Combining RS and Price Cycle Position

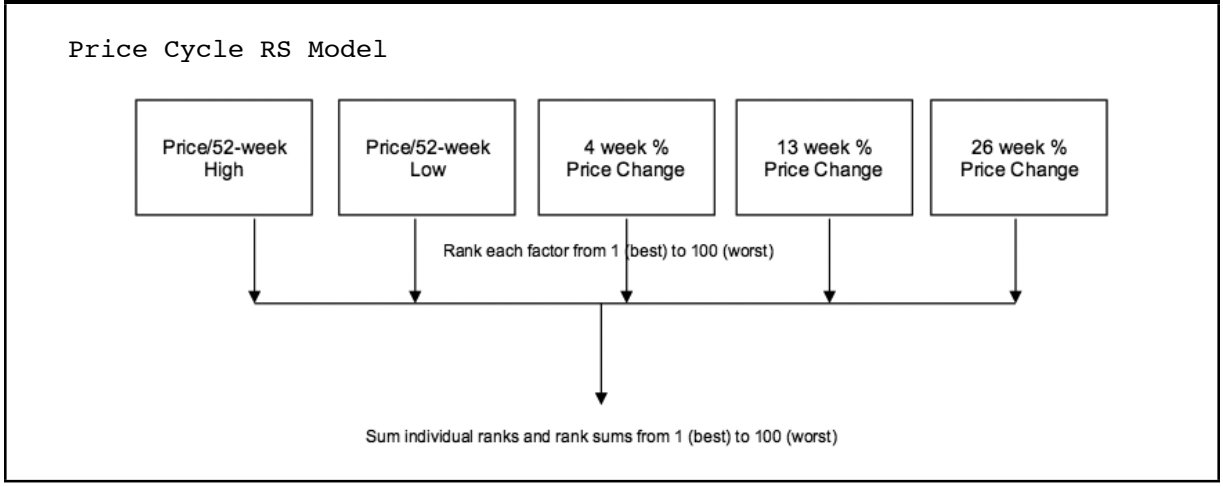
So far in this chapter, we have defined various means of calculating RS and highlighted the fact that there are an infinite number of variations possible with these calculations. The formulas can be combined in a number of different ways. Moving averages can be substituted for any variable in any equation. In short, you can spend a career seeking the best formulation to use when building a complete RS investment strategy.

Investors have invested millions of hours and dollars seeking the holy grail of investment strategies. Instead of falling into that trap and thinking of the possible permutations in calculating RS, it is best to keep in mind a principle known as Occam's razor, an idea first expressed in fourteenth century England by Franciscan Friar William of Ockham. The principle is usually summarized as "All other things being equal, the simplest solution is the best." In other words, when several options are available, the idea that requires the fewest inputs is usually the best.

However, sometimes an analyst will introduce additional variables to help refine a general idea. When doing this, there must be an underlying logic to justify the added complexity. Frederic Dickinson, CMT, has developed a multifactor RS model that incorporates terms based upon the stock's price relative to its fifty-two week high and low price.[19]

Dickson believes that day-to-day price changes are largely driven by the stock's ability to respond to changing market

FIGURE 2-10



factors. Over a three to six-month period he believes that the performance of the overall market is the most important influence on individual stock prices, and he sought to add that factor to his RS rankings by considering where a stock is in relation to its fifty-two week price cycle. To calculate RS using this technique, a picture (Figure 2-10) will be easier to follow than a formula.

Dickson is hunting for stocks showing good relative strength after they have formed a bottom. By including price in relation to its 52-week high and low, his calculations favor stocks that have been in a persistent uptrend. These values will be highest for stocks trading nearer their cycle high. The problem he sought to address was that high RS stocks tend to breakdown unexpectedly, resulting in losses. While his model adds additional factors to the equation, he reports that it offers increased predictability of returns. Predictable returns are important to institutional investors, who favor slow but steady returns to spectacular gains followed by dramatic drawdowns.

Accounting for Risk

Relative strength strategies involve a great deal of risk. The law of gravity tells us that what goes up, must come down and down always requires less work than up. If we think of a rocket, it takes an incredible amount of force to propel the vehicle out of the earth's gravitational field. But when returning to earth the greatest problems engineers face is slowing the vehicle down so it will not

crash into the ground. No additional force is required to bring it to earth once the returning spacecraft re-enters the gravitational field.

Stock markets are not immune from the laws of gravity. Stocks with the highest relative strength will go up the most but will often suffer sharp declines if the overall market turns lower or if dramatic changes occur in the underlying company's fundamentals. The chart of MSTR in Figure 1-1 showed that high RS stocks can decline even faster than they rise in price.

This is the risk that a successful strategy will need to mitigate. Since RS is largely a quantitative investment model, it should be possible to address risk by modifying the calculation. The CAPM defined beta as a measure of risk, and we calculated beta using by applying a linear regression to a stock's returns. In strict mathematical terms, beta can also be defined as the ratio of the covariance of the stock's price movement and the market to the variance of the stock's returns. Covariance measures how closely the movements of the two data series are related and variance measures how predictable the stock's returns are over time.

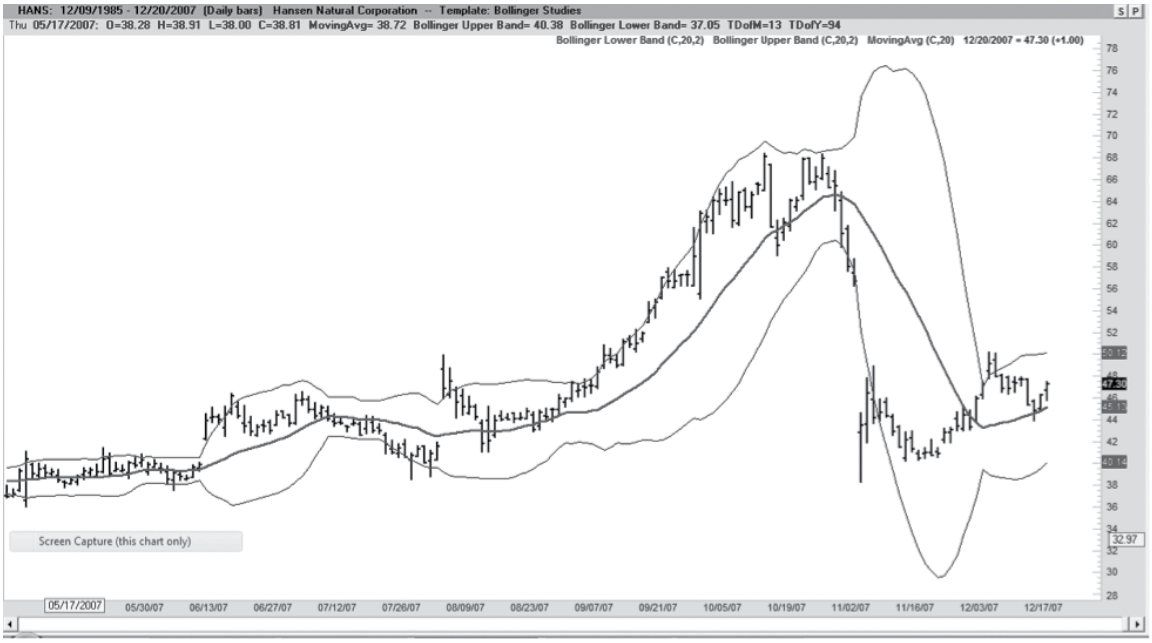
Another statistical concept that measures the predictability of returns is the standard deviation, which is the square root of the variance. Standard deviations are commonly used in financial analysis as a measurement of risk. Using Microsoft Excel, or a similar software package, standard deviation is easy to calculate for any data series. It is the mathematical principle behind Bollinger Bands, a widely used technical indicator.

To calculate Bollinger Bands, technical analysts find the twenty period moving average of price. Although any number of periods can be used, twenty is the default value in almost all software packages. It can also be calculated for any timeframe, from minutes to years, so that is why we refer to periods in this description of how to calculate the indicator. After finding the moving average, two standard deviations of that average are calculated, and the three lines are commonly drawn on a chart along with the stock price (Figure 2-11).

Two standard deviations should contain approximately 95 percent of the price movement. This is based upon the assumption that

FIGURE 2-11

This chart shows the price of Hansen Natural Corporation (HANS) with Bollinger Bands. We see that the width of the Bollinger Bands varies a great deal, forming a very tight band around price on the left of the chart and an extremely wide gap on the right of the chart as the stock's volatility increased suddenly and dramatically.



stock prices follow a statistical model known as the standard distribution. The details of this model are not critical to understand RS, but it is important to understand that there is an underlying theory supporting the use of standard deviations as a proxy for risk.

Bollinger Bands will be wider for stocks with higher variability of returns, and the chart offers a visual proof of that. If returns fluctuate wildly around the moving average of price, the standard deviation will be higher than for a stock which moves steadily upward or is in a narrow trading range. We can think of this simply as the more a stock's returns vary from the average return, the more volatile the stock. The wider price swings are associated with risk, since investors seem to prefer steady positive returns. Some investors apply these ideas by using standard deviation to adjust their RS calculation for risk.

To adjust for risk, the standard deviation can be added as a

denominator to any of the RS calculation methods. As an example, the RS Ratio formula (Formula 2.3), adjusted for risk would be:

FORMULA 2.13

$$RS = 100 * \frac{((P_{today} - P_{12\ months\ ago})/(IndexP_{today} - IndexP_{12\ months\ ago}))}{STDEV\ (P)}$$

where RS represents the relative strength
P_{today} represents the current price of the stock
$P_{12\ months\ ago}$ represents the stock price 12 months ago
$IndexP_{today}$ represents the current price of the index
$IndexP_{12\ months\ ago}$ represents the price twelve months ago of the index
STDEV (P) represents the standard deviation of the stock price for the past twelve months

Any of the other calculation methods would be modified in the same way.

If we divide any RS calculation by the standard deviation of each security within the investment universe, we will reduce the overall ranking of the more volatile issues while increasing the relative standing of less volatile issues. This may lead to slightly reduced gains on the upside, but the reduced downside risk should more than compensate for that drawback.

Which technique is best?

In this chapter, we have simply catalogued the various techniques to define RS. These techniques are listed in Table 2-5. In the next chapter we will put these techniques to the test, and determine if there are significant differences between the techniques. We'll also figure out if any technique offers traders an opportunity to outperform the market.

TABLE 2-5

RS Techniques	Formula
Differences of prices	2.1
Normalized rate of change	2.2
Ratio of prices	2.3
Chart analysis of RS ratios	
P&F analysis of RS	
Back-weighted ROC	2.5
Front-weighted ROC	2.6
Price/Moving average ratios	2.7
Ratios of multiple moving averages	2.8 & 2.9
Averaging different time periods	2.10
Alpha	
Beta	
Momentum of Comparative Strength	2.12
Combined Cycle Position	

Summary of RS techniques with references to the formulas used to calculate RS.

If we use standard deviation to account for risk, we nearly double the number of techniques. In total, we have identified eighteen different formulas which can be applied to solve for RS, in addition to countless variables for time periods within those formulas.

CHAPTER 3

Testing Relative Strength

In Chapter 1, we explained the economic and stock market theories needed to understand why RS should work. It's important to understand why investment strategies should work in order to have the confidence to stick with the strategy through good times and bad. The second chapter presented a variety of ways to analyze and calculate RS. In order to implement RS as an investment strategy, we need to test each of those calculations and determine if they have worked successfully in the past.

The future will not be exactly like the past, but when investing actual dollars, it is helpful to know how our decisions would have fared in the past. While the future results obtained will be different from the past, it is important to know that our strategy would have been successful. In this chapter we will test the different methods of calculating RS. In the next chapter, we address a way to evaluate whether or not the future is varying significantly from the past.

Developing a Testing Strategy

The first thing we need to do is test the different ways of calculating RS to find out if one is significantly better than the others. We will need to develop a complete RS investment strategy that ensures we are comparing apples-to-apples, and then apply that strategy uniformly to each calculation method. A complete testing strategy requires that we fully define the following parameters:

1. What to buy

2. What timeframe to use in the calculations
3. How many stocks to buy
4. When to buy, which will also answer the question of how often the portfolio needs to be reviewed
5. When to sell

In this chapter we will thoroughly address the thought process that is used to find the answer to these questions. The way we develop the answer to each of these questions can be applied by any investor to develop and implement an RS strategy, or any other trading system. The primary goal of an investment strategy is to develop buy and sell rules that will outperform the market over the long-term, while having less risk than a buy-and-hold index fund strategy. The secondary goal of the investment strategy we will develop is to create a strategy that requires a minimum amount of time for the individual investor to implement, ideally less than an hour a week to gather the data, process the calculations, make buy and sell decisions, and place any orders.

Answering these questions will tell us the best way to calculate RS. After answering the six questions from above, we will look at how we can improve the strategy. That will require an additional series of tests to determine the best answer to each question.

What to Buy?

RS calculations require a universe of stocks to perform the calculations on. The universe can include any group and any number of stocks. It can be as small as perhaps the dozen selections available through your employer-sponsored 401(k) plan or as large as all 50,000 stocks traded on any global stock exchange. For our purpose, we need to define a universe and complete different tests for each definition of RS against that same universe.

With the countless options available at this point, we first need to define the purpose of the test. We anticipate that the test results will be used by individual investors to guide their own investment decisions. Individuals often have limited choices

for their investment dollars. Employer-sponsored retirement plans generally offer a relatively small number of diversified mutual funds for participants to choose from.

We cannot duplicate the results for every retirement plan. But, we can generalize. The options offered by employers are usually designed to provide choices based upon how aggressive the investor would like to be. The choices usually consist of mutual funds because they offer diversification, which reduces risk, and they offer professional management at low cost. Choices often include a mix of mutual funds which invest based upon growth and value methodologies, targeted maturity funds, and varying levels of exposure to bond funds.

Growth funds seek to identify stocks which have rapidly growing sales and are expected to have rapidly growing earnings. They are considered to be aggressive because there is a great deal of risk associated with fast growing, low earning companies. Expectations that earnings will appear are often not met, and growth stocks often either significantly outperform the markets or disappoint the investor with subpar returns. Diversification and skilled management mitigates the risks.

Value funds look for beaten down stocks, or stocks with potential that the managers believe the stock market has not recognized. Value investing is usually considered to be more conservative than growth investing because value stocks often pay dividends and low market valuations mean they aren't expected to decline as much if earnings fail to meet analysts' expectations.

Target funds are actively managed funds that adjust over time as the investor approaches retirement. They are designed to change the investment allocation from more aggressive to more conservative according to target maturity date. Their overall goal is to produce growth as you prepare for retirement and income after you retire while requiring only a single decision from the investor. The investor picks the date closest to their retirement - 2020, 2030, 2040 - and the investment manager does the rest.

In testing, target funds will never be the best performers in a diversified universe. There are times when stocks will outperform

bonds and other times when bonds will outperform stocks. The hybrid nature of target funds guarantees that they will lag the leader during either of those times. While there is nothing wrong with the investment theory underlying the target funds, there is no place for them in an RS investment strategy.

Bond funds are widely believed to be less risky than stocks. Over the very long-term, high quality bonds will pay a guaranteed interest rate and eventually return the initial investment to the investor. Bond funds are traditionally expected to provide income and a measure of safety to the investor. There is a risk of default on almost any individual bond, and the advantage of mutual funds is, again, that diversification and professional management reduces the risk associated with possible defaults.

Bonds have a reputation as a boring investment, capable of delivering slow but steady gains that significantly lag stocks. From a buy-and hold perspective, this is a well deserved reputation. Looking at long-term US Treasury bonds, we find that the average annualized return is almost 8 percent, more than two points lower than the return available from equities. As to their reputation for steadiness, this too is well deserved from the perspective of the buy-and-hold investor. The volatility of Treasury bonds is a little more than half the volatility of stocks.

That fact that bond returns are volatile makes bond mutual funds a suitable candidate to include in an RS investment strategy universe. During a bear market in stocks, it is likely that bonds will be performing well. The strength in bonds will be reflected in the RS calculations, and may very well represent a profitable investment opportunity during those times when stocks are falling.

Considering the variety of investment options, selecting a broad-based testing universe is challenging. An increasingly popular investment vehicle is the asset class known as Exchange Traded Funds (ETFs). At the end of 2007, investors had a choice of more than 600 ETFs and the ETFs controlled more than $600 billion in assets. They represented the fastest growing investment class at that time. ETFs provide a wide variety of investment choices. They exist for most indexes, and investors can duplicate the

performance of the S&P 500, NASDAQ 100, Russell 1000, Russell 2000 or almost any other index by buying an ETF. Index variants, such as the S&P 500 Value Index which holds only the stocks with the lowest valuations, can offer even greater diversification to the individual investor. It is also possible for individuals to buy or sell ETFs designed to track industries such as energy, technology, or financial stocks. There are ETFs available for bonds, commodities, and some that profit when the market declines. ETFs offer an incredibly wide array of choices and low expenses for the RS investor.

The problem with testing on ETFs is that they have a short history. Most ETFs have been introduced within the past five years as of the time this is being written. That time period represents only a generally bullish phase in the market. The purpose of testing an investment strategy is to attain confidence that the strategy works. That requires testing it over an extended period of time and over varying market conditions. It is very important to test the strategy over both bull and bear markets, since individual investments will behave differently in both.

The short history available for most ETFs makes them a poor choice for testing strategies. That said, testing done on indexes which mirror the ETF holdings or on mutual funds with similar investment objectives is an alternative that you should strongly consider. It is reasonable to assume that an ETF will track the index it is designed to track. The RS investor can benefit from the wide array of options available through ETFs, their low management fees mean their actual performance is very close to the underlying index, and the fact that they are bought and sold like stocks means they can be traded at a very low cost.

After reviewing the advantages and disadvantages of mutual funds and ETFs for our testing strategy, we need to consider the merits of testing RS against a basket of individual stocks. Using the stocks that comprise an index is not a realistic testing option for most individual investors. While this is the method used in most academic research, it typically requires customized programming or specialized software to undertake these tests. Simple RS testing can be accomplished with spreadsheet software, such as Microsoft Excel, but it is not practical to use this

software with a large universe of stocks. The Dow Jones industrial Average contains only thirty stocks, and could be tracked using Microsoft Excel. However, the thirty stocks comprising this index represent only large companies and would not reflect the results attainable with a more diverse investment universe. The inability of most investors to duplicate the results of an RS test based upon an index make it a poor choice to use in this chapter.

To ensure that the results we obtain in this section are attainable by the average individual investor, we will use a small universe of mutual funds. This offers us the ability to test over an extended period of time and ensure that our tests includes bull markets, bear markets, and those times when the market moves sideways for an extended period of time.

In addition to a long history, testing the strategy on a small group of mutual funds offers diversified choices similar to those available to many investors through their employer-sponsored retirement plans. Fidelity Select Sector Funds will be used for the tests conducted to determine the best way to calculate RS. They offer a long history, with some funds dating back to the 1980s. We will use a very broad list of funds, including thirty-three funds currently offered (Table 3-1).

This list of funds offers all the variety of the stock market and is equivalent to all of the diversified options available in a typical retirement plan. Most plans offer a choice between growth and value funds, this list also includes representatives of those choices. At any given time, a sector will be dominated by growth — usually technology is among the largest holdings of growth funds. Value funds often include financial stocks, but the current choice of value managers will be represented on this list because a beaten down sector will eventually trade at valuation levels enticing to managers employing this style.

Likewise, investments equivalent to bonds are found in the investment universe of mutual funds that we've defined. Price movements of utility stocks are highly correlated with movements in bond prices. Both are usually bought by conservative investors seeking steady income. Utility stocks tend to do well during bear markets, at the same time that bonds are performing well.

TABLE 3-1: INVESTMENT UNIVERSE USED IN TESTING

Fund Name	Symbol
Fidelity Select Financial Services	FIDSX
Fidelity Select Leisure	FDLSX
Fidelity Select Industrial Equipment	FSCGX
Fidelity Select Brokerage	FSLBX
Fidelity Select Telecommunications	FSTCX
Fidelity Select Multimedia	FBMPX
Fidelity Select Consumer Discretionary	FSCPX
Fidelity Select Banking	FSRBX
Fidelity Select Retailing	FSRPX
Fidelity Select Utilities	FSUTX
Fidelity Select Technology	FSPTX
Fidelity Select Construction	FSHOX
Fidelity Select Computers	FDCPX
Fidelity Select Automotive	FSAVX
Fidelity Select Defense & Aerospace	FSDAX
Fidelity Select Software	FSCSX
Fidelity Select Insurance	FSPCX
Fidelity Select Health Care	FSPHX
Fidelity Select Home Finance	FSVLX
Fidelity Select Electronics	FSELX
Fidelity Select Chemicals	FSCHX
Fidelity Select Transportation	FSRFX
Fidelity Select Communications Equipment	FSDCX
Fidelity Select Food & Agriculture	FDFAX
Fidelity Select Environmental	FSLEX
Fidelity Select Air Transportation	FSAIX
Fidelity Select Industrial	FSDPX
Fidelity Select Biotech	FBIOX
Fidelity Select Paper & Forest Products	FSPFX
Fidelity Select Medical	FSHCX
Fidelity Select Energy	FSENX
Fidelity Select Natural Gas	FSNGX
Fidelity Select Energy Services	FSESX

Fidelity Select Sector Funds offer a long history and a diversified testing universe.

All tests that we complete will begin on January 1, 1990 and run through December 31, 2007. This eighteen year test period includes timeframes that represent all kinds of market conditions. For those concerned that we are missing the large decline of October 1987, we have included the large decline of October 1997, which was similar point-wise to the earlier decline. From a percentage perspective, the long decline in technology stocks from April 2000 to October 2002 did more damage to investor equity than the crash of 1987. While we recognize the uniqueness of this event and the impact that week has on trading system design, it is not possible to include it in this test because there were not a sufficient number of funds from this universe trading at that time. Additionally, from a long-term perspective, the impact of that event on an investor was minimal. While a crash may very well occur in the future, a diversified RS system should outperform the market as the crash unfolds and recover to new equity highs faster than the market.

Some funds began trading after the test period begins, and we simply added them on the date they were first offered to investors. This reflects the reality that most investors face as new investment opportunities are offered all the time.

A final advantage of using this group of funds is that the strategy we develop can be immediately implemented by investors using either these funds or a group of ETFs. The performance of each fund ion this universe can be attained through an ETF with the same investment objective.

What Timeframe to Use in the Calculations?

Having selected a single investment universe for the tests, we will now turn our attention to identifying a timeframe to test with. Timeframe is different from the test period we defined in the last selection. Timeframe refers to the time period represented by the time variable in the equations found in Chapter 2. For example, if we are going to calculate a rate of change, we first need to define the timeframe that we will use in the calculation.

This test will actually be broken down into two parts. First, we will test all definitions with the same timeframe variables

in the different equations. This will allow us to assess whether or not one definition is superior to the others. After presenting those test results, in a subsequent section we will go back and test the best method using various timeframes to assess how important this variable is to investment success.

There have been a large number of academic studies into RS, many of which are detailed in the Appendix. There is a general consensus in those papers that RS works, and most papers find that it works best when measured over time periods of three to twelve months. Academic research generally shows that in timeframes less than three months or longer than twelve months, stock prices are driven more by mean reversion behavior than trending behavior. We will rely on these peer-reviewed studies to guide us in our testing that tries to identify if there is a best way of calculating RS. For the initial tests, we will use a time period of six months, which is within the best timeframes, expressed as twenty-six weeks in our calculations.

Performing the calculations with weekly data instead of monthly data will provide us with more data points, and should result in smoother calculations. With monthly data, and only six pieces of data to work with, extreme price movements would take on too much importance in the calculations. Each week represents less than 4 percent of the data series, but in monthly calculations each month would represent almost 17 percent of the data series. By using weekly data, an extreme data point carries less than 25 percent of the importance that it does when using monthly data. The result should be smoother calculations, which will result in holding positions longer and decreasing trading costs.

Some formulas require the use of two time period variables, for example when calculating the ratio of RS measured over one timeframe to another timeframe. In these cases, we will use twenty-six weeks for the longer term value and twelve weeks for the shorter timeframe. Both of these values fall within the timeframes identified as optimal in academic studies. Other than that, there is no underlying reason for using these values. The initial set of tests could be conducted with any time values. Later in this chapter, we will run separate tests to assess the impact of timeframe selection on this investment strategy.

How Many to Buy?

This question of how many stocks or mutual funds to own is often a challenging one for individual investors. The advantage of employing a predefined trading strategy is that this question must be answered along with knowing that the buy and sell rules are clearly defined. We will buy the strongest funds, the ones at the top of the RS ranking. Initially, we will buy the top three ranked funds from our investment universe. As we sell, we will replace holdings with the highest ranked fund from the top three that is not currently in our portfolio. We will always hold three funds.

The decision to buy and hold the top three mutual funds is an arbitrary one. Experts do not agree on the correct number of holdings for an individual or an institution. Standard finance theory tells investors to diversify and recommends holding at least twenty different stocks, while Warren Buffett urges concentrated investments in only the best stocks in order to maximize their gains.

Using mutual funds, or ETFs, offers some degree of diversification to the investor since no single stock can cause too much damage to the total portfolio. Testing with three funds in our portfolio will combine some of the benefits of diversification with some of the benefits of concentration since the stocks held in any mutual fund will be limited to a sector For example, the Fidelity Select Retailing Fund would hold companies like Wal-Mart, Home Depot, and Nordstrom. All of these are similar in that they respond to changes in consumer spending habits, but offer diversification because they target different consumers and each performs best in a different economic environment.

In our pursuit of the best possible trading strategy, we will run a second set of tests later in the chapter. After identifying the best way to measure RS, we will return to the question of how many funds, or stocks, should be held in a portfolio, obtaining objective data to define what adequate diversification means to the average investor.

When to Buy?

Participants in retirement plans have full-time careers, and other life activities, which require their time. They are often

too busy to devote much time to monitoring their investments. But the allure of stock profits drives many investors to attempt to take control over their own investment fates. RS strategies offer the busy investor a chance to achieve profits with a very small investment in time.

Portfolios can be reviewed as frequently as several times a day. This is not appropriate for the part-time investor with a full-time career. Other review options include daily, weekly, or monthly timeframes. Based on best guesses, daily seems to be too frequent and monthly seems to be too seldom. Few investors would have the time to undertake a strategy which requires daily reviews and this should also lead to more trading activity which increases the cost of managing of the portfolio.

Monthly reviews seem to be too infrequent to be profitable. Open positions can suffer serious losses over the course of a month. One way to prevent this would be to place standing sell orders with a broker to close any position that fell below a certain price. This would prevent deep losses, but would risk allowing significant amounts of cash resulting from the sell to sit idle for extended periods of time, and that would significantly hurt performance. Cash generally earns very little when sitting in a brokerage account. The goal of any investment strategy, including RS strategies, is to effectively deploy cash in stocks that are increasing in value.

Weekly portfolio reviews seem to be adequate, but we will need to develop data to ensure that our logic is sound. We will use closing prices from Friday, or Thursday if the market is closed on a Friday, and assume that our trades are executed on Monday. For this investment universe, we will assume that trades are executed at the closing price for Monday Mutual funds are usually priced once a day and that is the price that all mutual fund transactions placed during that day are bought and sold at. After we test for the best definition using a weekly review, we will use that RS definition to test for the best timeframe to review our portfolio.

When to Sell?

Super investor Peter Lynch compared managing an investment portfolio to gardening and he advised traders to enjoy the flowers

while pulling the weeds. Left untended, a garden quickly fills with weeds, which makes it impossible to enjoy the flowers. In a portfolio, the weeds are the losing positions, which do real harm to the portfolio value and usually become the only concern of the investor. Having well-defined sell rules will prevent losers from becoming psychologically damaging to the investor and will limit the amount of money lost on any one position.

Selling is perhaps the single biggest problem the average individual investor faces. Too many investors allow selling to become an emotional decision, and the result is that they hang on to losing positions far too long, hoping the stock price will eventually recover and allow them to sell when they break even. Often, they give up this hope after further declines drive the price even lower and they end up selling at what is actually a long term bottom in the price. There are several successful trading strategies that are based on the idea that individuals will buy and sell at exactly the wrong time.

A recent study supports the logic behind these strategies and proved that individual investors are prone to make buy and sell decisions at exactly the wrong time. “Dumb Money: Mutual Fund Flows and the Cross-Section of Stock Returns ,” concluded that mutual fund investors tend to buy into a hot fund just as it is about to decline and sell at the bottom, often right before it enters a multi-year period of above-average performance.

The researchers found that 20 percent of mutual funds with negative investment flows (which means that there is more money leaving the fund as investors sell than is entering the fund because of purchases by new investors) over the previous three years performed 10.7 percent better per year than the 20 percent with the most positive investment flow. In other words, an investor buying a fund when the majority of investors are selling would have done very well and enjoyed significant profits.

This has long been known to market professionals. Contrarian indicators take the view that the majority must be wrong at market turning points and try to profit by going against the crowd. The mutual fund cash-to-asset ratio is an example of one of these

contrarian market timing indicators. A fund manager may choose to keep relatively large cash position if he is bearish on the stock or bond market, or if he cannot find securities he thinks are attractive to buy. A large cash position may also accumulate if many investors buy fund shares and the fund manager cannot put all the money to work at once. On the other hand, a low cash-to-assets ratio is an indication that the fund manager is bullish, because he is fully invested and expects stock or bond prices to rise. Contrarian investors believe that either way, the manager is usually wrong.

In a 1976 study[21], the mutual fund cash-to-asset ratio was shown to be a reliable indicator of market bottoms. During the time period covered in the study, whenever fund managers were excessively bearish and built up large amounts of cash in their portfolios, the stock market experienced above average returns over the next three to six months.

These examples are meant to illustrate that individuals and professionals have difficulty making sell decisions. It is important to understand the problems associated with the sell decision in order to appreciate the value of following a disciplined investment strategy. RS strategies precisely define rules to eliminate all emotion from the buy and sell decisions. This significantly reduces the possibility of investor indecision leading to paralysis as the market crashes or soars and helps to avoid large losses.

In the previous sections we decided that in initial tests, we would own the top three funds in our investment universe and to review our portfolio weekly. In an RS strategy there are two options for defining the sell rule. Both require determining a castoff level, meaning that when the RS falls below a certain rank, the stock is castoff from the portfolio. Selling is predetermined, and must always be done when dictated by the rule. Under the first option, we would always hold the top three funds, selling whenever a fund's RS fell to the fourth position or lower. The second option requires us to set a sell level below the fourth position, for example selling when the fund falls below the tenth rank in RS.

Intuitively, this second approach should deliver the best results. Using the first rule, we are at risk of suffering through a large number of whipsaw trades. It is very likely that a fund could flip-flop between the third and fourth positions on the RS ranking screen as its performance slows down. This would require a great deal of buying and selling, and incur higher transaction costs which will hurt the portfolio performance.

Under the second approach, the fund will be held as long it is outperforming some number of funds. By the time it is sold, it will be far away from the buy threshold, dramatically decreasing the possibility of a large number of whipsaw trades. It will allow us to hold long-term winners while they undergo normal pullbacks or short periods of consolidation.

Our investment universe is defined in Table 3-1 and includes thirty-three funds. In initial testing, we will sell when a fund drops into the bottom half of the RS rankings. If we define the top ranked performer as number 1, the second strongest fund as number 2, and so on, we will sell in this test when the ranking falls to 17 or lower. Later, we will test to determine whether or not a best cutoff rank exists.

These two approaches define how we can handle winning trades. Unfortunately, not all of our trades will be winners. Dealing with losing trades is equally important, and when to exit from these trades should also be rules-based. Many traders have become paralyzed in the face of rapidly declining markets so having rules is critical to preserving equity under these conditions.

It is possible that we will buy a fund and the price will immediately drop by 20 percent or more the very next day. As any experienced investor knows, these things happen. This scenario is more likely to occur with the purchase of an individual stock rather than a mutual fund which itself has many holdings and diversifies this type of risk by owning a large number of individual stock. Most successful investment strategies will include the use of stop-loss orders to prevent catastrophic damage to their portfolios. These orders are typically placed in advance and are instructions to sell the stock or fund if it trades below a certain price.

In order to be effective, the stop-loss order needs to be placed immediately after the position is initially purchased. It is designed to limit an investor's loss on a security position. In theory, placing a stop-loss order at a price 10 percent below the price you paid for the stock would limit your loss to 10 percent. Markets can be volatile, and the reality is that the stop-loss order will not be filled at the exact level which limits the loss to exactly 10 percent. The realized loss may be much larger, but by placing a stop-loss order, you are certain that you will not lose 100 percent of your investment.

Another type of stop order is the trailing stop. The trailing stop is similar to a stop-loss order in that it placed at a percentage level below the current market price. The difference is that the trailing stop is used to handle winning trades. It is placed at a percentage below the highest price seen during the trade and is adjusted upward as the position increases in value. This is a useful, yet seldom used, tool. Using a trailing stop guarantees that traders will let their profits run while ensuring that they cut losses at the same time.

Should stop-loss orders and trailing stops be employed in an effective RS strategy? While a solid rationale supports their use on any investment, data will be needed to determine if they improve the performance of the system. That will require testing to determine. After determining the best way to calculate RS, we will return to the question of selling and perform additional tests to determine the best rules for selling. We will provide more detail on each type of order and will then test each option to reach a conclusion as to the best selling rules based upon data rather than intuition.

Test Summary

Finally, we are ready to begin testing. We have defined a detailed testing scenario, and explained the reason for each rule we selected. At this point, we need to take a few moments to provide a summary of those rules.

Table 2-5 summarized the various methods we can use to calculate RS and is reproduced as Table 3-2. These techniques will

provide the basis for our testing.

TABLE 3-2

RS Techniques	Formula
Differences of prices	2.1
Normalized rate of change	2.2
Ratio of prices	2.3
Chart analysis of RS ratios	
P&F analysis of RS	
Back-weighted ROC	2.5
Front-weighted ROC	2.6
Price/Moving average ratios	2.7
Ratios of multiple moving averages	2.8 & 2.9
Averaging different time periods	2.10
Alpha	
Beta	
Momentum of Comparative Strength	2.12
Combined Cycle Position	

Fourteen methods of defining RS were described in Chapter 2. Detailed formulas were provided for nine of these methods.

Some of the techniques we described in Chapter 2 will not be included in the tests. There are several reasons for this. The differences of prices technique (defined in Formula 2.1) will not be tested. Since different stocks trade at different price levels, this calculation would favor the stocks which trade at the highest prices.

The ratio of prices technique (defined with Formula 2.3) is similar to the differences of prices in that each stock will be measured using different price levels. This makes it impossible to compare the performance of one stock to another and means that this technique is not that can be used to quantify the best performers on a relative basis.

Chart analysis (as illustrated in Figure 2-3) is not a quantitative technique, and cannot be objectively tested. Trend line breaks can be programmed, but the results are entirely determined by how they are programmed. Therefore although we can develop test results that look authoritative for this technique,

the reality is that other programmers would get different results. This variability of results means the method is not truly quantitative.

P&F analysis of RS (as illustrated in Figure 2-6) is also a visual approach, and would be difficult to back test. The strategy has been tested in real time by Clay Allen, CFA, who developed of this technique[22]. This test is conducted each year by providing a list every December of one hundred stocks that are expected to outperform the market over the next twelve months. The selection of this stock list is done by reviewing the RS P&F charts for each stock in the S&P 500 and identifying stocks in an uptrend with the strongest patterns. In part, some experience is required to properly assess the charts. However since the list is published in advance, it represents a valid test of the technique. Over the five year period from 2003 to 2007, the buy list significantly outperformed the index every year. On average, the list provided an excess return of 7 percent a year compared to the returns available in an index mutual fund.

The results from testing beta will be mathematically equivalent to the results obtained from the rate of change calculation, as detailed in Chapter 2. Therefore, beta will not be tested individually.

The momentum of comparative strength (defined by Formula 2.12), is an interesting technique, which in the end should provide results very similar to the ratios of moving averages technique (defined by Formula 2.9). Therefore, this method will not be tested individually.

The combined cycle position technique will not be tested individually since the results presented in the paper describing it do not offer compelling evidence that this calculation will improve on the standard techniques. It may offer some degree of risk reduction, but that is more likely due to the universe of stocks selected for the paper. The larger stocks favored by institutional investors tend to have lower volatility than the smaller stocks often chosen by smaller investors.

This leaves the seven techniques shown in Table 3-3. Our

testing will calculate RS using each of these definitions in an attempt to determine if a best way to calculate RS exists. If RS is truly a superior investment strategy, we would expect each technique to beat the market returns.

TABLE 3-3

RS Techniques	Formula
Normalized rate of change	2.2
Back-weighted ROC	2.5
Front-weighted ROC	2.6
Price/Moving average ratios	2.7
Ratios of multiple moving averages	2.8 & 2.9
Averaging different time periods	2.10
Alpha	

These seven means of calculating RS will be tested over the same timeframe, against the universe of mutual funds defined in table 3-1 to determine if a best calculation exists.

The remaining test assumptions follow from the discussion of each test parameter undertaken throughout this chapter. They are summarized below.

- What to buy? Our investment universe will be confined to the thirty-three Fidelity Select Sector mutual funds identified in Table 3-1. We will test each definition beginning with data on January 1, 1990 and ending December 31, 2007. Since data exists for some of these funds prior to the start of the test date, we will be able to begin obtaining hypothetical investment results immediately rather than having to wait for six months of data to accumulate.
- What timeframe to use? We will use twenty-six weeks for all calculations. In those cases where a second RS timeframe is needed, such as with the ratio of multiple moving averages, we will use twelve weeks for the shorter time period and twenty-six weeks for the longer time period.
- How many to buy? We will hold three funds at all times.
- When to buy? We will review our portfolio weekly. We will use closing data from Friday, or Thursday if the market is

closed on a Friday because of a holiday schedule. We will assume that all buys and sells are completed at the price an investor could obtain on Monday. Since mutual funds are being used in the test, the price will be the net asset value calculated after the close on Monday.

- When to sell? We will sell when the RS rank falls out of the top half of our investment universe. This means each week, we will continue to hold any fund we currently own as long as it has an RS rank of 1 through 16, and sell when the rank is equal to 17 or higher. Initially, no other sell rules will be employed.

Some specific clarification of formulas might be useful. The formulas that will be used in testing are shown in Table 3-4.

TABLE 3-4

RS Techniques	Formula
Normalized rate of change	$RS = 100 * \frac{P_{today} - P_{26\ weeks\ ago}}{P_{26\ weeks\ ago}}$
Back-weighted ROC	$RS = 100 * \frac{(P_{today} - P_{26\ weeks\ ago}) - (P_{today} - Price_{12\ weeks\ ago})}{P_{26\ weeks\ ago}}$
Front-weighted ROC	$RS = 100 * \frac{(P_{today} - P_{26\ weeks\ ago}) + (P_{today} - Price_{12\ weeks\ ago})}{P_{26\ weeks\ ago}}$
Price/Moving average ratios	$RS = \frac{P_{today}}{MA_{26\ weeks}}$
Ratios of multiple moving averages	$RS = \frac{MA_{10\ weeks}}{MA_{26\ weeks}}$ & $RS = \frac{MA_{26\ weeks}}{MA_{10\ weeks}}$
Averaging different time periods	$RS = \frac{MA_{10\ weeks} * MA_{26weeks}}{2}$
Alpha	INTERCEPT (stock returns, market returns

These formulas will be used in the testing. The formula for Alpha is an Excel function and uses percentage returns for a stock, or mutual fund, compared to the percentage returns for a broad-based market index, in this case the S&P 500.

The values used in the formulas are not optimized. These tests are only designed to determine if any definition is superior to the others and therefore the most important thing is that all the tests be run using the exact same values and exact same set of data. Those standards are met in these tests.

Test results

Summary test results are shown in Table 3-5. As a point of comparison, the stock market delivered an annualized return of 8.70 percent over the timeframe covered by the testing period. The stock market in this case is represented by the S&P 500 index. All results are based solely upon price, ignoring the impact of dividends or transaction costs.

TABLE 3-5

RS Techniques	Annualized Return	Maximum Drawdown
Normalized rate of change	20.10%	-52.26%
Back-weighted ROC	21.77%	-47.21%
Front-weighted ROC	19.83%	-53.06%
Price/Moving average ratios	18.87%	-55.42%
Ratios of multiple moving averages	21.94%	-42.41%
Averaging different time periods	21.10%	-50.15%
Alpha	20.94%	-53.53%
S&P 500	8.70%	-50.03%

All RS techniques outperformed the market, with even the worst results delivering twice the return achieved by a buy-and-hold investor.

Annualized return represents the compounded yearly increase in the value of the investment portfolio. Including the effects of compounding in the results matches the returns that most investors obtain, especially in retirement accounts. Compounding assumes that there are no withdrawals from the account during the test period and allows the gains from previous years to build upon each other. Annualized returns are slightly more complicated to calculate than average returns, which are found by adding the annual returns of a stock or fund and dividing by the number of years.

To calculate annualized return you need to use an exponential function. For example, to find a two year annualized return, you would first find the total return of the investment over the two years by subtracting the ending value of the investment from the starting value. You then solve for the square root of the total return over a two year period to account for compounding. If the

investment was held for three years, a cube root would be used to find the compound return. In Table 3-5, given an eighteen year test period, the eighteenth root of total returns was calculated to provide annualized returns.

Maximum drawdown shows the maximum loss endured by the hypothetical investor over the test period. It is the largest dip in their account value as measured from the highest total equity value to the lowest subsequent equity value. At one point, the account value may have risen to $100,000. A bear market set in and the account declined to a value of $48,000 over the next two years before recovering to a value of $110,000 three years later. At the low point, the account had endured a drawdown of 52 percent. In this example, the account took five years to recover its value from the previous equity high of $100,000. Maximum drawdown represents a significant psychological hurdle to the investor in real-time trading. It is a subject we will return to as we seek a method to minimize the risk associated with this investment strategy.

Table 3-5 shows the effectiveness of RS strategies. It is interesting to note that all of the techniques dramatically outperformed the market, in all cases at least doubling the returns of the S&P 500. This should give you confidence in these ideas, which will help you to endure the drawdowns which are unavoidable in any investment strategy.

The results shown in Table 3-5 seem to indicate that the ratio of multiple moving averages technique offers the best returns. The problem all investors must confront before implementing an investment strategy is whether or not they can continue using the strategy during the maximum drawdown. To help put the drawdown into perspective, it is important to remember that even buy-and-hold investors face tough times during a bear market. Losses are part of investing. Therefore the goal of an effective strategy needs to be minimizing the drawdown relative to the potential gains, rather than eliminating losses which is impossible to do. To determine which technique is actually the best, we need to consider the annualized returns in the context of the expected risk, as measured by the maximum drawdown.

One tool that investors apply to find the best overall strategy

is the Risk/Reward Ratio. This ratio compares the expected return of an investment to the expected amount of risk the investor faces in pursuit of these returns. This ratio is calculated mathematically by dividing the amount traders assume is at risk over the long-term (the maximum drawdown found in backtesting) by the anticipated rewards (measured by the annualized returns). There are other possible definitions and calculations of the Risk/Reward Ratio, but the important thing is to apply it consistently within the decision making process. We do that in Table 3-6.

TABLE 3-6

RS Techniques	Risk/Reward Ratio
Normalized rate of change	2.6
Back-weighted ROC	2.2
Front-weighted ROC	2.7
Price/Moving average ratios	2.9
Ratios of multiple moving averages	2.0
Averaging different time periods	2.4
Alpha	2.6
S&P 500	6.2

When adjusted for risk, the ratios of multiple moving averages offers the greatest potential rewards to investors.

Conservative investors have long been taught that the best investment strategy is to buy and hold an index fund, such as one that attempts to duplicate the gains attained by the S&P 500. As Table 3-6 shows, the risk of this simple approach exceeds the annualized returns by more than six times, much more risk than these investors are often willing to endure. Each RS strategy offers market beating returns with less than half the risk of the market on a relative basis. And, mathematically we have confirmed that the ratio of multiple moving averages technique offers the best return when risk is considered.

Applying this technique, we will now turn to answering the other questions raised about the best way to implement an RS investment strategy.

Does portfolio selection matter?

For our initial test, we held three mutual funds from a group of Fidelity Select Sector Funds which comprised our investment universe. The tests showed that the ratio of multiple moving averages technique offers the best return when risk is considered. The next question we need to answer is whether or not we would have obtained different results if we had completed the tests using a different investment universe. To find an answer to this question, we simply need to select a different investment universe and repeat the seven individual tests we completed earlier. The measure we will use to assess the results will be the same one from the previous test, the Risk/Reward Ratio.

We will use a portfolio of twenty Rydex mutual funds. Rydex is a mutual fund family offering a variety of funds to track indexes. They offer leveraged and unleveraged funds. Leveraged funds use borrowed funds or derivative products such as futures to increase the gain or loss experienced by the underlying index. For this analysis, we will use a variety of sector funds and index-tracking funds. These funds have similar investment objectives to the fund universe in the original test. The absolute returns that we obtain are not as important as the relative rankings of the calculated returns, on a risk adjusted basis. Annualized returns, drawdowns, and the Risk/Reward Ratios are shown in Table 3-7.

TABLE 3-7

RS Techniques	Annualized Return	Maximum Drawdown	Risk/Reward Ratio
Normalized rate of change	6.53%	-55.15%	8.4
Back-weighted ROC	4.22%	-65.61%	15.5
Front-weighted ROC	7.71%	- 53.18 %	6.9
Price/Moving average ratios	4.36%	- 69.19%	15.9
Ratios of multiple moving averages	7.64%	- 56.34%	7.4
Averaging different time periods	5.63%	- 58.38%	10.4
Alpha	6.08%	- 64.66%	10.6
S&P 500	8.07%	-50.03%	6.2

This table summarizes the disappointing results obtained by RS strategies when tested against a universe of Rydex mutual funds.

Portfolio selection obviously makes a difference in the results we obtained. Using the Fidelity funds, each technique delivered market beating returns with less risk. In fact, risk was reduced by at least half when compared to a passive buy and hold strategy. The portfolio of Rydex funds underperformed the market in all cases and the maximum drawdown exceeded the market drawdown in all cases.

These test results demonstrate the importance of backtesting any strategy on the securities that you will actually be trading. The problem with this portfolio is that it represented sectors and indexes and a money market fund. It also included several bear funds, which are mutual funds designed to increase in value as the market declines in value. The lesson to take away from this example is that selection of the investment universe is not an insignificant task. Care should be taken to ensure that all investment options meet the same general objective. The money market fund sought stable returns and income while the others attempted to maximize capital gains. Bear funds can work as part of an investment universe, but the testing would need to identify optimized parameters and stop-loss rules (which will be detailed shortly).

An example of a good investment universe includes a selection of sector mutual funds or ETFs. Sector funds all share the objective of outperforming the market through a concentration in stocks within a common business segment. Another suitable investment universe is a selection of funds or ETFs that seek to mirror the performance of an index. This universe might include ETFs designed to track the Dow Jones Industrial Average, the S&P 500, the NASDAQ 100, and a variety of Russell Indexes. They share the objective of outperforming the market based upon a concentration in stocks sharing a similar market capitalization.

Employer sponsored retirement plans usually represent a suitable investment universe to effectively employ a relative strength investment strategy. The options available through these plans typically represent a variety of investment styles, ranging from aggressive to conservative. They share an objective of outperforming the market through the application of a particular investment style. Historically, aggressive growth strategies

outperform conservative value strategies during some periods of time, and underperform at others. This rotation of favored styles within the market makes these funds a suitable investment universe.

While we have learned one lesson about portfolio selection, we have not yet answered the question of whether or not the universe dictates the best RS calculation technique to use. In order to determine which technique works best, we need to rank order the results. To do this, the Risk/Reward ratios from Tables 3-6 and 3-7 are displayed in Table 3-8, along with the relative rank orders. The technique ranked number 1 offers the best potential reward considering the risk associated with that technique; the number 2 ranked technique is the second best in terms of risk and reward; and so on.

TABLE 3-8

RS Techniques	Risk/Reward Ratio (Fidelity)	Rank (Fidelity)	Risk/Reward Ratio	Rank (Rydex)
Normalized rate of change	2.6	4	8.4	3
Back-weighted ROC	2.2	2	15.5	6
Front-weighted ROC	2.7	5	6.9	1
Price/Moving average ratios	2.9	6	15.9	7
Ratios of multiple moving averages	2.0	1	7.4	2
Averaging different time periods	2.4	3	10.4	4
Alpha	2.6	4	10.6	5

This table presents the ranking of each RS calculation technique for the two different investment universes.

At first glance, the test results appear to be dramatically different. However, we see that in almost all cases the rankings are very close to each other, off by a factor of one in almost all cases. The ratio of multiple moving averages technique, the number one strategy when testing the Fidelity portfolio, is the number two strategy tested against the Rydex portfolio. The important point is that it does well with either investment universe.

The largest difference between the two results is that the back-weighted ROC performed well against Fidelity funds and poorly in the Rydex test, while the front-weighted ROC was the

best performer in the Rydex universe after performing poorly on Fidelity funds.

Front-weighted ROC should be expected to perform poorly given the fact that stocks tend to revert to their mean performance over the short-term. Overweighting short-term performance should lead to frequent losing trades, which will hurt performance. But, with the Rydex funds, this technique offered the best potential return. This is because the money market fund was included in the portfolio. This type of mutual fund has a steady return since the manager seeks to maintain a constant value of $1.00 per share. As volatility impacts other funds, the money market fund will rise to the top of the performance rankings and will limit the losses incurred during the inevitable drawdowns. Referring back to Table 3-7, we see that the front-weighted ROC technique had the lowest drawdown, which confirms this logic.

The deterioration of the performance of the back-weighted ROC is also explained by the inclusion of the money market fund in the Rydex test. Instead of allowing the winners to run, as in the Fidelity test, the less volatile money market fund replaces better gainers before they can add significant value to the portfolio.

As a rule, money market funds should never be included in portfolios being invested with a relative strength strategy. These strategies need to be fully invested at all times in order to show market-beating returns. Money market funds have a place in an investor’s portfolio as a vehicle for holding cash reserves. They should not be included in the part of the portfolio dedicated to equities.

Backtesting will always highlight what worked well on a historical basis. The future will always be different from the past, and we will be investing in the future. Additionally, we may get conflicting results when we slightly vary the parameters of the historical test, which can lead to some doubt about what we should do in the future. It is actually very likely that the best technique in one test will not necessarily be the best performer in other tests. However, seeing that the best technique in one universe is very close to the best technique in a second universe should provide an investor with a high degree of confidence that

the strategy will work under any market conditions.

That is the conclusion from this section. The investment universe matters and any technique will work if applied consistently on an investment universe that has been selected to ensure that all funds share a common investment objective. The single best technique will vary across testing scenarios. Therefore, going forward in our testing we will use the ratios of multiple moving average technique of calculating RS. Investors could substitute any other technique, but they must choose a technique and apply it consistently over time in order to obtain the desired results.

Does Timeframe Matter?

In previous sections, we used twenty-six weeks in our testing, and when a second time parameter was required, we arbitrarily opted to use twelve weeks. The question we need to answer is whether or not using different values would impact the test results. The decision to use the ratios of multiple moving average technique complicates this testing since there are two timeframes that will need to be varied.

To provide the best answer possible, we will test on all possible combinations, varying the lengths of the first moving average from one through twenty-six and the second from one through fifty-two. In all, 1,320 combinations were tested.

One problem which occurs when so many possibilities are tested is that the results from the top-performing strategy will be superior to all the other test results because of a statistical fluke. Running hundreds of tests to identify trading rules is known as data mining. This term refers to the idea of sifting through large amounts of data (in this case eighteen years worth of weekly prices) and identifying potentially useful, but accidental, relationships within the data. The danger is that in a very large set of data, there is a possibility that extremely rare events will occur. In these tests, an example of a rare event might be a set of trading rules that generates a 50 percent annualized return with a maximum drawdown of less than 25 percent. These would certainly be outstanding results, actually they would seem to be

too good to be true, and as such they are unlikely to be available to investors in the future.

To guard against potential data mining, we will perform several tests to ensure the result is due to the underlying logic of the trading rules. In this case, the logic is that the RS strategy selected will work because strong stocks will continue to be strong in the future.

The first test will be a simple statistical test. Standard deviation has been discussed earlier as a measure of volatility. When used in that manner, the higher the standard deviation is, the less likely that future results will be in line with past performance. Another way of thinking of standard deviation is as a measurement of how spread out the data is. In other words, are most of the values grouped fairly close together or is there a wide spread between the lowest and highest number in the data set? Standard deviation provides a quantifiable answer to that question.

An interesting principle of the standard deviation concept is that we can add and subtract the value of the standard deviation to the average of the data series and know that it should contain about two-thirds of the total data series. Adding and subtracting two times the standard deviation from the average value should contain approximately ninety-five percent of the total data set. Events that occur outside two standard deviations of the mean are called outliers and are considered to be rare. Since we want to do all we can to ensure that the future performance will mirror the past performance, we will eliminate these extreme values and use parameters which provide returns closer to the mean, meaning it is more likely that the measured performance will be replicated in the future.

After running the tests against all 1,320 combinations of moving average values, thirty-eight combinations showed a higher annual return than the arbitrarily chosen values of twelve weeks and twenty-six weeks. The average return of all the tests was 18.88 percent, with a standard deviation of 2.07 percent. Adding two standard deviations to the average leads to us ignoring all results with average annualized returns exceeding 23.03 percent

(calculated as 18.88 + (2 * 2.07)). That eliminates seventeen combinations from our optimization study.

The remaining twenty-one combinations deliver annualized returns ranging from 22.33 percent to 22.92 percent. To assess which one is best, we will again calculate Risk/Reward Ratios and those results are presented in Table 3-9.

TABLE 3-9

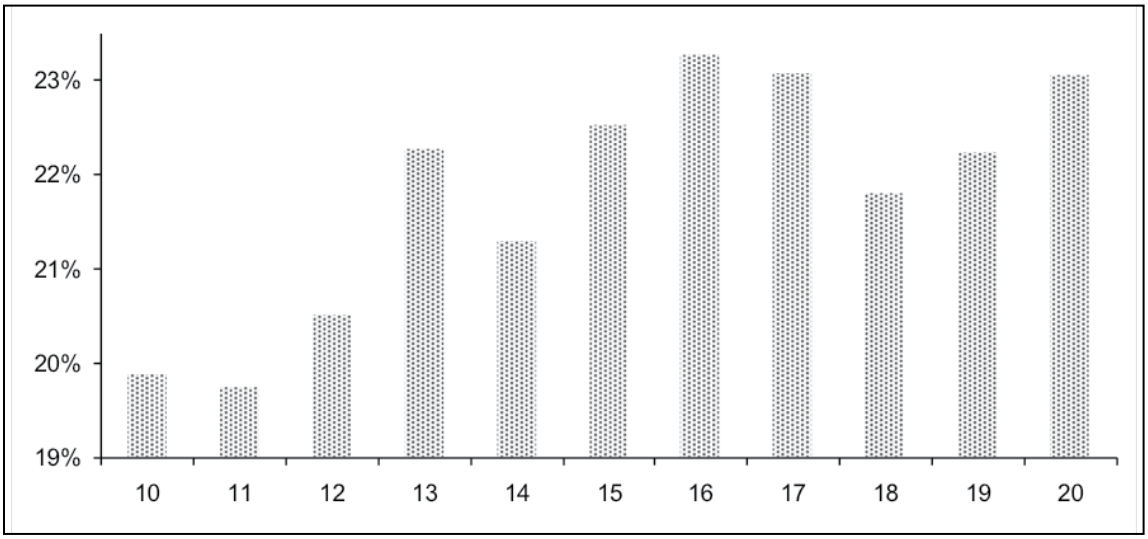
Moving Average Value 1	Moving Average Value 2	Annualized Return	Maximum Drawdown	Risk/Reward Ratio
8	15	22.54%	32.92%	1.46
3	27	22.33%	33.02%	1.48
6	19	22.71%	38.71%	1.70
3	26	22.47%	38.75%	1.72
4	22	22.41%	39.24%	1.75
4	21	22.69%	40.59%	1.79
13	14	22.35%	41.30%	1.85
14	17	22.61%	42.08%	1.86
5	22	22.92%	42.81%	1.87
13	18	22.53%	42.09%	1.87
12	19	22.49%	42.00%	1.87
15	21	22.59%	42.36%	1.88
15	18	22.82%	43.57%	1.91
16	17	22.56%	43.53%	1.93
10	24	22.54%	44.14%	1.96
10	17	22.71%	44.75%	1.97
15	17	22.36%	44.51%	1.99
9	17	22.66%	45.51%	2.01
11	24	22.41%	45.19%	2.02
13	21	22.50%	46.31%	2.06
12	14	22.41%	49.23%	2.20

The top results from 1,320 individual tests show remarkably consistent returns.

Using moving average values of eight and fifteen offers the best reward, relative to risk. As a next step to be certain that this performance is likely to continue into the future, we need to look at values relatively close to the optimized parameters and we want to see that the backtested performance is reasonably stable.

FIGURE 3-1

After identifying eight and fifteen as the optimal parameters, this chart shows the results of varying the second value. We see relatively stable and highly favorable returns on either side of fifteen.

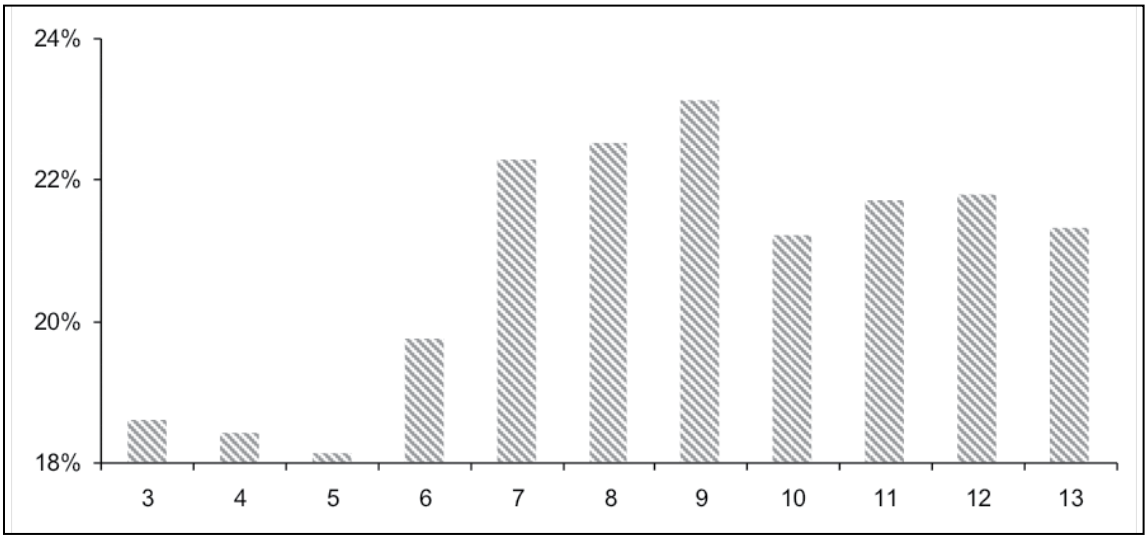


This will require two additional tests. We will look at moving average combinations holding one parameter steady while slightly varying the second value. In the first test, we will hold the first value of eight steady and vary the second parameter. We will look at combinations of eight weeks and fourteen weeks, eight weeks and sixteen weeks, etc., for the ten closest values. The annualized return for these tests is shown in Figure 3-1.

Looking closely at Figure 3-1, we see that the nearby values offer relatively consistent returns. It is important in this test that the results are close, but this is a subjective test without a mathematically precise definition of the term close. In this case, the results tail off dramatically towards the right side of the chart. This is not a large concern since the test results of more than 19 percent annualized returns still significantly outperform the market. Additionally, this change would be far less dramatic if the scale were changed to reflect a starting point of 0 on the y-axis of the graph. We chose to use a higher starting point to highlight the fact that there are varying degrees of return, but all returns are far superior to buy-and-hold strategies.

FIGURE 3-2

After identifying eight and fifteen as the optimal parameters, this chart shows the results of varying the first value. We again see relatively stable and highly favorable returns on either side of the best combination.



The second test holds the second moving average value of fifteen steady and varies the first parameter from eight by values of one. The results are shown in Figure 3-2, and provide the returns when the moving average ratio is calculated using values between three and thirteen for the first average while the second average is always set to fifteen.

The results show a great deal of stability on either side of eight. Moving higher, relatively stable returns are also evident. Results again drop off rapidly at lower values. And, again, since they are still market beating returns and the immediately adjacent tests show such high stability, this is not a concern.

To summarize this section, we found that the variables used in the calculation do have an impact on the returns that the investor should expect to see. But we also found that there is a reassuring stability around the optimized value. This indicates that profitable results are not dependent upon selecting a single best variable — choosing any calculation length near the best value delivered market beating returns, which is the primary objective of the RS investor.

How Many Stocks Should I Own?

So far, all test results that we have presented show profitability when we tested strategies that hold three funds. As we noted earlier, there is nothing precise about our choice of three funds, we chose that number as a matter of convenience. It seems to present some diversification and standard financial theories suggest that diversification is a key element of investment success.

Diversification is used by investors to limit risk. The idea is that at any time, any single stock can suffer a catastrophic loss. By owning more than one stock, the investor cushions the impact on their total portfolio value if there is a large decline in an individual stock that they hold. If a stock declines 20 percent, on a day that the overall market is flat, that represents an expected loss of 1 percent for the investor with twenty stocks in their portfolio.

Academic studies show that in portfolios holding at least twenty stocks, the risk associated with individual stocks is virtually eliminated and the portfolio contains only the risk associated with being in the stock market[23]. This risk, known as nondiversifiable risk, cannot be eliminated. For this reason, diversification is viewed as important to the individual investor.

The argument against diversification can be summed up as, "a little bit of a great many can never be more than a poor substitute for a few of the outstanding."[24] Widely revered as the greatest investor of all time, Warren Buffett attributes most of his gains to a lack of diversification. By owning a large amount of a few great stocks, he has amassed a considerable fortune.

In this portfolio of mutual funds, some diversification is already built in since funds own a large number of stocks. This has been one of the selling points of mutual funds since they were introduced as investment trusts in the 1920s. Combined with professional management, the instant diversification available from mutual funds to small investors should mean that we can own less than twenty funds and have all the theoretical benefits of a fully diversified portfolio.

Our theme throughout this chapter has been to take nothing for granted. We test everything and will develop a complete trading system objectively based upon test results. The question of how many funds to own can easily be tested. Given our investment universe of thirty-three funds, it is practical to test holding any number of funds from one through sixteen. Our sell rule dictates selling when a fund's relative strength drops into the bottom half of the investment universe, in this case when the fund's RS rank drops to 17 or below. If we tested the strategy using seventeen funds in our portfolio, the system would only be able to hold sixteen since anything ranked 17 or lower would be sold.

The remainder of the rules will be the same ones originally identified. We will apply the ratio of multiple moving averages calculation, with parameters of twelve weeks and twenty-six weeks, to the Fidelity universe defined at the beginning of this chapter. Sells will occur when the RS rank falls below 17 and no other stops will be in place. The number of holdings will vary from one to sixteen. The results are summarized in Table 3-10. They are sorted by Risk/Reward ratio, with the best returns on a risk-adjusted basis at the top of the table.

TABLE 3-10

Invest In	Annualized Return	Maximum Drawdown	Risk/Reward Ratio
13	19.27%	32.33%	1.68
14	19.18%	32.34%	1.69
12	19.31%	33.33%	1.73
1	24.32%	42.49%	1.75
15	18.82%	33.82%	1.80
16	18.98%	34.71%	1.83
8	20.41%	37.74%	1.85
3	21.94%	42.41%	1.93
11	19.50%	37.81%	1.94
2	23.08%	44.75%	1.94
4	21.08%	42.54%	2.02
10	19.49%	39.90%	2.05
9	19.51%	40.48%	2.07
6	19.67%	42.60%	2.17

TABLE 3-10

5	20.36%	44.76%	2.20
7	19.39%	42.97%	2.22

This table shows that holding 13 funds deliver the best Reward/Risk Ration. However, the annualized returns are significantly lower than the returns available to th investor holding only the single highest ranked fund.

This table needs some further exploration. Using the Risk/Reward Ratio to select the best strategy shows that the ideal portfolio would hold thirteen funds. Looking at fourth place on the table, we see that holding only a single fund will deliver the highest returns, but the maximum drawdown is quite a bit higher than the portfolio holding thirteen funds. The difference in differences in returns, more than five percent a year, might be worth accepting an increased risk. This amount represents nearly half the return the buy-and-hold investor hopes to achieve over the long term, too much to ignore solely because of the increased risk. We need to dig deeper to see whether the Risk/Reward Ratio or the annualized return represents the best way to answer the question of how many funds the individual investor should hold in their portfolio.

In Table 3-11, we have added a column showing the average number of trades required by the strategy each year. As the number of holdings increases, the trading frequency increases in a linear fashion — the more holdings, the more trades per year. Holding only the single highest ranked fund requires an average of less than five trades per year, at the other extreme, holding sixteen funds requires an average of more than one hundred trades per year, or two trades per week.

TABLE 3-11

Invest In	Annualized Return	Trades/Year	Trading Cost Drag	Adjusted Risk/ Reward Ratio
1	24.32%	4.68	0.15%	1.75
2	23.08%	9.84	0.37%	1.95
3	21.94%	15.47	0.70%	1.95
4	21.08%	20.21	1.04%	2.04
5	20.36%	25.47	1.47%	2.23
6	19.67%	30.95	1.99%	2.21

TABLE 3-11

7	19.39%	36.90	2.48%	2.27
8	20.41%	41.37	2.37%	1.89
9	19.51%	47.86	3.15%	2.14
10	19.49%	54.24	3.58%	2.12
11	19.50%	60.99	4.02%	2.02
12	19.31%	67.53	4.59%	1.81
13	19.27%	74.92	5.12%	1.76
14	19.18%	83.43	5.78%	1.78
15	18.82%	92.05	6.76%	1.92
16	18.98%	103.59	7.41%	1.96

Adjusted for trading costs, holding only a single fund delivers the best risk-adjusted returns.

Trades cost money. Each trade has an immediate cost associated with such things as commissions, or delayed costs resulting from unavoidable things such as capital gains taxes. While some would argue that these costs are significant, others think that in an age of low commissions offered by internet-based brokers, trading costs have become immaterial. We will take a middle ground and assume that they matter, but we need to quantitatively determine how much they matter. To estimate the impact of trading costs on total returns, we can arbitrarily assign total costs of $10 to each trade. Most experienced traders would agree that this is not enough to truly account for commissions, taxes, and all other costs. However, this seemingly insignificant amount reduces the total profits in the portfolio holding sixteen funds by more than 7 percent. The performance drag on the one fund portfolio is only 0.15 percent of total profits. This example shows that trading costs matter.

After adjusting for trading costs, the one fund portfolio offers the highest absolute returns and the best returns after adjusting for risk. This may be a surprising result to those trained in standard financial theory that stresses the importance of diversification. It can be argued that this simple test partly validates Warren Buffett's philosophy of putting all your eggs in one basket and watching that basket closely.

Which Sell Rule Works Best?

Up to this point in our analysis, all tests have sold positions

whenever the relative strength rank fell into the bottom half of the investment universe. Additional sell rules are available to investors, and many traders consider it the gravest of sins to enter a position without immediately limiting the maximum loss by placing a stop loss order.

Usually investors buy or sell using market orders. These are directions given to a broker, or entered into an online discount brokerage screen, to execute a trade as quickly as possible at whatever price the market is trading at. This guarantees that the order will be executed, but in fast moving markets, the investor may suffer from a significant amount of slippage. Slippage is the amount the market moves between the time a market order is placed and the time the order is filled. While it will generally only be a few cents, it can be a significant amount on days the Federal Reserve cuts interest rates or there is other significant news affecting the market or an individual stock.

To avoid slippage, another type of order that investors can use is the limit order. Limit orders can only be used with stocks or ETFs; you will not be able to use these orders with mutual funds. This order is placed with a brokerage to buy or sell a certain number of shares at a specified price or better. For example, if a stock is trading at a price of 10 per share, the investor can place an order to buy one hundred shares at a limit of 9.75. This tells the market that you are willing to buy if price falls below and the stock trades at or below 9.75. The limit order does exactly what its name says it will do - it limits the amount that an investor will pay to buy a position.

Limit orders work the same way on the sell side. For a stock trading at 10, the investor can place a limit order to sell at 10.25. In this case, the order will only be executed if the stock trades at that price or higher. The investor may or not get filled at that price. If the price reaches the limit price for a moment and then immediately falls back below the limit price, the order will not be executed and the investor may end up holding the stock as it continues falling.

A stop order is like a limit order in that allows the investor to specify a price level where the action is to be taken. The

difference is that a stop order becomes a market order once the stock trades at that price. If an investor wanted to use a stop order to buy that stock trading at 10 per share, he would be filled as soon as the stock traded at his stop price of 10.25 for this example. His order may be filled at 10.50, or even higher. Stops do not place a limit on the price the trade will be executed at.

A special kind of stop, the stop-loss order, is designed to limit an investor's maximum possible loss on a position. In theory, placing a stop-loss order 10 percent below the price at which you bought the stock will limit your loss to 10 percent. For a 10 dollar stock, if the stop-loss order is placed at 9, the position would immediately be sold at the market price if the stock trades at 9 or less.

The advantage of a stop-loss order is that you can preserve capital and prevent large losses without having to continuously monitor how your portfolio is performing. If a position declines too far in value, the trade will automatically be executed.

The disadvantage is that the stop price could be activated by what turns out to be a short-term fluctuation in the stock's price. The challenge is to choose a stop-loss percentage that allows a stock to fluctuate day to day while preventing the permanent large losses which can occur in a single day. Placing a stop-loss 5 percent below the current price for a stock that has a history of fluctuating more than 10 percent in an average week is almost guaranteed to result in being stopped out of the position.

Stop-loss orders are usually placed immediately after the position is initiated and are thought of as a way to prevent large losses. Another way to use this type of order is as a tool to lock in profits. When used this way, the stop-loss order is usually called a "trailing stop". In this case, the trailing stop order is placed at a certain percentage level below the highest price reached during the trade. The price where the trailing stop order is placed adjusts upward as the stock price fluctuates. Successful traders will tell you that a stop-loss order should never be changed downward since that defeats the purpose of employing the stop-loss strategy.

By using a trailing stop, you will be letting your profits

run while at the same time cutting your losses short. Again, successful traders will tell you that this is the key to long-term profits in any market. This is also the rationale behind the success of relative strength investment strategies.

For example, we can assume that we bought a stock at 10 and it immediately moved higher to 12. We can lock in part of our profits by placing a trailing stop 10 percent below this new price, which would be at 10.80. This, in theory, guarantees us a minimum profit of 8 percent on this trade. In reality, the trailing stop order becomes a market order whenever the stock trades at or below the stop price. This means the actual trade is likely to be executed, near 10.80, but probably a little bit below that price.

With that background in the different types of sell rules that are possible, we can address testing the idea of including stops in our RS investment strategy. We will apply the ratio of multiple moving averages calculation, with parameters of twelve weeks and twenty-six weeks, to the Fidelity universe used in tests throughout this chapter. We will hold three funds in our portfolio. Sells will occur when the RS rank falls below 17, or when the stop rules are triggered.

We will test the portfolio using a variety of stops. We will vary the initial stop-loss level from 0 percent to 10 percent and vary the trailing stop level by the same parameters. We will test all possible combinations, for example a 1 percent initial stop with all trailing stop levels between 0 percent and 10 percent. A total of 121 tests were done.

In all cases, adding protective stops reduces the overall profitability of the system. This result is known to all traders and is something found when testing any trading strategy. The reason is that stops increase trading frequency and trading costs and often take you out of a position at a panic low. Holding on to open positions during short-term, news-driven market panics would allow the trader to recover their profits occasionally, but more often than not the market would continue lower. There is no way for an automated test to know in advance whether the market is likely to recover soon, and it sells the position immediately when the stop is hit.

The advantage of stops is that they should reduce risk. Again, testing rarely supports this idea. In fact, in the 121 tests, only one offered a better Reward/Risk Ratio than the no-stop strategy. The best results came from using a 5 percent initial stop on a position and a 6 percent trailing stop from the highest high reached while in the trade. Annualized returns were reduced from 21.94 percent to 21.26 percent when stops were added. But, the worst drawdown declined from 42.41 percent to only 33.41 percent. In other words, a 3 percent reduction in profitability resulted in a 21 percent reduction in risk.

Stops will be employed in the optimized strategy, because this level of risk reduction should allow investors to sleep better at night without significantly reducing the upside. Initial stops and trading stops can be used with mutual funds, but will require the investor to monitor their accounts. When the fund closes below the stop level, the investor will need to place a market order to sell at the next close.

A second question related to sell rules relates to the best castoff rank to use. We arbitrarily selected 17 simply because that meant that RS had fallen out of the top half of performance at that level. To determine if that is the best value, we tested all values between one and thirty-two. There is no need to test a castoff rank of thirty-three because that means that nothing would ever be sold and the ending portfolio would consist of the three funds purchased at the beginning of the test. The top five results are shown in Table 3-12.

TABLE 3-12

Cutoff Rank	Annualized Return	Maximum Drawdown	Risk/Reward Ratio
24	22.50%	32.97%	1.47
25	21.92%	38.58%	1.76
17	21.94%	42.41%	1.93
7	21.89%	45.11%	2.06
8	21.62%	47.54%	2.20

A cutoff rank of 24 is the best performer.

While a castoff value of 17 performed very well, the castoff

value of 24 worked best. The annualized return improved, and the maximum drawdown was reduced. Using the higher castoff value also reduced the number of trades, a significant factor to consider as we will demonstrate in the next section. Fewer trades means that we will reduce trading costs and get to keep more of our profits. The optimized value of 24 will be used,

How Often Should I Trade?

As we have noted several times, trades cost money. Getting in and out of a position creates a significant penalty for performance. When a trade occurs, there are certain costs that are obvious — the brokerage statement shows the cost of commissions, fees that the exchanges charge to execute a trade, and taxes that the government imposes on any transaction.

Less obvious is the spread, which is the difference between the bid and ask on a stock. Market makers are willing to buy a stock at one price and sell at a slightly higher price. How much higher is determined mainly by the liquidity of the stock, which refers to how actively traded the stock is. The difference between the bid and ask is a cost that traders can control with limit orders. Mutual funds are sold at the net asset value, and there is no spread involved with buying or selling mutual funds.

Another hidden cost is slippage, the amount that the stock moves between the time that an investor makes the decision to buy and the time the trade is executed. In a fast moving market, this cost will be significant. Even under normal market conditions, it will still have a slight adverse impact on portfolio performance.

Taxes also represent a cost to the investor. Whenever a winning position is closed it results in a capital gain and the government claims a small piece of that gain through taxes. Active traders are very aware of their need to overcome this hurdle, but all traders face this problem. The ideal strategy will minimize trading costs, including taxes, and allow the investor to keep as much of their gains as possible.

Another factor related to the idea of trading frequency is how much time the investor wants to devote to portfolio

management. Ideally, this time needs to be minimized recognizing that most investors have a full-time career. If some time is required everyday to manage positions, it will be difficult to for most people to follow the strategy. Therefore, we will need to significant performance improvement to justify this level of activity.

Rather than speculate on the optimum time to spend on the strategy, we will run objective tests. We will again test the ratio of multiple moving averages calculation, with parameters of twelve weeks and twenty-six weeks, to the Fidelity universe used in tests throughout this chapter. We will hold three funds in our portfolio. Sells will occur when the RS rank falls below 17; no other stop rules will be used at this point. The results are in Table 3-13.

TABLE 3-13: TRADING FREQUENCY

	Annualized Return	Maximum Drawdown	Average Number of Trades/Year
Weekly Trading	21.94%	42.41%	15.47
Daily Trading	21.52%	45.35%	16.47

Using an RS strategy, trading once a week offers better results than daily trading.

The results show that there is no advantage to reviewing the portfolio more than once a week. Daily trading lowers annualized returns slightly, increases the drawdown, and requires more effort on the part of the investor. Overall, the increased level of effort measurably hurts performance.

Putting It All Together

We began this chapter looking for a profitable strategy. In the first tests, we found that any RS technique would be superior to a buy-and-hold strategy. We selected the ratio of multiple moving average technique as the best strategy, after consider risk adjusted returns. Starting with this profitable strategy, we then ran a series of tests to determine if we could improve on the simple rules. We showed that it is possible to improve returns while minimizing risk using optimized rules. The minor changes

significantly improve the performance. The original strategy and the revised rules are presented in Table 3-14.

TABLE 3-14

	Original Strategy	Optimized Strategy
Timeframes to use	12 weeks & 26 weeks	8 weeks & 15 weeks
How many to buy?	3	1
Cutoff rank	17	24
Initial stop	0	5%
Trailing stop	0	6%
Trading frequency	Weekly	Weekly

Using a ratio of moving averages to calculate RS, we tested each parameter to identify the components of the best strategy.

Using the optimized values, the annualized return increases to 25.60 percent, compared to 21.94 percent in the original test. The maximum drawdown was slightly reduced, to 42.07 percent from 42.41 percent. And, the Risk/Reward Ratio improved to 1.64 from 1.93. These are results any investor would be pleased with, but the risk is still too high for the average investor to accept.

In the next chapter, we will address some strategies to reduce that risk. We will then conclude with a discussion on how to implement RS investment strategies.

CHAPTER 4

Managing Your Risk

Any investment carries some risk of loss. RS investing can magnify that risk. As we saw earlier, the stocks that go up the most in a bull market are likely to go down very fast in a bear market. Our stock selection strategy relies on a quantitative methodology and ideally we will be able to identify quantitative ways to reduce the investment risks. Quantitative approaches eliminate the possibility of making a bad decision based upon emotion, a common problem that investors face. We are all prone to panic at bottoms and become irrationally exuberant at tops. Using an RS strategy, mounting losses as we near the market bottom may very well be deep, and the pain may cause investors to lose faith in their systems at precisely the wrong time

Previously we defined risk in mathematical terms, and we will return to this idea shortly. But before doing that, let's look at historical risk in percentage terms and review what a bear market actually means to the buy-and-hold investor. Table 4-1 summarizes all major declines which have occurred in the stock market since 1926. This year is used as the starting point because that is the full extent of the data provided by Standard & Poor's in their history of the S&P 500 index.

TABLE 4-1

Market Peak	Total Loss	Market Bottom	Bear Time	Time to Recover
Sep 1929	-83.4%	Jun 1932	34	151
Jun 1946	-21.8%	Nov 1946	6	35
Aug 1956	-10.2%	Feb 1957	7	5
Aug 1957	-15.0%	Dec 1957	5	7
Jan 1962	-22.3%	Jun 1962	6	10

TABLE 4-1

Jan 1966	-15.6%	Sep 1966	8	6
Dec 1968	-29.3%	Jun 1970	19	9
Jan 1973	-42.6%	Sep 1974	21	21
Jan 1977	-14.1%	Feb 1978	14	5
Dec 1980	-16.9%	Jul 1982	20	3
Sep 1987	-29.5%	Nov 1987	3	18
Jun 1990	-14.7%	Oct 1990	5	4
Jul 1998	-15.4%	Sep 1998	2	3
Sep 2000	-44.7%	Sep 2002	25	49

On average, bear markets last a little more than a year. Recovery time averages nearly two years.

The table shows every market decline of at least 10 percent. The deepest decline was during the Great Depression, and took more than 80 percent off the price of the index over almost three years. After that, investors waited more than twelve years for prices to return to their previous peak after that decline. While the other declines have been less severe, they still averaged ten months in duration and prices required more than thirteen months to retrace the average decline of approximately 22 percent.

Readers familiar with standard financial theories, such as the Capital Asset Pricing Model, may believe that RS strategies should lose more than a broad index during a market decline. They hold this belief because high RS stocks have a high beta. We actually showed in Part 2 that beta is simply another way of defining RS. However, in the tests we detailed in Part 3, we showed that RS strategies in all cases experienced smaller losses than the overall market during steep declines.

The RS strategy will usually experience its greatest losses as the bull market ends. There will be a shift of leadership among stocks from the high growth winners that have been so profitable to the RS investor to more defensive issues which rank low in RS near the market peak. The strategy will eventually recognize this shift in leadership and will dictate that the former leaders be sold and replace them with the stocks that are strongest in the new market environment. By adapting in this way, successful RS strategies will always suffer smaller declines than the overall market.

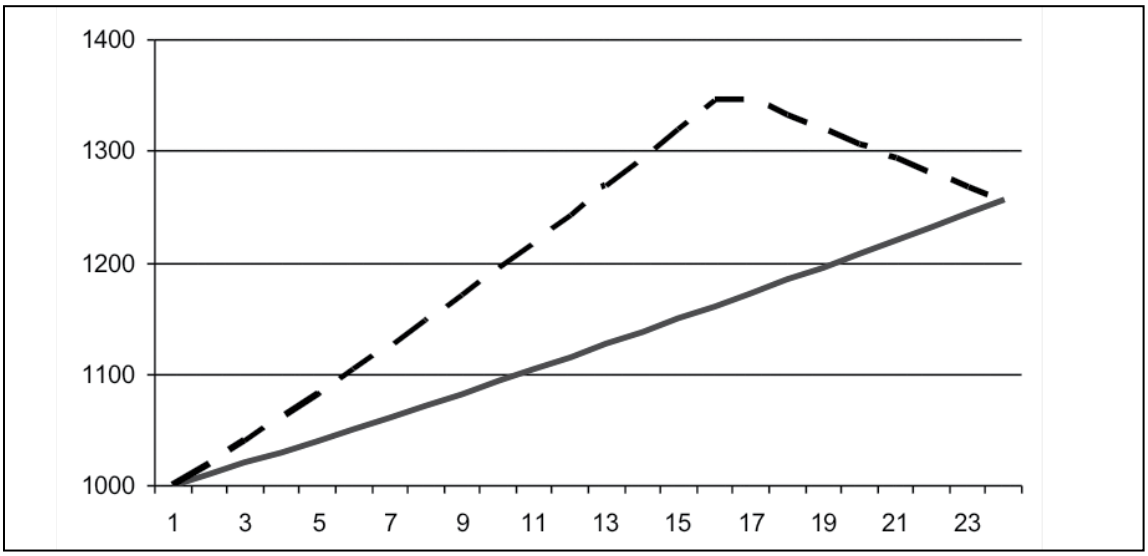
While losing less money than the market is admirable, any RS is very likely to lose money during bear market periods such as those identified in Table 4-1. The goal of this section is to find a way to reduce the losses endured during these times when the overall market declines severely. We also want to find a way to recognize when the specific RS strategy that you are employing itself is performing poorly and develop rules to limit losses during those times.

Volatility

We saw in previous Parts that standard deviation can be applied to mathematically measure a stock's volatility. The standard deviation is also considered to be a reliable measure of the risk of a stock, stock portfolio, or mutual fund. The general concept is that the more a stock's actual historic returns vary from the stock's average return, the higher the calculated standard deviation. Higher standard deviation stocks are referred to as more volatile than stocks which have a lower measure of standard deviation. Investors prefer steady gains and associate volatility with risk, and that means standard deviation is also a measure of risk.

FIGURE 4-1

Variability of returns can be high between portfolios even when the end results appear to be the same.



An example will help illustrate this idea. Consider two stock portfolios which both end the year with total gains of about 25 percent. Both portfolios began with a value of $1,000 and end up increasing in value to $1,250. The monthly returns are shown in Figure 4-1.

Most investors would prefer the steady gains of 1 percent per month shown in the lower line of Figure 4-1. While both investors end up with the same account equity, the investor symbolized with the upper line in that figure gets there by giving back a significant amount of profits along the way. This is a drawdown, and although it is unavoidable, investors often have a difficult time accepting them psychologically. The loss of paper of profits hurts just as much as realized losses. Had you invested with the manager who achieved the returns shown by the upper line in Figure 4-1, you might even feel like you lost money during the year.

This graphic portrayal of the sequence of the gains illustrates the idea that investors usually prefer lower volatility when it comes to returns. This visual observation can be confirmed mathematically through a calculation of the standard deviations of the monthly returns. The gain achieved with a steady 1 percent per month return has a standard deviation of 79, significantly lower than the standard deviation of 111 for the upper line shown in Figure 4-1.

From this relatively simple example, we can see that standard deviation can serve well as a measurement of risk. Steadier gains are preferable to most investors, and the steadier the gains the lower the standard deviation.

In earlier tests of RS strategies, we determined what we considered to be the best strategy by calculating the Risk/Reward Ratio. In that calculation, we divided the worst historic drawdown by the annualized average returns. The technique with the lowest ratio was considered to be the best system. We can combine returns with standard deviation by a similar calculation and the Risk/Reward calculation would then become Standard Deviation/Returns calculation and carry the same meaning to define risk adjusted returns.

Applying this idea to the two equity curves shown in Figure 4-1 identifies the steady returns of 1 percent per month as the better

investment choice. The Standard Deviation/Reward ratio for that curve is lower than for the upper line, the actual values are 316 for the lower line compared to 445 for the upper line.

This type of calculation can be done in real-time and the result would be a predictive measure of the best way to beat the market while minimizing risk. To apply the concept of the Risk/Reward Ratio to the future, the first step we will take is to define risk as standard deviations and define reward as relative strength. The transformation of risk to standard deviation has been developed previously.

The logic behind defining reward as relative strength is that the relative strength calculation will be used to determine the portfolio holdings and the investor's reward is ultimately determined by the portfolio holdings. Therefore, mathematically the reward and the holding are equivalent. Under our rules-based approach to investment selection, the holding is defined by the formula used for the buy rule. In other words, the method we use to define RS is equivalent to the reward defined in the Risk/Reward Ratio. This concept can be confusing as a series of words, so we will hopefully clarify the idea with Formula 4.1.

FORMULA 4.1

Reward ≡ Portfolio Holdings ≡ RS Formula

where ≡ represents the mathematical symbol for 'equivalent to'

Thus far, to help limit risk and identify stocks which are likely to do well in the future, we have rewritten the Risk/Reward Ratio to be:

FORMULA 4.2

Standard Deviation/RS

To make the calculation technique more universal, we will use the inverse of this calculation and take a measurement of RS

divided by Standard Deviation. The reason for this is that we will need to find the RS first, and then calculate the standard deviation. If an investor wants to run these calculations in Microsoft Excel or another spreadsheet program, placing the standard deviation function in the numerator would result in an error because the software would read this as a circular reference. Placing the standard deviation in the denominator eliminates this problem within the spreadsheet software and ensures that the methods described in this book can be implemented by the largest number of investors. The final calculation is simply Formula 4.3.

FORMULA 4.3

RS/Standard Deviation

where RS represents one of the formulas provided for the calculation of relative strength defined in Part 2 and Standard Deviation represents the standard deviation of the relative strength over a defined look back period.

As an example, we will use the ratio of multiple moving average technique for calculating RS as we did for the testing conducted in Part 3. This uses the formula for RS defined as Formula 2.8.

FORMULA 4.4

$$\text{Risk Adjusted RS} = \frac{\dfrac{MA_{10\ \text{weeks}}}{MA_{26\ \text{weeks}}}}{\text{Standard Deviation of RS for 26-weeks}}$$

Formula 4.4 could use any of the RS calculations defined in Part 2 as the numerator of the Risk Adjusted RS ratio. The number of weeks used for standard deviations was arbitrarily set to twenty-six in Formula 4.4 but could be any number larger than

twenty. The reason for these parameters is that as the number of observations increases, the degree of variability tends to stabilize and follow a normal distribution defined by the Bell Curve. Generally, as long as there at least twenty data points in the series, the standard deviation will remain fairly stable over the short-term, making it a useful risk measurement variable.

With this method of calculating the risk adjusted RS (Formula 4.4), the highest calculated number represents the preferred investment approach. We will now apply this calculation technique to identify the best risk-adjusted method of calculating RS. In all cases, standard deviation is calculated over the previous twenty-six weeks. All other test parameters are the ones detailed in previous sections and used to create Table 3-7. The initial results are shown in Table 4-2, which includes the annualized return, maximum drawdown, and the drawdown divided by the return in order to allow for test results to be compared with the results obtained in Part 3.

TABLE 4-2

RS Techniques	Annualized Return	Maximum Drawdown	Annualized Return (with SD)	Maximum Drawdown (with SD)
Normalized rate of change	20.10%	-52.26%	18.93%	-27.18%
Back-weighted ROC	21.77%	-47.21%	21.83%	-42.50%
Front-weighted ROC	19.83%	-53.06%	21.46%	-43.32%
Price/Moving average ratios	18.87%	-55.42%	11.15%	-26.91%
Ratios of multiple moving averages	21.94%	-42.41%	10.99%	-26.93%
Averaging different time periods	21.10%	-50.15%	19.71%	-40.05%
Alpha	20.94%	-53.53%	20.59%	-31.29%
S&P 500 buy and hold	8.70%	-50.03%		

When standard deviation is included in the calculation, returns are generally lower, as is the drawdown.

The results are fairly different than the ones we obtained in Part 3. The best performing technique from those earlier tests is now the worst performing technique. To complete the comparison, the annualized return of each method is divided by the maximum drawdown, and these results are shown in Table 4-3.

TABLE 4-3

RS Techniques	Risk/Reward Ratio	Risk/Reward Ratio (with SD)
Normalized rate of change	2.6	1.4
Back-weighted ROC	2.2	2.0
Front-weighted ROC	2.7	2.0
Price/Moving average ratios	2.9	2.4
Ratios of multiple moving averages	2.0	2.5
Averaging different time periods	2.4	2.0
Alpha	2.6	1.5
S&P 500	6.2	N/A

When adjusted for risk, the normalized rate of change now offers the greatest potential rewards to investors.

The most important conclusion from Table 4-3 indicates that dividing the RS calculation by standard deviation significantly lowers the risk. This is an important point. Although returns are lower, with the lower maximum drawdowns that an investor will have to suffer through, the average investor is more likely to be able to endure the painful losses that are inevitable in any systemic approach to investing.

What may be troubling to some readers is the fact that the relative ranking of the techniques has changed so much from those we obtained in Part 3. This should not be a concern because the RS concepts are still shown to be sound. Again we find that all techniques provide higher annualized returns than the market, as measured by the S&P 500 index. And, again we see that the maximum drawdown is lower for all techniques than what the buy-and-hold investor is likely to experience. Rather than be troubled by the variability of the results, you need to remember that results will vary whenever any of the conditions defined in the previous section are modified. Before implementing any of these strategies, you will want to test them on the exact securities you will be trading. Specific guidance on implementation will be found in the next part of this book, but for now we will return to the test results shown in Table 4-3.

The best overall returns are available from the back-weighted or front-weighted rate of change calculations. However, the maximum drawdown in both cases exceeds 40 percent. The goal of this part is to achieve a large reduction in that drawdown. Given the high risk associated with the weighted rate of change techniques, it is unlikely many investors would be able to stick with this strategy through the bad times in order to reap the benefits in the good times.

We need to address the question of why these approaches would see so much improvement from modifying the calculation to include the standard deviation. The back-weighted rate of change gives more weight to earlier price action while front-weighting the calculation means that more recent price changes are emphasized. Using either approach, volatility of returns is rewarded. Dividing the calculated RS by the large standard deviation partially offsets the impact of this high volatility. It identifies stocks with the greatest movement and delivers high returns in this case, with high risk.

The ratios of multiple moving averages approach delivered rather disappointing results, although the drawdown is held to a very tolerable level. The results are surprisingly stable — in 625 tests varying the length of the moving averages, the annualized returns ranged from 9 percent to 11.5 percent, a very narrow range. Varying the length of time used to calculate the standard deviation also offered no improvement in system performance. Stable, market beating returns, even when they are half the best available, increases confidence that the underlying logic of the RS strategies are sound.

The best risk adjusted return was achieved with the normalized rate of change divided by standard deviation. Second best was alpha divided by standard deviation. It is interesting that the simplest calculation method offered such strong results. There are advantages to using the more complex calculations required for alpha. If you could tolerate the maximum drawdown of more than 31 percent endured with the alpha technique, compared to the 27 percent drawdown suffered with the normalized rate of change, the additional gains of 1.5 percent per year would increase account equity by more than 34 percent in twenty years. This example

illustrates the power of compounding returns, and highlights the dilemma investors face as they seek a trade-off between risk and reward.

The difference in ending account values also emphasizes the importance of a long-term perspective for RS investors. While drawdowns can be reduced with the simple addition of standard deviation to the calculation, they cannot be eliminated. You will need the commitment to continue investing with these strategies through what can be a protracted period of losses to reap the great rewards available over time.

Trading the Equity Curve

Another risk mitigation strategy, and one of the most powerful available to traders, is to apply a simple trading strategy to the equity curve of the system. Applying a moving average system to the equity curve can dramatically improve the results an investor sees in their long-term performance. This is a technique that some professional traders use to recognize when a system has stopped working.[25] It is important to remember that any trading system will experience extended periods of time when it seems to stop working. These periods of underperformance are usually associated with unusual market activity, but they can last for years. If the system is well designed and based upon sound logic, it will resume delivering superior performance after the market returns to normal conditions.

One of the most famous trading systems of all time is the Turtle system[26]. In the mid-1980s, market wizard Richard Dennis argued with his partner, Bill Eckhardt, about whether great traders are born with some innate skill, or whether anyone can be taught to trade well. To settle their argument of nature versus nurture, they decided to train a group of apprentices to trade with a precise set of rules. These beginners became known as the 'Turtles' and over a four year period, as a group they delivered a compound rate of return of over 80 percent. The argument was settled, anyone could become a great trader and a great story was written[27].

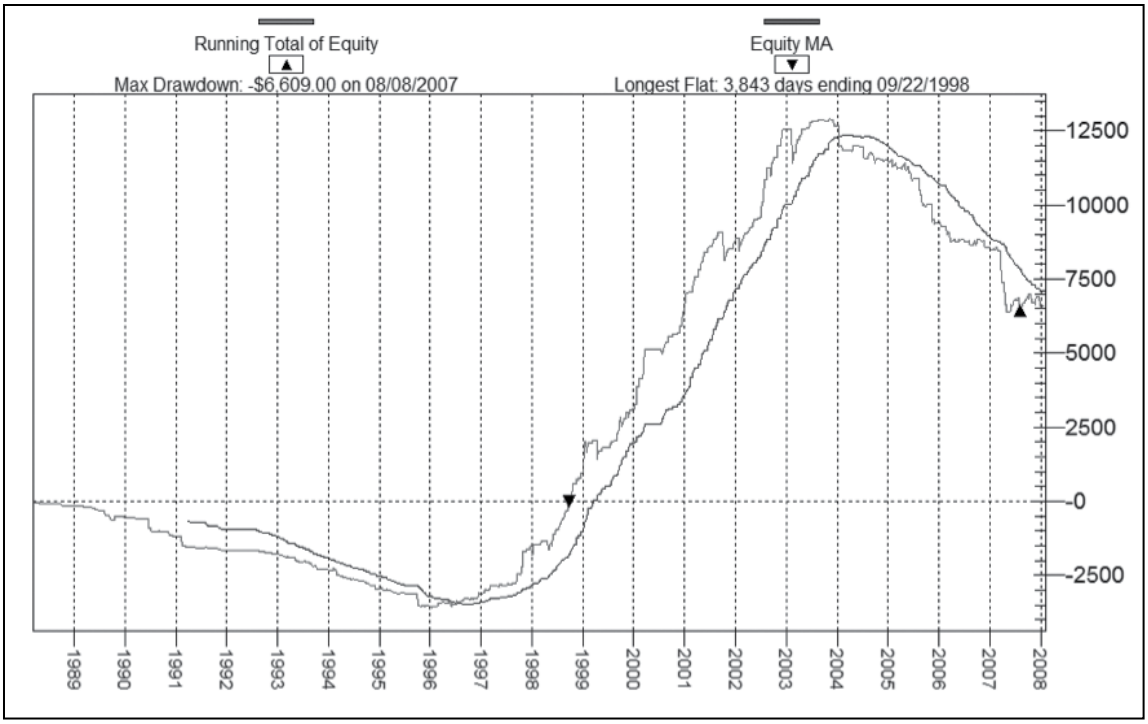
The Turtle system rules withstood the test of time. Over a twenty year period, strictly following the rules would have turned a $50,000 investment into more than $750,000. But, in 2003, the

system just stopped working and began losing money. This example is only provided to highlight the fact that any system can stop working for a time. Readers may also be aware of the complex but academically unassailable trading systems employed by the Nobel Prize winning economists at Long Term Capital Management that stopped working in 1998 with spectacular results that almost led to a global meltdown in the banking system[28].

Knowing that any system can fail, we can take steps to know when a system based upon RS stops working. This will allow us to take steps to avoid the losses incurred when the system is not in synch with the market. By continuing to monitor the system, we will also be able to determine when the system has started working again.

This idea is illustrated in Figure 4-2, which shows the equity curve of a trading system along with a fifty-period moving average of the equity curve. Starting on the left side of the figure, we see that initially the system lost money when the test period began in 1988. After fifty trades were completed, we were able to calculate the moving average and initially the equity curve

FIGURE 4-2



was below the moving average. The equity curve crossed above the moving average in 1996 and remained above the moving average until late 2003. The equity curve spent the next five years below the moving average.

This example was selected because the crossing points are so easy to spot. It represents a short-term trading system that worked very well, for a time, on the S&P 500 ETF known as the Spyder. Starting with $100, the trader would have made nearly $15,000 in the seven years that the system was working. Without looking at the moving average on the system equity curve, the trader would have made less than half as much money, assuming they had continued trading during the initial seven years worth of losses.

From this admittedly well-chosen example, the power of trading the equity curve is obvious. This technique takes trades only when the system is working and ignores signals when the system is experiencing protracted drawdowns. We let the market tell us when to ignore signals, rather than attempting to override the system based upon judgment or intuition.

To summarize this concept, we track the performance of a trading system in a simulated equity account. Almost all commercially available trading software provides this capability, and it can also be done manually using Microsoft Excel. A moving average of the equity curve is calculated, and plotted on a chart along with the equity curve. Trade signals are only taken when the equity is above the moving average. When the equity falls below the moving average, trade signals are ignored. Even when we are not actively trading the system because the equity has dipped below its moving average, we continue to run the system and track all signals so that we will know when the equity crosses back above its moving average.

With this tool, we avoid trading systems which have stopped working. We are also not concerned about whether the system will ever resume its prior success. If the equity curve crosses back above the moving average we start trading the system again. Since successful systems are based upon sound logic, there will come a point in the market cycle when they do start working again.

The moving average can be calculated over any time period. From experience, thirty or fifty periods works well. A period is defined as the time when account equity is reviewed. In the testing we completed earlier, we looked at prices on a weekly basis and recalculated RS at that time. For this concept, we would chart the equity curve and calculate its moving average on a weekly basis. For daily trading systems, we would obviously calculate and chart account equity on a daily basis.

Trading the equity curve works very well with RS trading strategies. In Table 4-4, we show the summary for an ETF trading system that uses alpha divided by the standard deviation to define RS. A thirty week moving average of the equity curve is used a filter — trades are only accepted when the equity curve is above its moving average.

TABLE 4-4

	Without filter	**With filter**
# trades	124	90
Ending equity	$94,077	$168,091

Applying a moving average to the equity curve significantly improves the performance of an RS trading strategy.

The results shown in Figure 4-4 are fairly typical of the improvement possible with this idea. With the filter, profits are increased by nearly 79 percent. This improvement in performance also virtually eliminated drawdowns. The worst drawdown experienced with the filter was a little over 9 percent. This compares to a drawdown of more than 30 percent with the unfiltered signals. Employing the filter means not taking trades when the equity curve is below its moving average and closing any open positions when the curve falls below the moving average.

This tool is not without its shortfalls. One problem is the same issue associated with any moving average system, whipsaws will occur as the equity curve fluctuates above and below the moving average line. This will result in repeated trades in and out of positions while the longer term trend of the equity curve asserts itself. While this can be frustrating, the data shows that it is better to suffer through the whipsaws than it is to stay fully invested throughout the downturns.

Another problem with this approach is that you will never be able to catch a market bottom. The equity curve will need to move higher as a result of several winning trades before you will be given a buy signal to take action on. This can be frustrating for many investors. The majority of individual investors try to buy bottoms and sell tops in the market or with single stocks. Unfortunately, this is impossible to do on a consistent basis. Using this approach, you are assured of missing all bottoms and staying invested a little past the ultimate top. But, again, the data supports this technique as superior to being fully invested at all times and proves to be far better than a buy-and-hold strategy.

Trading the equity curve is a powerful tool that you honestly cannot afford to ignore. It requires little more effort than the work needed to generate the trading signals for any strategy. But, this is a game where you, the individual investor, is competing against professionals working full-time to analyze and beat the markets. An extra two columns in a spread sheet can deliver hedge fund like returns, and is well worth your time.

Summary

In the previous section, we introduced stops as a risk reduction strategy. Stops need to be used to guard against catastrophes. Very few investors are able to continuously monitor their portfolio during the trading day, and stops ensure that adverse price movements will have a limited impact on their accounts. We demonstrated with testing that they slightly diminish returns but decrease risk. For that simple reason, we think they are the most important part of managing investment risk. An initial stop loss should always be entered whenever a position is entered. Trailing stops should be used to lock in profits as the trade shows a profit.

In this section we added two additional components to the RS investment strategy. First, we divided each RS calculation by the standard deviation and found that this lowered drawdowns. Given that most investors prefer steady gains, this means that introducing standard deviation into the stock selection process will benefit investors. We saw test results that showed this tool

reduced risk, and that is why we include this as a preferred part of our RS investment strategy.

Finally, we introduced a concept that might be challenging to understand, the idea of trading the equity curve. Studying these ideas is important to success, and it is worth the effort to reread this section several times and to actually experiment with this idea. It can be done very easily with any spreadsheet software, so there is no excuse for any investor to watch their account equity drop dramatically during the bear markets of the future.

CHAPTER 5

Trading Applications

In the previous sections, we have addressed what relative strength is, the theory that explains why it should work, how it can be applied as part of an overall trading strategy, and how to reduce the risk that is associated with these strategies. In this section, we will provide specific ideas on how RS can be used to add value to any investor's account. We'll look at trading exchange traded funds and individual stocks, managing your retirement account with RS, and conclude by showing that RS concepts apply to futures trading as well.

Exchange Traded Funds

The fastest growing asset class of this decade has been the exchange traded fund (ETF). These investments have been available since 1986, when an ETF designed to provide individuals with a low cost product that would match the performance of the S&P 500 started trading. By the beginning of 2008, there were more than 600 ETFs listed on exchanges in the US, with total assets of about $600 billion. ETFs at first covered only major stock indexes, but they now represent sectors, countries, global regions, and taxable and municipal bonds of varying maturities. An ETF is an investment combining key features of traditional mutual funds and individual stocks. ETFs hold stock portfolios just like open-ended index mutual funds do. An important difference is that ETFs trade like stocks and can be bought and sold through a traditional or online broker at any time during the trading day. Traditional mutual funds are only available for purchase and sale once a day, based on the closing price of the portfolio holdings. ETFs are priced continuously throughout the trading day.

The fact that ETFs are priced continuously means that stop orders can be effectively employed with them. Stop orders cannot be placed in advance for a mutual fund, which allows investors to implement better risk management procedures with ETFs, as compared to traditional mutual funds. ETFs also offer extremely low expense ratios, although they do incur brokerage costs whenever they are bought or sold. Overall, the commissions are usually less than the management fees associated with traditional mutual funds.

The large number of available ETFs means that you can use them to create a widely diversified investment universe, which is the first step in developing an RS investment strategy. There is a very compelling argument to be made that ETFs represent the most cost effective way to implement an RS trading strategy, provided that you use a discount broker for all trading activity

At this point, we are going to provide very specific details and create the actual system used to develop the smooth equity curve illustrated in Table 4-4. We will provide a great amount of background information in order to fully explain the logic behind the system. This will allow you to go through a similar thought process on your own to create your own trading systems. The usual investment caution is needed here — past performance is no guarantee of future investment performance. It is also important to remember that all of these performance tables and backtested results are hypothetical and do not represent trading in actual accounts.

Strategy Overview

This strategy will actually combine three separate strategies. We will seek to diversify risk by creating three separate RS systems employing different investment universes and different rules in each system. One of the systems will apply RS to sectors within the stock market, a second strategy will employ RS across different asset classes, and the third strategy will look at the global investing environment and select the strongest ETF that duplicates the performance of a basket of international stock indices.

Each strategy will be run individually on a weekly basis. Any individual strategy may or not be in the market at any given

time, depending upon the filter which applies a moving average to the equity curve. In the end, all three strategies contribute to a single equity curve, which represents the true measure of increasing wealth for the investor, and that is ultimately the best measure of investment success.

Investment Universe Selection With ETFs

The goal of this strategy is to achieve the broadest possible exposure to the markets, and hopefully be holding something that is going up when the US stock market is crashing. ETFs offer an almost overwhelming variety of investment options, so it is likely that we can reach this goal by selecting a diversified investment universe.

Foe individual investors, investment options are usually thought of as stocks, bonds, cash, and real estate. Within stocks, most financial planners will recommend some exposure to small cap stocks, large cap stocks, and international markets. For the fixed income portion of the investment portfolio, investors usually choose between taxable and tax-exempt issues. All of these options are available through ETFs.

For US stock exposure, we will go beyond the traditional allocation models and look at including sector ETFs, just as we used sector mutual funds in Part 3 to develop the test results. The twelve funds identified in Table 5-1 offer exposure to industries representing almost the entire economy, and therefore should experience shifts in leadership as the economy progresses through the business cycle. There are other funds that can be included in this listing, but the funds shown in the table were the ones which traded with sufficient liquidity when this list was assembled several years ago. Average daily trading volume is a good measure of liquidity. Higher liquidity reduces trading costs by narrowing the difference between the bid and ask spread. Average trading volume of 10,000 shares over the past twenty days is a reasonable value to ensure that you can enter and exit positions at a reasonable cost. This threshold value is for individual investors buying or selling no more than a few hundred shares at a time. Larger investors and institutional investors will need to use a higher average trading volume filter.

TABLE 5-1: SECTOR ETF INVESTMENT UNIVERSE

Name	Symbol
iShares Dow HealthCare	IYH
iShares NASDAQ Biotech	IBB
iShares Dow Utilities	IDU
iShares Dow Consumer Noncyclical	IYK
iShares GS Natural Resources	IGE
iShares Dow Energy	IYE
iShares Dow Basic Materials	IYM
iShares Dow Telecom	IYZ
iShares Dow Consumer Cyclical	IYC
iShares Dow Financials	IYF
iShares Dow Industrials	IYJ
iShares Dow Transports	IYT

Twelve funds representing a broad offering of stock market sectors.

An expanded list of asset classes will be included in this strategy through a group of ETFs that invest by market capitalization, take positions based upon growth or value investing styles, hold bonds of varying maturity levels, and offer exposure to commodities which are represented through an ETF investing in gold. Again, other funds are now available and if the list were being prepared today, it would include more exposure to commodities given an increased number of offerings in that class. The purpose of this section is not to develop the best RS strategy available today, but to walk through the steps of system development to demonstrate that the system development process does not vary with time.

TABLE 5-2: ASSET ALLOCATION ETF UNIVERSE

Name	Symbol
iShares Comex Gold	IAU
iShares 7-10 Yr Treasury Bond	IEF
iShares Emerging Markets	EEM
iShares 1-3 Yr Treasury Bond	SHY
iShares 20+ Yr Treasury Bond	TLT
iShares MSCI EAFE Index	EFA

TABLE 5-2: ASSET ALLOCATION ETF UNIVERSE

iShares Russell 1000 Value	IWD
iShares Russell 1000 Growth	IWF
iShares Russell Midcap Value	IWS
iShares Russell Midcap Index	IWR
iShares Russell 2000 Value	IWN
iShares Russell 2000 Growth	IWO
iShares Russell Midcap Growth	IWP

These funds offer exposure to different stock market investment styles and asset classes.

In an increasingly global economy, investors need to consider adding exposure to international stocks to their portfolio. ETFs offer individual investors the ability to invest in individual countries, or to further limit risk by selecting funds which invest regionally and offer simultaneous investments in several countries. Either option meets the goal of adding a diversified asset to the portfolio. The list in Table 5-3 was selected based upon a minimum liquidity screen requiring an average trading volume of at least 10,000 shares per day.

TABLE 5-3: INTERNATIONAL ETF INVESTMENT UNIVERSE

Name	Symbol
iShares Malaysia	EWM
IShares Hong Kong	EWH
iShares Switzerland	EWL
iShares MSCI Italy	EWI
iShares Australia	EWA
IShares Mexico	EWW
IShares Spain	EWP
IShares Belgium	EWK
IShares Japan	EWJ
iShares France	EWQ
IShares Germany	EWG
iShares Canada	EWC
IShares Singapore	EWS
iShares Netherlands	EWN

TABLE 5-3: INTERNATIONAL ETF INVESTMENT UNIVERSE

iShares MSCI United Kingdom	EWU
IShares Austria	EWO
IShares Sweden	EWD

ETFs offer the opportunity to invest in the stock market of almost any country.

The three groups of ETFs are tracked separately and traded separately. The trading can be done within a single account, but all rules are followed as if you are trading three individual systems. For all calculation of RS, the S&P 500 index will be used as the comparison baseline. This is the typical performance benchmark used by professional investment managers, and the individual investor should seek to outperform professionals. If you can not outperform the professionals, then it is best to simply buy and hold a low cost index-based mutual fund or ETF. The trading rules to be applied in these systems are defined in the next sections.

Parameter Selection

For this strategy, we used alpha divided by standard deviation to define RS. This selection was made after testing all possible formulations of RS and assessing the relative merits of each. The overall portfolio is intended to be a long-term investment; therefore it is important to maximize gains. As shown in the previous section, small differences in annualized returns add up to a large amount of terminal wealth. The primary objective of long-term investing needs to be maximization of gains, with the understanding that drawdowns along the way may be severe. In this analysis, maximizing potential rewards while keeping total risk, defined as the maximum drawdown, to a reasonable level was the objective used to decide on which calculation method to use. Drawdowns can never be fully eliminated and you need to realize that before continuing with any system development.

We decided to hold only the single highest ranked fund in each category — one sector-based ETF, one ETF from the asset class category, and one international ETF. This means that at any given

time we will be holding up to three ETFs, which represents broad diversification. We will use weekly prices to minimize the trading activity. The trading rules are summarized in Table 5-4.

TABLE 5-4

	Sector Strategy	Asset Allocation Strategy	International Strategy
Timeframes to use	40 weeks	35 weeks	40 weeks
How many to buy?	1	1	1
Cutoff rank	8	10	8
Initial stop	5%	5%	5%
Trailing stop	10%	7%	5%
Trading frequency	Weekly	Weekly	Weekly

A summary of the system parameters that will be used in this example.

Individually, none of these systems is particularly noteworthy. All provide unfiltered returns slightly better than the markets with about the same risk as the market. Together, they tend to perform well at different times and deliver more profits with less drawdowns. Although diversification is usually thought of in terms of the number of stock holdings an investor has, system diversification can lead to excellent results.

One surprising characteristic in Table 5-4 is the cutoff rank, which is probably higher than expected. In real-world trading, experience shows that the majority of trading profits come from big winners. Returning to the Turtle system, which is usually considered to be among the best systems of all time, in most years, about 40 percent of the trades are winners. In other words, traders using this system should expect to be wrong six out of ten times, and if they can psychologically withstand this high error rate they can expect to earn great profits. Individual traders often have difficulty continuing to trade these types of systems. But, professionals know that it is important to give a winning trade time to build up profits, and that means sitting through frequent retracements. The high cutoff ranks in these optimized systems give these trades the time they need to develop into big winners.

Optimization

The parameters in Table 5-4 are optimized. They all use alpha divided by standard deviation because that was found to be the best measure of RS fro these investment universes after thousands of tests were completed. That leads to the question of whether or not that definition of RS will continue to perform well in the future. The answer, we believe, is an emphatic yes. The theory supporting RS has been well documented in previous sections, and the testing undertaken to prove it works has shown it to consistently beat the market while decreasing risk over the long term. This leads to a high degree of confidence that RS will continue to provide superior risk-adjusted returns in the future. Alpha divided by standard deviation may not represent the best way to measure RS five years from now, but it is very likely to still be delivering superior results when compared to a buy-and-hold strategy.

Some investors think that optimization is similar to data mining. As discussed earlier, this is not true. An exercise in data mining would be to find the stocks which performed the best week to week and then go back and identify characteristics to explain why this occurred. We may discover that stocks whose ticker symbol begins with 'B' always outperform all other stocks in the week before a full moon occurs. This is data mining — we have found an effect with no obvious cause. It is extremely unlikely that the letters within the ticker symbol have any bearing on future returns. It is also unlikely that phases of the moon will have a long-term impact on stock prices. Without underlying logic to support the finding, data mining is the only explanation for the system.

We began our system design with solid underlying logic. We exhaustively detailed why the logic supporting RS should work when it is applied to select stocks expected to outperform the market in the future, and we then tested the logic under a variety of conditions. That is the opposite of data mining. In our case, we have statistically validated a hypothesis. More detailed statistical analysis supporting relative strength strategies can be found in many of the papers referenced in the Appendix.

Starting with a sound rationale, the next step in our process is to identify the best parameters to use that satisfy our goal of maximizing gains while minimizing risk. To accomplish this, we repeated the tests as outlined in Section 3, beginning with an examination of each possible definition of RS. Those tests used a constant time parameter with each formula, a constraint we abandoned in this current series of tests.

The decision to use a constant time parameter in Section 3 was made for the sake of clarity. The goal of that section was to develop a test protocol that all readers would be able to understand and recreate on their own. We think that goal was met as we showed that all definitions of RS will deliver acceptable investment performance. In this section, we are illustrating an example of developing a professional quality trading system that can be used to manage money for an individual. That removes all constraints from the testing process, and in fact imposes an obligation to validate the final result by completing every test that is mathematically possible. In the end, the results closely mirror the simpler approach we applied earlier. Again, this should boost your confidence in the principles explained in this book.

After testing all possible combinations, we found that alpha divided by standard deviation worked best and delivered excellent performance over a variety of timeframes. All best performing timeframes were within the three months to one year timeframe identified by several academic research studies as being the best lookback period for calculating RS. This is yet another confidence boosting factor in the optimization process.

Cutoff rank optimization also conforms to the theory we set forth in Section 3. In that section, we chose to sell whenever the RS rank indicated that performance had deteriorated and was below the fiftieth percentile of the universe. This is an excellent rule of thumb to apply when designing RS trading systems. In optimization testing, the best performance is usually close to this rule of thumb. In all cases shown in Table 5-4, we are fairly close to using a cutoff rank near that fiftieth percentile level.

Optimization testing demonstrates that each investment universe has unique characteristics. It is always best to run a series of

tests on the specific equities you intend to trade to identify those characteristics. The general guidelines presented throughout this book can be used to set up a simple trading system using Microsoft Excel, or even a free, open-source spreadsheet program such as the one available in Open Office. Actual trading results using such an approach are very likely to be acceptable, meaning they beat the market while reducing risk. Optimization accounts for the differences within the different investment universe and answers the question, "Could I do better by defining specific parameters instead of applying general trading system guidelines?"

Risk Management Through Diversification

There is no single best way to manage risk in the face of uncertainty. If you think about the personal computer that you will run these trading systems on, you may very well be connecting to an encrypted router through your firewall that your anti-virus software recognizes as safe. Computers rely on a defense-in-depth concept using multiple tools to provide a comprehensive situation. There is no single security system available for a personal computer that completely protects the hardware and software. Similarly, there is no reason to expect that a single tool can be used to fully protect your trading capital.

The first, and perhaps most important risk management tool we are employing in this strategy is diversification. We are trading three separate trading systems that buy and sell ETFs from three distinct investment universes. Such a broad diversification is likely to usually find a winning position.

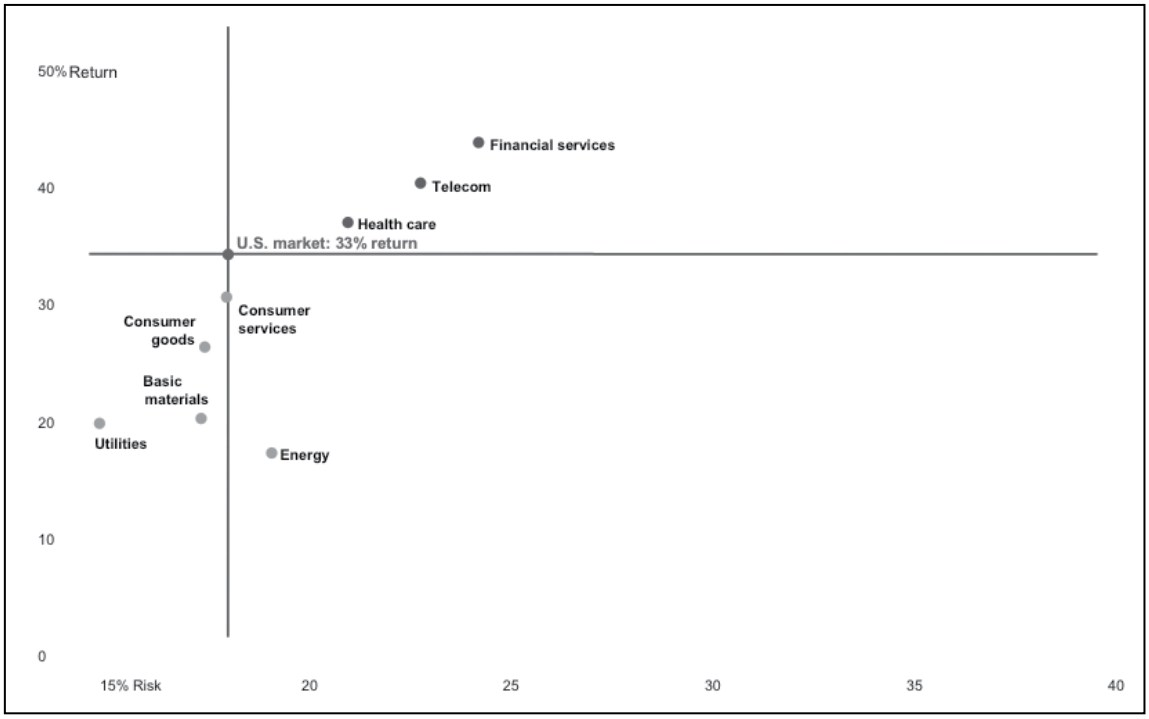
The word "usually" in that last sentence summarizes the uncertainty associated with any investment. Among traders, a popular saying is that, "In a market crash, all correlations go to 1." This means that no matter how much diversification you have built into your portfolio, during those unusual times of market crisis, everything seems to go down in price. When traders all around the world, in every market, are trying to raise cash, increasingly connected global markets tend to fall as one. That illustrates the importance of building multiple risk management tools into this, or any, trading strategy.

In this case, we have included a large number of market sectors. This takes advantage of the business cycle that was illustrated in Figure 1-5. Under normal economic conditions, which means except during those times when the stock market crashes, something should be going up. We are trying to find that something, and be invested in that sector at the right time. While technology stocks often enjoy periods of explosive growth, utilities are known for slow but steady gains. This investment universe capitalizes on that simple idea and looks for the sector performing well at any given time in the business cycle.

During bull markets, investors buy everything, but some sectors will do better than others. This idea is shown in Figure 5-1. The sectors in this figure do not fully match the sectors within our investment universe, but several general conclusions can be made. We can see that even in bull markets, risk is highly correlated with returns. While financials offer the greatest rewards in this group, they also carry the greatest risk. Utilities and

FIGURE 5-1: BULL MARKET PERFORMANCE OF SECTORS

Financials do better than all other sectors in the average bull market.



Data: Morningstar, Inc.

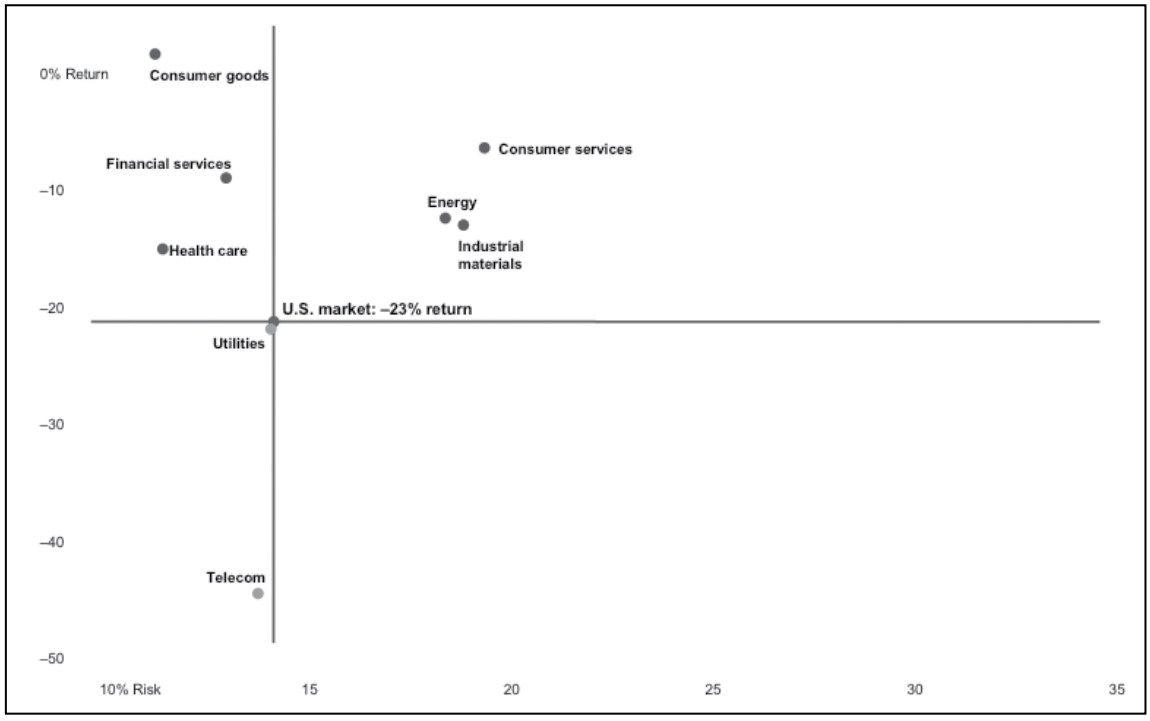
energy dramatically underperform the market, but energies deliver underperformance with greater risk, a combination most investors would rather avoid.

Bear markets are very different than bull markets, as we can see in Figure 5-2. Stocks of consumer goods companies, on average, show slight profits during bear markets. This sector includes stocks such as Proctor and Gamble, which makes cleaning products. There are some companies which are recession-proof, in a way, and this is one example. While it would be nice to understand why these sectors perform so differently during the various phases of the stock market, RS strategies simply try to exploit those differences. Combined with the picture we see in Figure 5-1, these two figures demonstrate why it is important to switch between sectors in pursuit of profits as the market cycle runs its course.

Figure 5-2 clearly shows that during a bear market, almost all stocks will suffer declines. That is why we included the asset

FIGURE 5-2: BEAR MARKET PERFORMANCE OF SECTORS

Consumer goods are the only sector that delivers a small gain in the average bear market.



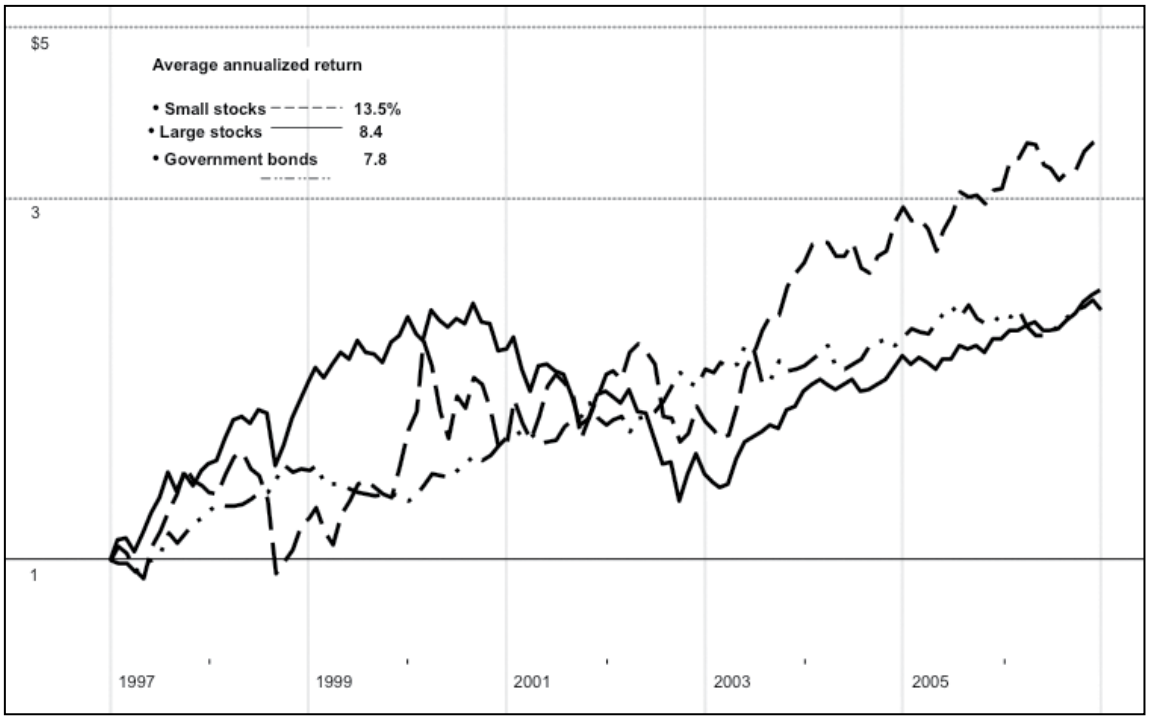
Data: Morningstar, Inc.

allocation universe within this investment strategy. This universe recognizes the fact sometimes all stocks will be going down, and seeks to profit from this insight by offering investment options other than stocks. Bond ETFs of varying durations are represented within this investment universe, and bonds are included as an opportunity to profit during those extended periods when stocks underperform bonds. The ten years from 1997 through 2006 included two strong bull markets divided by a deep bear market in stocks. In Figure 5-3, we show the annualized returns for small cap stocks, large cap stocks, and long-term government bonds during that timeframe.

At some point during those ten years, each asset class led the performance race for at least a short time. From 19997 until the end of 2000, large cap stocks were the relative strength leaders. As stocks bottomed near the end of 2002, bonds were actually the strongest performer. In 2003, as a bull market emerged, small cap stocks were the investment choice of relative strength investors. The investment universe defined in Table 5-2 would have accrued

FIGURE 5-3: ASSET LEADERSHIP CHANGES '97-'06

Over this ten year period, leadership rotated between three asset classes



Data: Morningstar, Inc.

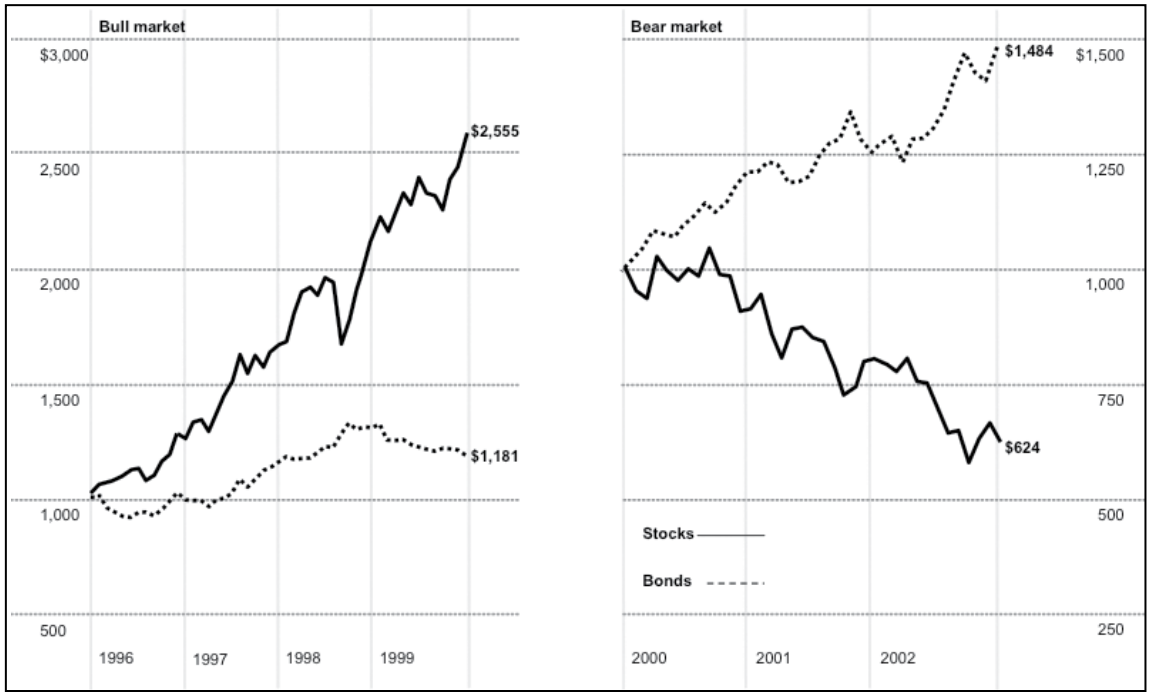
profits during this entire period as it took advantage of this leadership rotation.

Often these shifts in market trends can lead to significant gains. Figure 5-4 highlights the difference in performance between stocks and bonds during bull and bear markets. Stock prices more than doubled in only four years from 1996 through the end of 1999, while bonds barely beat inflation. But as the bear market lowered stock values in this figure by more than 40 percent, bonds did very well, increasing almost 50 percent in value in an almost steady upward march. Using relative strength, you would avoid the bulk of the losses that accrue in stocks while capturing most of the upside in bonds.

Another asset class that can do well at times is commodities. The ETFs listed in Table 5-2 includes gold as a representative of the commodity class. Gold stocks usually lead commodities higher and turn lower ahead of cyclical bear markets in commodities.[29] This makes a gold-based ETF a suitable proxy for a commodity

FIGURE 5-4: ASSET CLASS LEADERSHIP CHANGES

Bonds can perform very well as stock investors endure painful losses.



Data: Morningstar, Inc.

investment. As shown in Figure 5-5, the price of gold often, but not always, trends up when stocks move down, and vice versa. The dashed line in that figure shows that stocks rose steadily as gold searched for a bottom. After gold prices turned higher in 2003, the relationship with stocks continued but turning points have become more frequent. The intention of including a gold-based ETF in this investment universe is to increase profits during those times when stocks are in a bear market.

The asset allocation universe also recognizes that different stock market investing styles do better than other styles as the economy moves through the business cycle. There are two general investment styles, value and growth, that dominate the mutual fund industry and account for a large part of stock market trading. Value investors look for stocks that they believe are trading for less than their intrinsic values. Typically, value investors select stocks with lower-than-average price-to-book or price-to-earnings ratios and/or high dividend yields. Growth investors

FIGURE 5-5

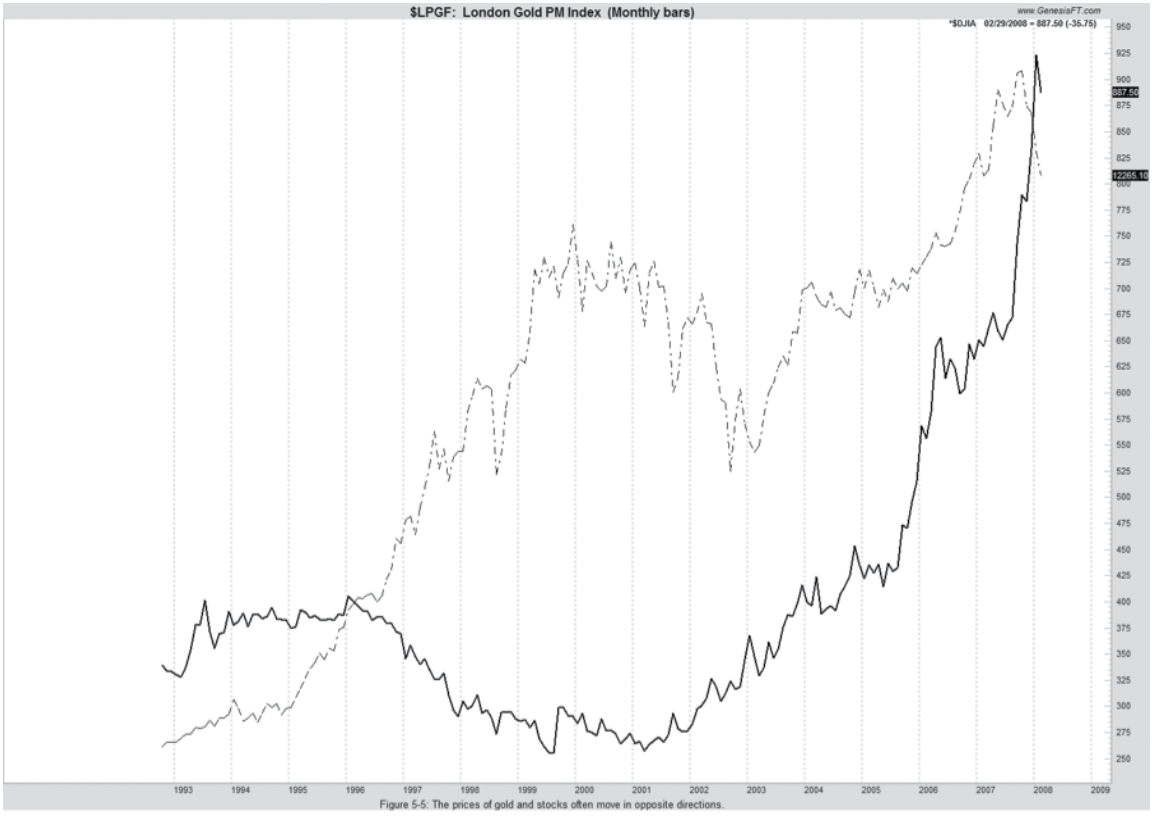


Figure 5-5: The prices of gold and stocks often move in opposite directions.

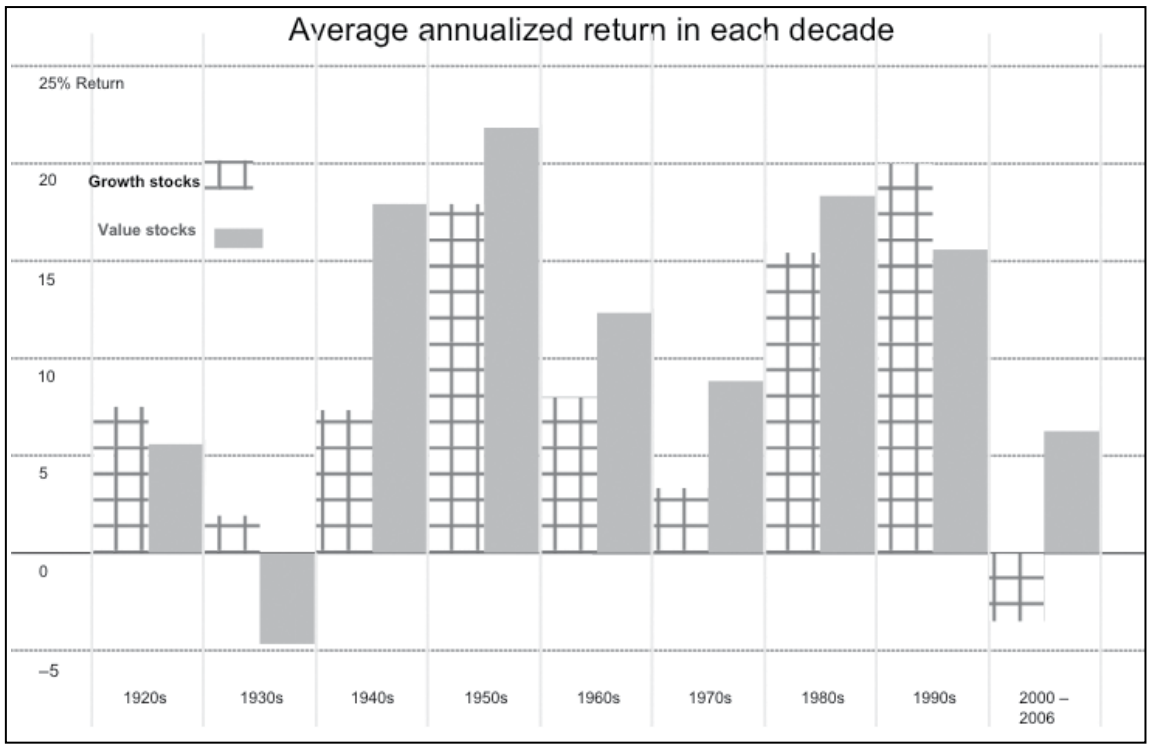
try to find stocks that they think offer prospects of strong growth potential. They usually define a growth stock as a company whose earnings are expected to grow at a fast rate compared to its industry or compared to the market as a whole.

Over the long term, most studies find those employing the value style outperform investors using a growth methodology. But there are no absolute rules in investing and at any given time, one style will be performing better than the other. It is impossible to predict which style will be outperforming the other, but the RS investor is not trying to predict. By following an RS investment strategy, you will be reacting to performance and profiting rather than forecasting. Figure 5-6 demonstrates that predicting which style works best under various economic conditions is impossible.

In the bull market of the 1920s, growth outperformed value. But in the 1980s bull market, value won out. Investors looking in the rear-view mirror to develop an investment strategy for

FIGURE 5-6: GROWTH AND VALUE

Growth and value methods each enjoy periods of strong performance.



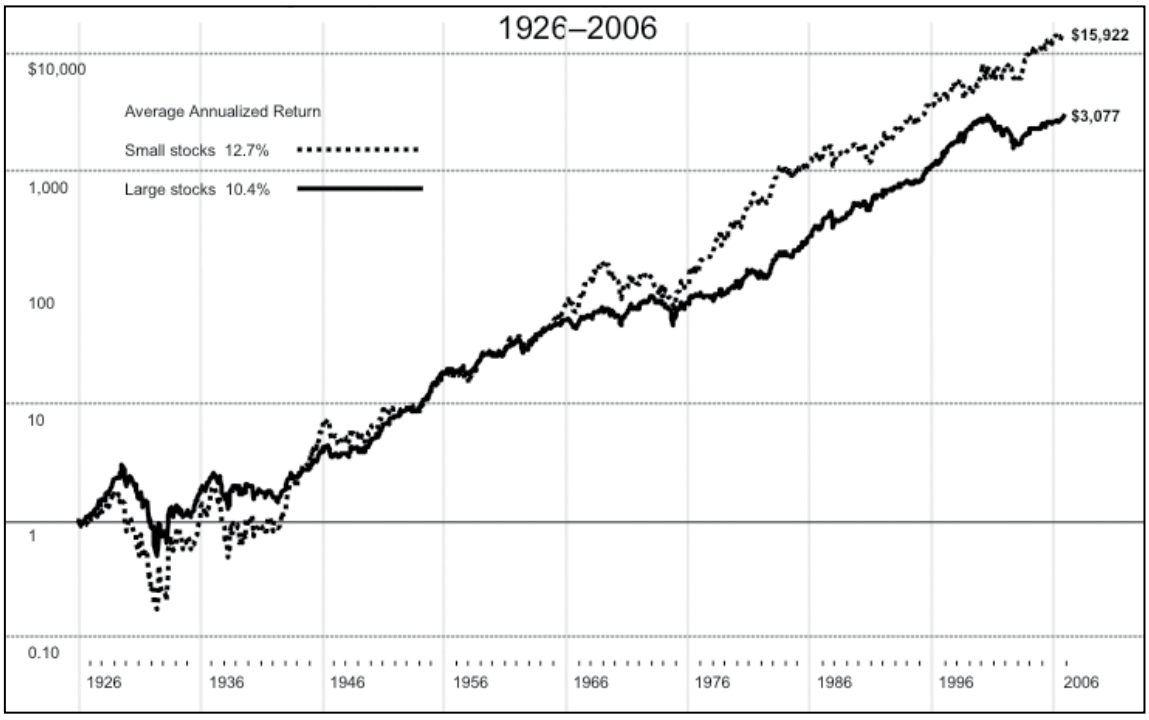
Data: Morningstar, Inc.

the next decade would have underperformed in the 1990s as growth regained the leadership between the investment styles. Bear markets are equally as unpredictable. Growth outperformed value during the Great Depression, but failed to keep pace with value strategies during the next two devastatingly deep bear markets that took place in the 1970s and the beginning of the twenty-first century. By including growth and value ETFs within the asset allocation universe, we are increasing our chances of consistently outperforming the market.

This asset allocation investment universe also includes representation among different market capitalizations. The term market capitalization refers to the total dollar market value of all of a company's outstanding shares. Market capitalization is calculated by multiplying the total number of outstanding shares by the current market price of a single share. Market capitalization is frequently called "market cap" by professionals. There are no exact definitions, but as rough guidelines, the

FIGURE 5-7: LARGE/SMALL CAP STOCK PERFORMANCE

Small cap stocks have done much better than large caps over the very long-term.



Data: Morningstar, Inc.

following values can be used:

Large Cap: $10 billion or more in market cap

Mid Cap: $2 billion to $10 billion

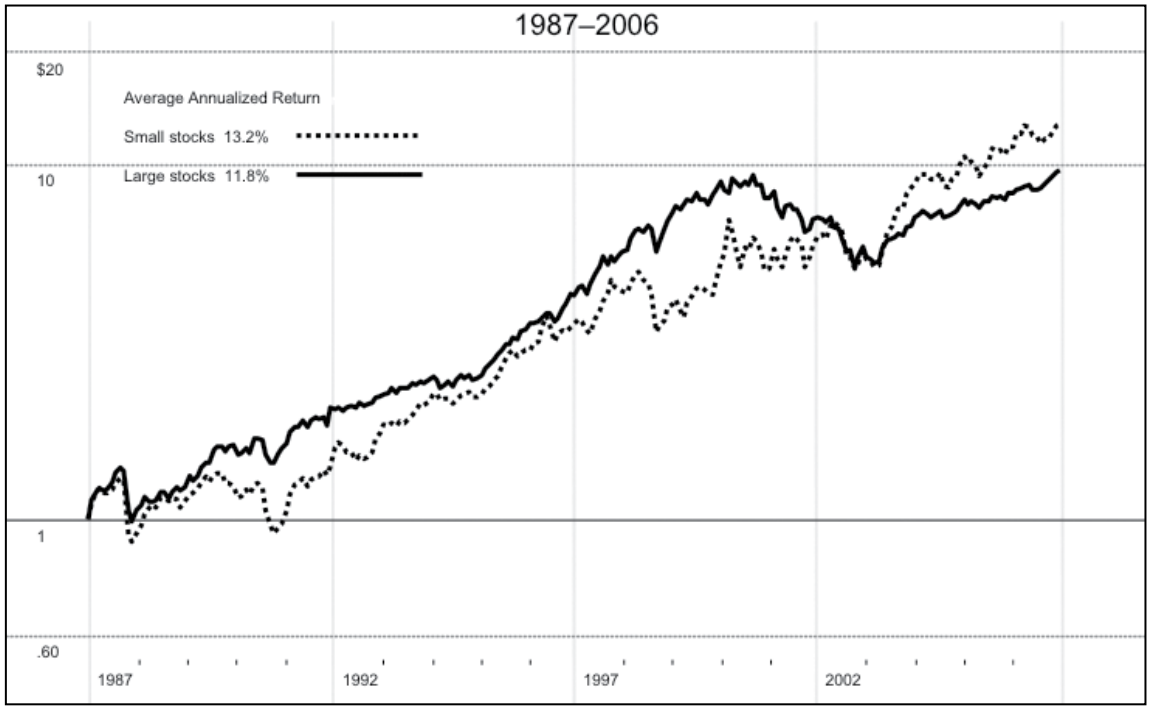
Small Cap: Less than $2 billion

Over time, small cap stocks have enjoyed significantly better performance than large cap stocks. Figure 5-7 illustrates the relative performance of small caps and large caps over the very long-term. The difference in average annualized returns, 2.3 percent, seems small but certainly adds up over eighty-one years. The most important conclusion to draw from this figure is that at varying times one degree of market capitalization will be doing better than another.

It is easier to spot the leadership rotations between the two market caps by looking at a shorter timeframe. The twenty year time period ending in 2006 is shown in Figure 5-8 and we can

FIGURE 5-8: LARGE/SMALL CAP STOCK PERFORMANCE

Leadership tends to rotate between small caps and large caps.



Data: Morningstar, Inc.

clearly see that relative performance varies. Over that shorter timeframe, we see that large caps outperformed over the first fifteen years and small caps outperformed for most of the next five years.

Within the investment universe shown in Table 5-2, we see that all market caps are represented. The Russell 2000 index is a measure of small cap stock performance. This index measures the performance of the smallest 2,000 companies in the Russell 3000 index, which represents the 3,000 largest US companies in terms of market cap. The Russell 1000 includes the largest capitalization stocks within the Russell 3000. Midcaps are also found in the investment universe. The Russell Midcap index includes the bottom 800 stocks in the Russell 1000 index.

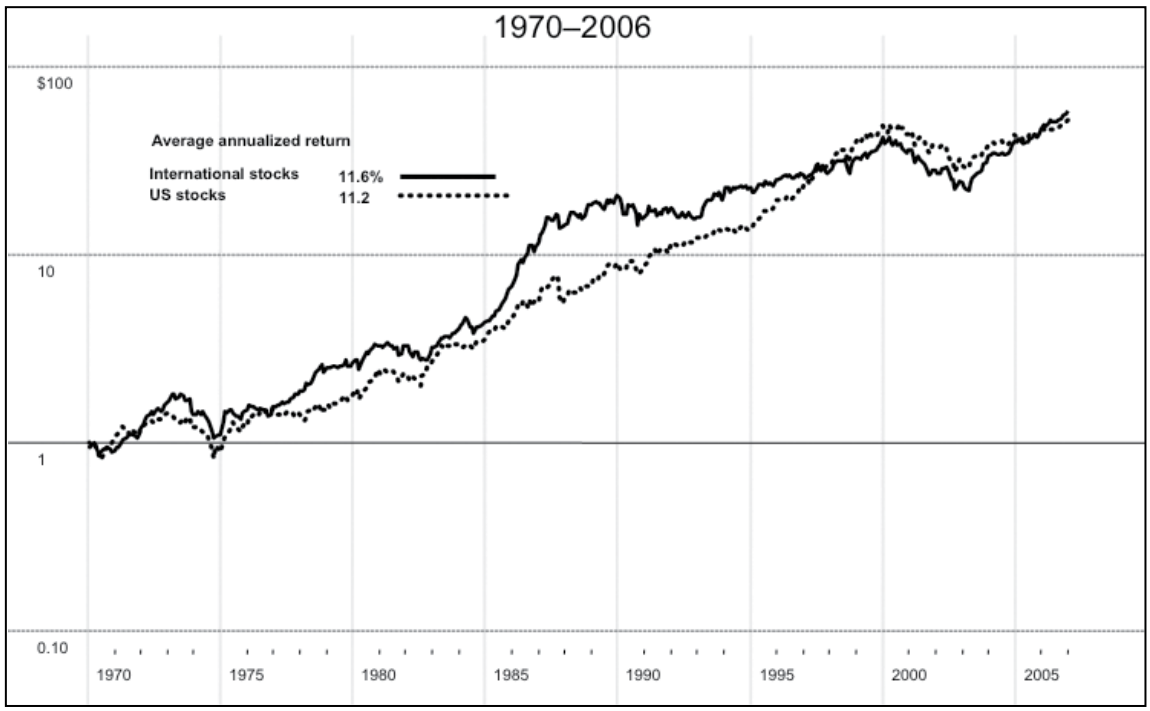
There is obviously some overlap between the Russell 1000 and Russell Midcap indexes. The Midcap index represents only 25 percent of the value of the large cap index. As expected, this index usually provides a degree of performance between the small caps and large caps.

The advantage of including midcap stocks in this investment universe comes from the further division that is available. As can be seen in Table 5-2, all market cap indexes are also further broken down by style. This segmentation between growth and value investment styles seeks to capture the dominant investment psychology of the market. During the bear market that started in 2000, small cap value and mid cap value stocks bottomed in July 2000, and increased at annual rates of 16.5 percent and 13.7 percent respectively through the end of 2003. During this same time, the market was essentially flat, and most stocks suffered significant declines from July 2000 into the ultimate bottom as measured by major stock market indexes in October 2002. By including these capitalization and style ETFs in the investment universe, we are more likely to be able to participate in gains while the broad market averages are suffering declines.

The final element of diversification in this trading strategy comes from the use of the international ETFs identified in Table 5-3. The idea is that there should always be a bull market somewhere in the world. Of course, during a crash, that is not

FIGURE 5-9: US AND INTERNATIONAL STOCKS

Over the long-term, international stocks and US stocks offer similar returns.



Data: Morningstar, Inc.

true. But, in general, emerging markets have different economic fundamentals than the stock markets in more developed nations. Therefore their stock markets should perform differently than the markets in the developed nations. In the end, as shown in Figure 5-9, we find that over the long-term, there is little difference between international markets and the US stock market.

As in all the other figures we've seen in this section, the important thing to observe in Figure 5-9 is that leadership rotates between the various assets, in this case US stocks and international markets. The goal of the RS investor is to profit from the leadership shifts. The ETFs that comprise the international investment component of this investment strategy provide exposure to different countries in all parts of the world. More importantly, they offer exposure to countries with varying degrees of economic development. Just as we saw with market cap, countries with smaller, but fast growing economies are likely to have stocks markets which perform better than larger cap countries.

Combined, the three investment universes we selected to form this overall strategy offer us the best opportunity to achieve profits in any type of market condition.

Risk Management With Stops

Preplaced stop orders are expected to limit the possibility of large losses. As such, they are critical for investors who cannot monitor their portfolios continuously throughout the trading day. In all of these strategies, we employ an initial stop of 5 percent, meaning that immediately after our buy order is completed to enter a trade, we will place an order to sell that entire position if prices decline by at least 5 percent from our purchase price.

We will also use trailing stops designed to lock in profits. The trailing stops are shown in Table 5-4, and were determined by an optimization process. We tested each system for all stop levels between 3 percent and 10 percent. The values in the table represent the best option which maximizes profits.

There are several ways to actually implement the stops. Placing them in advance guarantees that you will follow this disciplined approach to exiting trades. However, some traders prefer to use mental stops, which means they don't actually place the order in advance but monitor the markets and enter their orders at that market price after the stop price has been reached.

The reason for mental stops is that some traders believe that traders on the floor at the exchanges know where all the stops are placed and try to drive prices lower so they can buy their own positions at these levels. While this may have occurred in the past, most trades are now executed through computer systems and it is unlikely that anyone is actually out there looking for our stop levels. The rationale behind mental stops, if it ever existed, has become a victim of technology and mental stops now simply expose investors to a greater degree of risk.

Another way to implement this risk management tool is to use the stop levels on a close-only basis. This method requires the

ETF to close below the stop price, and ignores intra-day low prices when it comes to executing the order. Following this method requires a great deal of discipline on your part. We live in a time when the markets are always open, and investors can usually find some news to bolster their optimism. This means that you can talk yourself out of placing the trade when the strategy calls for it, and that increases the chances that the loss will grow. It is possible that you will be too busy to check prices every day, and missing one day can lead to large losses.

Stop orders should always be placed in the market, for all open positions. This is the single best way to avoid large losses.

An alternative to using a fixed percentage of price for all positions is to base the stop level on volatility which is a unique characteristic of each individual ETF. Volatility-based stops react to changing market conditions and allow room for ETFs to experience normal market corrections without triggering sell orders. One way of setting a volatility-based stop price is to calculate the value using a multiple of the Average True Range.

A stock's range is defined as the difference between its high and low price over any given time period. The range reveals information about how volatile a stock is. Large ranges indicate high volatility and small ranges indicate low volatility. The True Range addresses the problem of measuring ranges on days when a stock opens with a gap, which is a large difference between the previous close and the next open. This indicator accounts for the gap and more accurately measures the daily volatility. True Range is the largest value found by solving the following three equations:

1. **TR = H — L**
2. **TR = H — C.1**
3. **TR = C.1 — L**

where TR represents the True Range
H represents today's high
L represents today's low
C.1 represents yesterday's close

If the market has gapped higher, equation (2) will accurately show the volatility of the day as measured from the high to the previous close. Subtracting the previous close from the day's low, as done in equation (3), will account for days that open with a gap down.

To calculate the TR with a single equation, we can write these three formulas as:

TR = Maximum (H, C.1) – Minimum (L, C.1)

The Average True Range (ATR) is an exponential moving average of the True Range. Traders often use a 14-period ATR. This timeframe works well with RS strategies, although you can use shorter or longer timeframes based upon your personal trading preference. Longer timeframes will be slower to react to changing market conditions and lead to fewer trading signals, while shorter timeframes will increase trading activity.

A common application of stops using ATR is the Chandelier Exit, developed by Chuck LeBeau[30]. The Chandelier Exit places a trailing stop from the highest high that the stock reaches since you entered the trade. The distance between the highest high and the stop level is defined as some multiple times the ATR. As an example, we can place the stop at the highest high since we entered the trade minus three times the value of the Average True Range.

The value of this type of trailing stop is that it rapidly moves upward in response to the market action. LeBeau chose the Chandelier name because, "just as a chandelier hangs down from the

FORMULA 5.1

Stop = HighestClose – (3 * ATR(10))

where Stop represents the price level where the stop order is placed
HighestClose represents the highest closing price since the trade was entered
ATR(10) represents a 10-day exponential moving average of the true range

ceiling of a room, the Chandelier Exit hangs down from the high point or the ceiling of our trade.[31]"

ATRs are in some ways superior to using a fixed percentage because they change based upon the characteristics of the stock being traded, recognizing that volatility varies across issues and market conditions. As the trading range expands or contracts, the stop distance automatically adjusts and moves to an appropriate level to protect profits while allowing the stock to move within its normal range.

At least one study has demonstrated the value of the Chandelier Exit[32]. Dr. Van Tharp set out to answer the question of whether entry rules or exit rules were more important to the profitability of a trading system. To assess the impact of the exit rules, he conducted a series of tests to determine if a completely random entry could be profitable when used with a sound exit strategy. He found that the Chandelier Exit could deliver profitable results even without a rational entry methodology. His exit strategy was to use three ATRs subtracted from the highest close. This test defined ATRs with a ten-day exponential moving average of the True Range. The formula for this stop would be:

The use of protective stops is highly recommended in all trading strategies. While percentage stops serve well, there are more advanced strategies that you can experiment with to increase the profitability of your trading system. The most important thing to remember is that stops on long positions should never be lowered after they are entered because that defeats the purpose of having a stop in place.

Implementing the Strategy

Having fully detailed the theory behind this ETF strategy, we now turn to how to implement the rules. We use Friday's closing prices, Thursday's prices if the markets are closed on Friday. Over the weekend, we download prices for all of the funds listed in Tables 5-1, 5-2, and 5-3. To do this, we use Monocle II analytical software which is affordable for individual investors[33]. With a little more effort, the same results can be duplicated in Microsoft Excel, or another spreadsheet software package. Macros can be created to automatically update the closing prices and run

all required calculations. Other software programs, requiring varying degrees of programming skills, can also be used[34].

After downloading prices and running the required calculations, the next step is to update the equity curve of each portfolio. We also calculate a fifty-week moving average of the equity curve. This is the most important part of our risk reduction strategy, and requires attention each week. If the equity curve is below its fifty-week moving average, we are done with that system for the week. If it's above the moving average, we continue to the next step.

Assuming the equity curve filter is bullish, we look at the top ranked ETFs and our current holdings. This is done for all three systems. We need to make sure that current holdings are all above the required cutoff rank, and if it falls below that value then we sell the ETF we have in the portfolio and replace it with the current top ranked stock.

Current holdings which are not being replaced need to be reviewed to determine where the appropriate stop should be placed. Stop loss levels are calculated by hand after reviewing price charts to determine the highest closing price the fund reached since the time we entered the trade. This step requires multiplying the highest price by the stop percentage, and subtracting that product from the highest price.

If orders need to be placed, we then enter the buys as market orders to be executed at Monday's opening price. Sells dictated by strategy rules are also placed as market orders. Stop loss orders are then placed as stops, to be activated only if the ETF price declines and trades at that level during the next week.

Implementation takes less than thirty minutes per week. Orders are not placed every week, although stops are usually adjusted to reflect the recent market action. During the week, it is best not to even review the portfolio since no action is ever required.

Stocks

The idea of using RS in stocks makes a great deal of sense as we discussed earlier. In the first part of this book, we

highlighted the fact that RS is a part of the Investor's Business daily CAN SLIM method and also a part Value Line's stock selection technique. There are no clear sell rules with CAN SLIM. With Value Line, sell rules are well defined. But, there is a significant problem with implementation. It requires holding all highly rated stocks, and individual investors can not invest in hundreds of stocks at one time. The result is that investors have a valuable guide, but the selection of actual investments can lead to results which are worse than the market averages.

To obtain a manageable list of stocks, fundamental filters can be applied to a group of high RS stocks. This idea was first popularized by James O'Shaughnessy. The difficulty with that approach is that his method still required investors to own fifty stocks, too many for the average individual investor.

Fundamentals as an Additional Screening Factor

In *What Works on Wall Street*, O'Shaughnessy tested more than sixty investment strategies involving various fundamental criteria and relative strength. His conclusion was that almost any fundamental filter beat the stock market as a whole. Fundamental filters include ratios such as the popular PE Ratio. They are values that are found by using the data available in a company's financial reports, which include the balance sheet and income statement. To ensure that these ideas are understood, we will summarize some basic fundamental factors that can be used for investment selection:

- Price-to-earnings (PE) Ratio is defined as a measure of a company's current price per share compared to its earnings per share. It is calculated simply as the stock price divided by the reported earnings per share. For example, if a company is currently trading at $40 a share and earnings per share over the past twelve months were $2.00, the PE Ratio for the stock would be 20.

  The earnings used in the calculation are usually what the company reported for the last four quarters. But, they can also be taken from estimates of earnings expected in the next four quarters. Using estimates often results in an optimistic valuation of the stock and earnings estimates are frequently

subject to revision. In testing, it is best to use historical certainties rather than future projections.

Recent history has shown that historical earnings are also frequently subjected to revisions. Enron is a famous example of a company that manufactured nothing but earnings. When the accountants finally discovered the problems, the company went into bankruptcy and the stock price went to zero. Enron demonstrated to investors that no matter how earnings are calculated, there is always some doubt as to whether or not they will undergo some revision in the future. This makes the PE Ratio a good tool to use, but far from perfect.

In general, a high PE Ratio suggests that investors are expecting larger gains in future earnings growth when compared to companies with a lower PE Ratio. Value investors prefer the safety that comes with low PE stocks.

- Price-to-book (PB) Ratio compares a stock's market value to its book value. The term 'book value' refers to the total amount that all of a company's assets are worth, which is in theory, the amount that shareholders would receive if the company were sold off, piece by piece. The PB Ratio is calculated by dividing the stock's current closing price by the book value per share, as reported in its most recent quarterly report.

  A lower PB Ratio could signal to investors that the stock is undervalued in the market. However, it might also mean that something is fundamentally wrong with the company since a company that is only weeks away from bankruptcy will likely have a low PB Ratio. Using this ratio, just like the PE Ratio, offers a good, although imperfect, guide to the fundamental value of a stock.

- Price-to-sales (PS) Ratio divides the stock price by a company's revenue per share. Like the other ratios, this one divides the stock's price by a fundamental item that all companies report in required Security and Exchange Commission filings. Sales represent the total revenue generated by the company. In all sales, an outside party, the customer, is buying something that the company provides. These transactions are easily verified by auditors, and for

that reason, many analysts feel that the PS Ratio is the most difficult valuation ratio for company management to manipulate.

Given that there are multiple ways to define value, and that all are subject to revision and some degree of doubt, an objective analysis is needed to determine if one fundamental ratio works better than the others. O'Shaughnessy tested each of these filters with and without relative strength. His test period began with data from 1954 and ran through 1994. For this test, the portfolio consisted of the top fifty stocks determined by the criteria and was revised annually. He found that the PS Ratio offered the best results. A summary of his test results is shown in Table 5-5.

TABLE 5-5

Strategy	Average Annualized Return without Relative Strength	Average Annualized Return with Relative Strength
Low PE Ratio	11.18%	16.66%
Low PB Ratio	14.38%	17.27%
Low PS Ratio	15.42%	18.14%

These results again demonstrate the value of using relative strength as an investing tool.

The results that O'Shaughnessy obtained demonstrate the importance of testing market wisdom. The PE Ratio is the most widely followed fundamental measure of a stock's value, and is frequently mentioned by commentators when they discuss a stock. Of the three ratios tested, it delivered the worst performance. The returns obtained from using only the PE Ratio to make investment decisions actually trailed the market, which averaged a return of 12.45 percent during the test period. The PB Ratio and PS Ratio portfolios significantly outperformed the market.

Relative strength, in these tests, was defined by calculating a one-year rate of change. In another test, O'Shaughnessy found that using only this definition of RS to select stocks also beat the market. The fifty stocks with the highest rate of change were held in a portfolio which was reviewed annually. This portfolio delivered an average annual return of 14.03 percent. While superior

to the market return, Table 5-5 shows that combining RS with fundamental filters offers even better results. Buying the strongest stocks with the best valuation ratios clearly beat the market.

Fundamentals Lower Risk

In his work, O'Shaughnessy also looked at the risk an investor faced to obtain the returns. He found that the high RS strategy beat the market, but did so with greater risk. The strategies that combined strong fundamentals with high RS beat the market while reducing risk — a combination that most investors seek. The difficulty with obtaining results by applying O'Shaughnessy's methodology is that his tests held fifty stocks at any given time, too many for the average individual investor.

Charles D. Kirkpatrick, II, CMT, distilled this work into a method that could be implemented by individual investors. Kirkpatrick had managed stocks since the early 1980s using a technique that combined RS with strong earnings growth. He was looking at methods to reduce risk when he read O'Shaughnessy's book. Combing that work with his own, Kirkptarick came up with a simple screen to identify stocks with strong potential, which we summarize in Table 5-6. This level of openness is rare in the investment business, where stock selection methods are rarely fully disclosed to the public.

TABLE 5-6

Relative Strength > 90
Relative EPS Growth > 90
Relative PS Ratio < 30
Market Cap > $500 Million
Price > $5
Stocks meeting all of these tests are bought.

Kirkpatrick immediately implemented this strategy and to prove its effectiveness, his results were reported in real-time rather than being obtained through backtesting. They are shown, as he reported them, in Table 5-7.

Performance of Stock Selection Lists as Reported by Kirkpatrick's Market Strategist

TABLE 5-7: PERFORMANCE OF STOCK SELECTION LISTS AS REPORTED BY KIRKPATRICK'S MARKET STRATEGIST

	S&P 500	Kirkpatrick's Portfolio
1999	19.1%	59.8%
2000	-9.8%	48.5%
2001	-12.1%	33.9%
2002	-24.6%	-18.3%
2003	25.2%	58.9%
2004	10.6%	27.1%
2005	3.0%	20.1%
2006	13.6%	25.4%
2007	4.2%	25.3%

These results were reported on a weekly basis and could have been duplicated by an individual investor.

The returns shown are astounding, and the method is simple. Usually there are only fifteen to twenty stocks that meet the investment criteria and are held in the portfolio at any given time. Assuming a $1,000 investment in each stock, individual investors with as little as $20,000 can follow this strategy and it is worth looking at each item from Table 5-6 in more detail. In order to appear on the buy list, a stock must meet all of the criteria listed.

- Relative Strength > 90: Kirkpatrick defines RS using the Price to Moving Average Ratio method as described by Formula 2.7. He divides the weekly closing price by a twenty-six week moving average of the price. This calculation is completed for all stocks in his database, and the results are then sorted into percentiles. To pass this test, the stock must show an RS rank that is at the ninetieth percentile or higher.
- Relative EPS Growth > 90: The percentage change in earnings per share is calculated for each stock, and these are then sorted into percentiles. Only stocks with earnings per share growth in the top ten percent are considered to be potential buys.

- Relative PS Ratio < 30: In this step, Kirkpatrick calculates the PS Ratio of each stock in his investment universe and then rank orders the ratios into percentiles. He is looking to buy only those stocks which have a PS Ratio in the bottom thirty percent.
- Market Cap > $500 million & Price > $5 per share: These filters prevent speculative penny stocks from being bought and ensures that any stock in the portfolio is an investment that institutional investors would be able to hold.

One problem that value investors face is that a cheap stock can get cheaper. Sometimes a stock has low fundamental ratios because it is in a declining industry with dim prospects for growth in the future. At other times, a stock has a low valuation because it is in a cyclical industry and is experiencing a regular downturn in business, but activity will pick up as the business cycle turns. The screen developed by Kirkpatrick is able to differentiate between the low valuations the stock market assigns to both a company heading for bankruptcy and a company with improving business prospects. Only a company with bright prospects will have high relative strength measured over a six-month period. By adding RS to the investment selection process, the value trap of buying stocks headed lower is avoided.

Relative strength investors also face problems. One difficulty encountered is that the market can become irrational and prices will rise solely because of investor's emotions, and the winners in this type of market environment will be identified by high RS rankings. Thinking back to the Internet bubble, this problem affected a large number of stocks which soared to stratospheric levels and then declined as quickly as they rose. Table 5-7 shows that Kirkpatrick's model easily sidestepped the problems of that time and performed very well as the Internet bubble unwound.

The fundamental filters he used identified bubble stocks and rejected them from the portfolio. Many of those stocks had no earnings at all, which means they failed the EPS growth screen. But some would see earning grow from one cent per share to three or four cents per share, demonstrating a high percentage growth, and placing them at the top of the EPS growth rankings. This demonstrates the

importance of the Relative PS Ratio filter. By requiring that the stocks have strong fundamentals with a low PS Ratio, high fliers likely to suffer severe declines are eliminated as potential buys.

Stocks with low Relative PS Ratios represent companies with revenue, and are more likely to have well defined business strategies than startup companies taking advantage of easily accessible venture capital to develop an operating company. This ratio was largely responsible for the great returns achieved in 1999 and 2000 as the Internet bubble popped and inflicted a great deal of harm on the portfolio of the average investor.

The sell rules for this strategy rely only on the EPS growth rate and the RS ranking. Whenever these factors decline below a cutoff level, the stock is sold. The specific criteria Kirkpatrick defined in his work are to sell when RS falls below 30 or the EPS rank falls below 50. Whenever either of these events occurs, the market is telling you that something has changed for the worse in the company and the stock is unlikely to recover any time soon. By setting these cutoff levels so low, Kirkpatrick is trying to ensure that he will hold the winning stocks long enough to enjoy large gains without being shaken out during normal market reactions.

While fundamental ratios are a good tool for identifying stocks to buy, they are not suitable for timing the sell decision. A stock can easily become overvalued according to the fundamental ratios, and stay that way for an extended period of time. This may happen because the company starts growing revenue and earnings at a rate significantly faster than the market and the stocks of these companies are usually rewarded with high valuation ratios. Basing a sell decision on an arbitrary valuation level means that you risk selling while the stock is still trending higher. Therefore, it is better to rely on other factors, such as price to determine the timing of your sell decision.

Each week, Kirkpatrick runs this stock screen. If a new stock passes all of the tests, it is added to the portfolio and bought at the open on the following Monday. If one of the current holdings falls below the sell criteria, it is sold at Monday's open. Orders can be placed over the weekend, and no further monitoring of this system is required during the week.

Kirkpatrick's investment method is not perfect. It suffered a significant drop as the bear market reached its bottom in 2002. However, the next year it more than doubled the market's return and significantly outperformed the market as stocks rebounded over the next four years. This simple strategy illustrates the wisdom of combining relative strength with strong fundamentals to find top performing stocks.[35]

Managing Your Retirement Plan

Many employers offer retirement plans as a part of their total employee compensation package. Many self-employed also maintain retirement plans because of the tax benefits and because they are a valuable part of an individual's overall financial planning. Traditional pension plans paid employees a percentage of their pay after their retirement. More recently, rising costs forced employers to shift the burden of funding retirement to employees, resulting in defined contribution plans.

Under a defined contribution plan, employees contribute a portion of their total pay into an individual account. Often the employer matches part of the contribution. The total contributions are invested, usually in the stock market, and the returns on the investment, which ultimately may be positive or negative, are credited to the individual's account. Upon retirement, the balance in this account is used to provide retirement income.

Examples of defined contribution plans include 401(k) plans available to employees of large and small companies and various forms of Individual Retirement Accounts (IRAs) which are available to some employees and all self-employed. No matter what type of plan is available to an individual, the employee or self-employed person is responsible for determining the investment allocation of the money in the retirement plan. This may range from choosing one of a small number of mutual funds selected by the employer to selecting individual stocks or other securities.

Most self-directed retirement plans include tax advantages. In exchange for these tax benefits, the government places strict limits on withdrawals from retirement accounts before you reach a certain age. This means that retirement accounts are truly long-term

investments and should be managed as such. Long-term management makes these accounts the perfect vehicle to apply a relative strength strategy to, seeking market-beating gains while being able to accept a great deal of risk. The risk reduction strategies discussed earlier should still be used because they will increase the gains.

In this section, we will develop a strategy to manage a typical retirement plan offered by an employer. This could easily be duplicated by someone who is self-employed since the self-employed have access to a nearly unlimited range of options when managing their retirement plans. We will assume that the employer offers a typical range of investment options, which usually includes about a dozen different mutual funds. The options available under a hypothetical, representative plan are shown in Table 5-8.

TABLE 5-8

Name	Symbol
Vanguard 500 Index	VFINX
Vanguard Small Cap Index	NAESX
Vanguard Total International Stock Index	VGTSX
Vanguard Emerging Markets Stock Index	VEIEX
Vanguard Wellington	VWELX
Vanguard Life Strategy Income Fund	VASIX
Vanguard Life Strategy Conservative Growth	VSCGX
Vanguard Life Strategy Moderate Growth	VSMGX
Vanguard Life Strategy Growth	VASGX
Vanguard Short Term Treasury	VFISX
Vanguard Intermediate US Treasury	VFITX
Vanguard Long-Term US Treasury	VUSTX

Retirement plan options usually include a diverse selection of stock and bond mutual funds.

The funds in that table include a selection of index funds, exposure to international stocks, an actively managed mutual fund, targeted funds of varying levels of aggressiveness, and bond funds with different maturities. With only twelve funds, the plan offers broad exposure to different investments and allows all investors, from very conservative to very aggressive, an opportunity to match their investment style. The list also offers rule-based, system traders enough selection to achieve market beating returns.

As a first step towards actively managing this account, we will test a simple system. The easiest calculation technique we defined was the simple rate of change. We will calculate the twenty-six week percentage price change for each of the twelve funds on a weekly basis and invest all of the money in the account in the fund with the greatest change. That fund will be held while it is among the top three strongest funds, and sold when it falls to ranking number four or below. At that time, an order will be placed to buy the fund with the greatest percentage change in price. All other test parameters are the same ones we used in Section 3 of this book.

The results from this simple strategy easily beat the market. We show an average annualized return of 12.54 percent compared to a return of 8.70 percent for the S&P 500 over the same timeframe. On average, there were eleven trades per year, about one per month. The maximum drawdown of 25.66 percent was nearly half of the worst loss experienced by the broad market indexes over that timeframe. This strategy, which would require less than thirty minutes a week and spreadsheet software to implement, would beat the returns of many market professionals with less risk.

With the returns from the rate of change RS strategy, a thirty year old making $40,000 per year and contributing three percent of their income a year with an employer match could retire at age sixty-five with an account worth almost $1.5 million. A coworker who simply invested in an index fund mimicking the S&P 500 would retire with about $655,000. Either employee would be happy with the performance of their account, but the RS investor would have more than doubled their money as a result of dedicating thirty minutes a week towards managing their retirement account. Over thirty-five years, that increased rate of return values the investor’s time at more than $700 per hour.

Using the same retirement plan options, an optimized strategy could easily be developed. Optimization of the trading strategy follows the same series of steps outlined in Section 3. We begin by identifying the best way to define relative strength and find that the alpha divided by standard deviation formulation delivered the best returns. The second step is to optimize each variable in the equation. This requires a total of 1,344 tests. We arrive

at a twenty-two week period for alpha and we invest in only one fund at any given time. A cutoff rank of three defines the level when we sell each holding. An initial stop loss of 9 percent and a trailing stop of 11 percent from the highest price reached in the trade deliver the best risk adjusted return.

Employing the optimized parameters in the trading system offers an annualized average return of 16.14 percent with a maximum drawdown of 17.04 percent. Testing for the stability of parameters as was done earlier demonstrated that this is a reliable system. You should be aware that the twelve funds listed in table 5-7 were selected completely at random, and the test results presented are not based upon a well-selected universe derived from exhaustive testing of a variety of possible combinations. These tests were done to demonstrate that superior results can be obtained with any diverse selection of funds.

Using alpha divided by standard deviation will require more effort to begin implementing the trading strategy. However it can still be done in Microsoft Excel or any other spreadsheet software. It will require you to collect weekly closing prices for the S&P 500 in addition to the funds that you will be trading. Then you will calculate the y-intercept value of each fund against the market average. This is the method of calculating alpha shown in Table 3-4. The highest calculated intercept value is used to identify the fund to buy. Once the spreadsheet is set up, maintenance should take about the same amount of time as the simpler rate of change calculations to process each week.

The difference in results is well worth the added effort. With this rate of return, the hypothetical worker would retire with an account worth more than $3.3 million.

Applying Relative Strength to Futures

Futures are highly leveraged investments on such things as physical commodities like corn, oil, or gold; or financial instruments like stock indexes or Treasury bonds. Futures exchanges define contract terms allowing the commodity or financial instrument to be traded with dates when the contracts expire. At expiration,

or before that time, buyers and sellers of futures contracts can take profits or losses, depending on whether or not the market has moved in their favor. A complete description of futures is beyond the scope of this book, but any investor considering an investment in futures should carefully study the market prior to investing.

Leverage means that investors, or more accurately speculators, trade in these markets with only a fraction of the amount of money required to actually deliver according to the contract terms. It is not uncommon to trade futures with as little as five to ten percent of the required funds being posted as margin. It is the high degree of leverage which makes futures attractive to some investors since they can amass great fortunes on small investments by correctly forecasting market movements. The high degree of leverage is also responsible for scaring many investors away from the futures markets since an entire investment can be lost on a relatively small price move.

In theory, relative strength strategies should work well with futures. But, the nature of the markets requires some modifications to the strategy. While futures markets exhibit periods of long trends, the high degree of leverage means that stops must be placed fairly close to the price where the trade was entered to guard against large losses. Risk management strategies are critical to the success of futures traders, and differ from the strategies we outlined in earlier sections which can be applied to stocks, ETFs and mutual funds.

Given these fundamental differences in the markets, it should not be surprising that relative strength must be thought of differently when applied to futures. Before discussing how the strategy can be applied, we need to define a few more terms unique to futures markets.

Futures contracts trade with fixed expiration dates. At any given time, there are several months worth of contracts trading, for example it may be possible to buy a contract on oil speculating on what the price will be in March, June, September or December. There will be price data available on each of these four contract months.

There are a number of factors that ultimately determine the price of each contract month. One of these is known as the "cost of carry," which is defined as the total cost of holding a particular amount of a physical commodity or financial instrument. The cost of carry includes the amount of money used to buy and hold the asset which underlies the futures contract, and can include costs for storage as in the case of corn or pork bellies, or the cost of borrowing the money, as in the case of Treasury bonds. These costs are priced into a futures contract.

Generally, the longer you hold something, the more it costs to hold it. Looking at corn as an example, if I expect to hold it for three months, I'll need to rent a storage facility for three months, and pay to insure the crop against losses for that same time. If I expect to hold it for six months, I should expect to spend twice as much money for storage and insurance. This means that futures contracts will usually cost more for later months than earlier months. If it is January and I am looking at contracts expiring in March, June, September and December, the March contract should be the least expensive and the December contract the most expensive.

Under normal conditions, when contracts expiring in the more distant months are progressively higher priced relative to the earliest month, the market is said to be in contango. Conversely, if the later months are priced lower than the earlier months, the market is said to be in backwardation.

To measure relative strength in the futures markets, we look at the degree of backwardation and contago. For futures, backwardation indicates high momentum because it means buyers are chasing the most liquid contract, which is the one closest to expiration. When the market is backwardated, more distant contracts are selling for less than near term contracts, and the market has gotten ahead of itself in the short-term. The markets are likely to return to normal conditions, and eventually, the long-term contracts will be more expensive than the short-term contracts.

A study has shown that applying this idea can lead to profits in the futures market across a broadly diversified portfolio.[36]

This study tested a long–short portfolio that buys backwardated contracts and sells contangoed contracts. It also found that there was a low correlation between these futures strategies and the returns of traditional asset classes. This makes the commodity-based relative strength strategy an excellent candidate to include in a well diversified portfolio as a tool to reduce volatility of the overall equity curve. However, drawdowns in futures trading can be very deep, and before using this strategy you need to fully test the idea.

Futures carry an extremely high degree of risk and the truth is that they are not suitable for most investors. However, the great potential returns possible by correctly identifying market trends often proves to be too much for many investors to resist and they are lured into what is nearly certain to be a loser's game. While we are not advocating that you invest in futures, the fact that relative strength strategies can be successfully applied to this investment should increase your confidence level that the underlying logic supporting relative strength is sound.

There is a safer way for investors to participate in the potential gains without the exposure to unlimited risk normally associated with futures trading. A new investment, Exchange Traded Notes (ETN), have been introduced in recent years. The first ETN began trading in 2006. These instruments are similar to ETFs in that they trade on stock exchanges and are easily bought and sold. They tare structured as bonds for tax purposes and ETNs offer exposure to commodities, currencies, and other financial indexes. They carry the same degree of risk that any stock investment would carry, with the downside limited to the purchase price. This makes ETNs appealing to conservative investors wanting exposure to asset classes previously available only to futures traders.

ETNs can be added to the ETFs listed in Table 5-2 which invested in the strongest asset class. This will allow you to obtain limited exposure to futures contracts when they are the best performing asset classes, with the same degree of risk found in any ETF strategy. As more of these products based upon commodities and financial futures are introduced, it will be possible to develop a complete strategy using only this investment tool.

As financial markets continue to evolve, relative strength investors need to continually monitor the markets and develop new strategies to take advantage of these innovations.

Conclusion

Can you beat the market with relative strength strategies? Yes, if you willing to dedicate the time and effort required to implement the ideas discussed in this book. We demonstrated strategies that nearly double the market return while reducing the market risk by half. To earn gains like this, you must be disciplined and follow the rules in good times and bad.

Professionals have known about the importance of relative strength for decades. The problem many individual investors faced was that developing a strategy to use relative more time than they had available in their busy lives. The principles of applying of relative strength were never explained in popular investment books in a way that individuals could duplicate.

This book changes that. We presented the techniques in sufficient detail that anyone can follow them. We also explained exactly how to design your own trading system, and we showed that the results of the simplest system can be followed using spreadsheet software.

Individual investors can beat the professionals, and we hope that you will use the tools we presented to do that.

Appendix

Relative strength is surprisingly well supported by numerous academic studies. This body of research spans more than sixty years. This appendix provides a comprehensive listing of studies conducted into relative strength. In academic research, relative strength is usually referred to as momentum. Practitioners differentiate between the two, but in these papers, the terms are synonymous.

The author's abstracts from each work, except the first one, are provided so that the reader can learn something about the study and determine if it would be useful to them in their own work. A synopsis follows the abstract, attempting to highlight the key finding of each paper. While no bibliography can be guaranteed to be comprehensive, every effort has been made to ensure the completeness of this listing. Works are arranged chronologically, by publication date.

Gartley, H. M. (1995). "Relative Velocity Statistics: Their Application in Portfolio Analysis." *Financial Analysts Journal*, 51 (1), 18-20

Abstract: In addition to the usual valuation methods applied to a stock, analysts should consider its velocity. The velocity statistic is a technical factor in the stock's price volatility that measures the percentage rise and fall of a stock price against an average—preferably the industry group. The measure is reliable for certain groups of stocks, so the analyst needs to know the stock's velocity record. Portfolio velocity also can be measured, and surprising results may be obtained by measuring

the percentage of market value of a stock (weighted to reflect its velocity) relative to the whole portfolio (weighted to reflect its velocity. Analysts must keep in mind the limitations of the velocity measure, however, in projecting the future.

Synopsis: This is a reprint of the original article from 1945 which appears to be the earliest Journal article that defines a method for calculating RS. Gartley compares the performance of an individual average to a broader index to find the relative leaders and laggards within different industries. Recognizing that individual stocks respond differently to bull and bear markets, Gartley advocated two sets of velocity statistics, on for each type of market environment. In many ways, Gartley's approach is similar to beta which would be defined in the 1960's. Calculating separate values for bull and bear markets is more sophisticated than beta, which compares a stock's performance to the overall market for a prescribed period of time.

Levy, Robert A. (1967. "Relative Strength as a Criterion for Investment Selection." *Journal of Finance*, 22 (4, 596-610.

Abstract: None.

Synopsis: Levy tested RS portfolios using closing price compared to the stock's twenty-six week moving average, the close compared to the close twenty-six weeks ago, and the close compared to the closing price of four weeks ago. Levy performed these calculations on 200 stocks, and ranked them. After calculating RS, he built portfolios of twenty stocks, using the top twenty for one portfolio, etc., and measured subsequent gains over the next four weeks and the next twenty-six weeks. He found that the twenty-six week average worked best, and found that holding stocks for twenty-six weeks maximized returns in his tests.

Levy, Robert A. (1971), "Stationarity of Beta Coefficient." *Financial Analysts Journal*, 27 (6, 55.

Abstract: "For the usual type investor who is diversified across securities, the important risk is that due to stock market fluctuations. A measure of stock market risk with wide acceptance among academicians is the so-called beta-coefficient. The author

finds that, for portfolios holding the same 25 or more stocks over two successive intervals of 26 weeks or longer, the actual beta value of the first interval provides an excellent estimate of the beta value in the second interval, even when the two intervals span an important stock market reversal. Evidence indicates that this risk measure is remarkably stationary for large portfolios, less stationary for smaller ones and unpredictable for individual securities. Predictability improves as forecast period lengthens. Given constraints, managers adept at stock market timing can rely on persistence of volatility for stock selection."

Synopsis: In this paper, Levy finds that beta works well over a six-month lookback period. As he moves out in time, he finds it retains effectiveness over a year as well. His findings about portfolio size support the assumption that stock returns are normally distributed. This means that for any single stock, it is difficult to define the expected returns. But as the number of stocks in the portfolio increases, you can predict with confidence that the portfolio will mirror the performance of the market. With portfolios of more than 25 stocks, he concluded that market risk is virtually eliminated and the portfolio should very closely track market returns.

Levy, Robert A. (1974). "Beta as a Predictor of Return." *Financial Analysts Journal*, 30 (1), 61.

Abstract: "Beta is a measure of stock price volatility - that is, the sensitivity of each stock's price to changes in the market. Beta represents the percentage performance of the stock which has historically accompanies a one percent move in the market. In statistical terms, beta may be defined as the turns (s) on the market's subperiod returns (m). Alternatively, it is the covariance of s & m divided by the variance of m. Capital market theorists have conjectured that returns and betas will be positively correlated during bull markets and negatively correlated during bear markets. All the bear markets since World War Two support this conjecture - however the evidence is statistically significant for only one out of three bull markets. It may be that betas should be computed separately for up-markets and for down-markets. Bull market returns might be then better forecast by prior bull-market betas and bear market returns by

bear-market betas."

Synopsis: Contradicting the findings he published in 1971, Levy finds that over long periods beta is not a stable predictor of future returns. He concludes that it might be better to consider the market conditions when calculating beta, and separately calculate beta for bull markets and bear markets. Although not referenced, this is the idea behind Gartley's velocity statistics, proposed nearly thirty years earlier.

Greene, Myron T. and Fielitz, Bruce D. (1979). "The Effect of Long Term Dependence on Risk-Return Models of Common Stocks." *Operations Research*, 27 (5) 944.

Abstract: "It has already been demonstrated that common stock returns are characterized by a phenomenon known as long term dependence. The implications of the presence of this phenomenon are addressed for existing risk-return model in the field of finance. It is demonstrated that: 1. risk rankings of stocks or portfolios tend to vary with the differencing interval selected to measure security returns, 2. efficient portfolios vary with the differencing interval selected, and 3. in order for the model to hold, the unrealistic, homogeneous time horizon assumption of the capital asset pricing model must be retained. Given these limitations, the usefulness of the capital asset pricing model in making investment decisions must be questioned, and the evaluation of money managers on the basis of performance statistics derived from that model also does not appear to be valid."

Synopsis: Long-term dependence is the way mathematicians would describe a price trend in the stock market. Differencing intervals would be the lookback period used in calculating an indicator, in this case RS. The authors find that trends exist and that future performance of the trend is related to how it is measured (mean reversion plays some role over the short-term and the very long-term). They use these findings to question the capital asset pricing model, which is derived from the Efficient Market Hypothesis.

Huberman, Gur and Kandel, Shmuel (1987). "Value Line Rank and Firm Size." *The Journal of Business*, 60 (4), 577-589.

Abstract: “The relation between the Value Line Investment Survey’s successful record in predicting relative stock price movements and the firm size effect is studied. First, the pertinent regularities associated with firm size and with the Value Line ranking system are reviewed, noting the similarities between the two and demonstrating how ubiquitous the size effect is. The two primary data sources are Value Line’s weekly recommendations for the 469 weeks between July 9, 1976, and June 28, 1985, and the daily returns of the stocks for the period July 9, 1976-December 30, 1983. The data reveal little direct relation between Value Line’s record in predicting stock price movements and the firm size effect. Value Line tends not to rank small firm stocks, and the small firm stocks that are ranked are more likely to receive a low rank than large firm stocks. In addition, within each size-sorted quintile of the market, the mean payoffs on costless positions created according to Value Line’s recommendations are positive.”

Synopsis: The authors accept the validity of RS investing, in particular the Value Line Timeliness Ranking. They seek to explain the success of the system as being related to the total stock market capitalization of the stock. Academic research shows that small cap stocks tend to outperform large cap stocks, and they were looking for this in their study. They expected to find that the Value Line methodology assigned the best scores for timeliness to the smallest stocks in the Value Line universe. They found that this was not the case. They also found that when they sorted the universe into different groups based upon market capitalization, the highest rated stocks in each group showed the best future performance. The end result is a paper strongly supporting the idea of RS.

Bremer, Marc and Sweeney, Richard J. (1991). “The Reversal of Large Stock-Price Decreases.” *The Journal of Finance*, 46 (2), 747-754.

Abstract: “Data on the stock returns of Fortune 500 firms during the 1962-1986 period indicates a substantial reversal following large stock price declines. The analysis indicates that extremely large negative 10-day rates of return are followed, on average, by larger-than-expected positive rates of return over the following days. This price adjustment lasts approximately 2

days and is observed in a sample of firms that is largely devoid of methodological problems that might explain the stock price reversal phenomenon. The major interest of this phenomenon is the long recovery period of the stock price reversal; such a slow recovery is inconsistent with the notion that market prices fully and quickly reflect relevant information."

Synopsis: While not directly addressing the ideas of RS investing, Bremer and Sweeney provide detailed proof that trends exist in the stock market. RS investment strategies require trends in order to profit.

Jegadeesh, Narasimhan and Titman, Sheridan (1993. "Returns to buying winners and selling losers: Implications for stock market efficiency." *The Journal of Finance*, 48 (1), 65 — 92.

Abstract: "It is shown that trading strategies that buy past winners and sell past losers realize significant abnormal returns over the period 1965-1989. For example, for the strategy examined in most detail, which selects stocks based on their past six month returns and holds them for six months, realizes a compounded excess return of 12.01% per year average. Additional evidence indicates that the profitability of the relative strength strategies are not due to their systematic risk. The results also indicate that the relative strength profits cannot be attributed to lead-lag effects that result from delayed stock price reactions to common factors. The evidence is consistent with delayed price reaction to firm-specific inflation. Part of the abnormal returns generated in the first year after portfolio formation dissipates in the following 2 years. A similar pattern of returns around the earnings announcements of past winners and losers is also documented."

Synopsis: In this important study, Jegadeesh and Titman find that a six month lookback period optimizes returns. This validates the work done by Levy in his initial studies on the subject. One difference in the study is in the sell rules. Levy sold based upon a loss of RS whereas Jegadeesh and Titman sold after a predefined holding period. Both studies demonstrate the value of buying based upon RS. Traders would not hold a stock for a set time period, which means that the returns reported in this study can be

improved upon with trade management rules.

Dreman, David N. and Berry, Michael A. (1995). "Overreaction, underreaction, and the low-p/e effect." *Financial Analysts Journal*, 51 (4), 21-30.

Abstract: "Although earnings surprises have been studied extensively, they have not been examined in the context of contrarian strategies. Positive and negative earnings surprises affect "best" and "worst" stocks in an asymmetric manner that favors worst stocks. Long-term reversion to the mean, in which worst stocks display above-market returns while best stocks show below-market results, regardless of the sign of the surprise, continues for at least 19 quarters following the news. These results are consistent with mispricing prior to the surprise, and a corrective price movement after the surprise is consistent with extant research on underreaction. The mispricing-correction hypothesis explains the superior returns of contrarian strategies noted here and elsewhere in the literature."

Synopsis: Dreman and Barry use earnings surprise as a fundamental screening criterion. On Wall Street, analysts publish estimates of a stock's future earnings. When the company announces its earnings, if they differ from the estimate, the Street calls this an "earnings surprise." Failing to meet the estimate is a negative surprise, and posting earnings which exceed the estimate is a positive surprise. The authors found that an earnings surprise, whether it was positive or negative, impacted the stock's performance over the next 19 quarters. This works best for a stock which is trading near its lowest price of the year and announces a positive earnings surprise. These stocks tend to do very well in the future. This work was confirmed, in a general way, by the work of Clifford S. Asness several years later. The weakest stocks, those with low RS, often have low fundamental valuations because investors have low expectations for the future performance of the company.

Chan, Louis K C, Jegadeesh, Narasimhan, and Lakonishok, Josef (1996). "Momentum strategies." *The Journal of Finance*, 51 (5), 1681-1713.

Abstract: “A study examines whether the predictability of future stock returns from past returns is due to the market’s underreaction to information, in particular to past earnings news. Past return and past earnings surprise each predict large drifts in future returns after controlling for the other. Market risk, size, and book-to-market effects do not explain the drifts. There is little evidence of subsequent reversals in the returns of stocks with high price and earnings momentum. Security analysts’ forecasts also respond sluggishly to past news, especially in the case of stocks with the worst past performance. The results suggest a market that responds only gradually to new information.”

Synopsis: Finding that the “market responds only gradually to new information” means that RS will work because performance persists over time. Strong stocks will remain strong for some time into the future and weak stocks will remain weak for a time.

Carhart, Mark M (1997. “On persistence in mutual fund performance.” *The Journal of Finance*, 52 (1, 57-82.

Abstract: “Using a sample free of survivor bias, it is demonstrated that common factors in stock returns and investment expenses almost completely explain persistence in equity mutual funds’ mean and risk adjusted-returns. Hendricks, Patel and Zeckhauser’s (1993 “hot hands” result is mostly driven by the one-year momentum effect of Jegadeesh and Titman (1993), but individual funds do not mean higher returns from following the momentum strategy in stocks. The only significant persistence not explained is concentrated in strong underperformance by the worst-return mutual funds. The results do not support the existence of skilled or informal mutual fund portfolio managers.”

Synopsis: The authors applied the idea of RS to mutual funds, looking at whether or not the performance of a mutual fund manager can be explained by the idea of RS. They conclude it cannot and that mutual fund managers bring unique skills to their work.

Asness, Clifford S. (1997). “The interaction of value and momentum strategies.” *Financial Analysts Journal*, 53 (2), 29-36.

Abstract: “Value and momentum strategies both have demonstrated

power to predict the cross-section of stock returns, but it is questioned whether these strategies are related. Measures of momentum and value are negatively correlated across stocks, yet each is positively related to the cross-section of average stock returns. A study examines whether the marginal power of value or momentum differs depending upon the level of the other variable. Value strategies work, in general, but are strongest among low-momentum stocks and weakest among high-momentum stocks. The momentum strategy works, in general, but is particularly strong among low-value stocks. These results hold despite finding comparable spreads in value measures among stocks with different levels of momentum and comparable spreads in the momentum measure among stocks with different levels of value."

Synopsis: This study provides academic support for the findings of James P. O'Shaughnessy in his 1998 book, W*hat Works on Wall Street: A Guide to the Best-Performing Investment Strategies of All Time*, and Charles Kirkpatrick's 2001 paper, "Stock Selection: A Test of Relative Stock Values Reported over 17 ½ Years," which was not peer-reviewed and is therefore not included in this listing. Buying high RS stocks with low valuation outperforms the market. Both O'Shaughnessy and Kirkpatrick use the price to sales ratio as their preferred value parameter.

Conrad, Jennifer and Kaul, Gautam (1998). "An Anatomy of Trading Strategies." *The Review of Financial Studies*, 11 (3), 489-519.

Abstract: "In this article we use a single unifying framework to analyze the sources of profits to a wide spectrum of return-based trading strategies implemented in the literature. We show that less than 50 percent of the 120 strategies implemented in the article yield statistically significant profits and, unconditionally, momentum and contrarian strategies are equally likely to be successful. However, when we condition on the return horizon (short, medium, or long) of the strategy, or the time period during which it is implemented, two patterns emerge. A momentum strategy is usually profitable at the medium (2- to 12-month) horizon, while a contrarian strategy nets statistically significant profits at long horizon, but only during the 1926-1947 subperiod. More importantly, our results show that the cross-sectional variation in the mean returns of individual securities included in these strategies

plays an important role in their profitability. The cross-sectional variation can potentially account for the profitability of momentum strategies and it is also responsible for attenuating the profits from price reversals to long-horizon contrarian strategies."

Synopsis: This was a comprehensive study of technical trading strategies. It concludes that RS works over 3-12 month testing periods. Other than RS, no other strategy worked in all kinds of market environments.

Chan, Louis K. C., Jegadeesh, Narasimhan, and Lakonishok, Josef (1999). "The profitability of momentum strategies." *Financial Analysts Journal*, 55 (6), 80-90.

Abstract: "Momentum strategies based on continuations in stock prices have attracted a wide following among money managers and investors. This paper evaluates the profitability of price momentum strategies based on past return and earnings momentum strategies based on standardized unexpected earnings and revisions of consensus forecasts. The strategies proved to be profitable for intermediate horizons. Chasing momentum can generate high turnover, however; hence, implementation of momentum strategies requires a focus on managing trading costs. Comparing the strategies yielded evidence that they reflect distinct phenomena and provided information about the sources of profits. The results indicate that the market is slow to incorporate the full impact of information in its valuations."

Synopsis: In this paper, the authors find that RS works, but note that the timeframe is very important. It does not work well, they conclude, over short time periods, or if the time period used in the calculations is too long.

Moskowitz, Tobias J. and Grinblatt, Mark (1999). "Do Industries Explain Momentum?" *The Journal of Finance*, 54 (4), 1249-1290.

Abstract: "This paper documents a strong and prevalent momentum effect in industry components of stock returns which accounts for much of the individual stock momentum anomaly. Specifically, momentum investment strategies, which buy past winning stocks and sell past losing stocks, are significantly less profitable

once we control for industry momentum. By contrast, industry momentum investment strategies, which buy stocks from past winning industries and sell stocks from past losing industries, appear highly profitable, even after controlling for size, book-to-market equity, individual stock momentum, the cross-sectional dispersion in mean returns, and potential microstructure influences."

Synopsis: Using sector or industry exchange traded funds to trade RS will work. This paper offers academic support for the idea and tests extensively to determine why. Their conclusion is that it works but they don't why. Fortunately, investors can focus less on why and more on profits.

Jegadeesh, Narasimhan and Titman, Sheridan (2001). "Profitability of momentum strategies: An evaluation of alternative explanations." *The Journal of Finance*, 56 (2), 699-720.

Abstract: "Many portfolio managers and stock analysts subscribe to the view that momentum strategies yield significant profits. This paper evaluates various explanations for the profitability of momentum strategies documented in Jegadeesh and Titman (1993). The evidence indicates that momentum profits have continued in the 1990s, suggesting that the original results were not a product of data snooping bias. The paper also examines the predictions of recent behavioral models that propose that momentum profits are due to delayed overreactions that are eventually reversed. The evidence provides support for the behavioral models, but this support should be tempered with caution."

Synopsis: Jegadeesh and Titman had studied RS using academic tools for several years by this time, and they keep finding that it works. In this paper, they use a different timeframe than their original study to ensure that they did not select an inadequate sample to prove the concept. Behavioral finance attempts to explain how investors think about the buying and selling process, and they find that this model seems to explain why momentum strategies work. But, they caution that more research is needed.

Jegadeesh, Narasimhan and Titman, Sheridan (2002). "Cross-Sectional and Time-Series Determinants of Momentum Returns." *The Review of Financial Studies*, 1 (1), 143-157

Abstract: “Portfolio strategies that buy stocks with high returns over the previous 3-12 months and sell stocks with low returns over this same time period perform well over the following 12 months. A recent article by Conrad and Kaul (1998 presents striking evidence suggesting that the momentum profits are attributable to cross-sectional differences in expected returns rather than to any time-series dependence in returns. This article shows that Conrad and Kaul reach this conclusion because they do not take into account the small sample biases in their tests and bootstrap experiments. Our unbiased empirical tests indicate that cross-sectional differences in expected returns explain very little, if any, of the momentum profits.”

Synopsis: The authors show that momentum strategies work, but don’t find any statistical reason for this. Cross-sectional returns are a sophisticated concept that produces results similar to those found with beta, a measure of the market impact on a stock. In their research for this paper, Jegadeesh and Titman were trying to duplicate the results of another study, and found that the first study was not correct. They were able to then conclude that momentum exists in some stocks independent of the market.

Johnson, Timothy C. (2002). “Rational momentum effects.” *The Journal of Finance*, 57 (2 585-608.

Abstract: “Momentum effects in stock market returns need not imply investor irrationality, heterogeneous information, or market frictions. A simple, single-firm model with a standard pricing kernel can produce such effects when expected dividend growth rates vary over time. An enhanced model, under which persistent growth rate shocks occur episodically, can match many of the features documented by the empirical research. The same basic mechanism could potentially account for underreaction anomalies in general.”

Synopsis: Johnson accepts the fact that RS works, and then demonstrates that this fact is compatible with standard theories of how the markets work.

Lewellen, Jonathan (2002. “Momentum and Autocorrelation in Stock Returns.” *The Review of Financial Studies*, 15 (2, 533-563.

Abstract: “This article studies momentum in stock returns, focusing on the role of industry, size, and book-to-market (B/M) factors. Size and B/M portfolios exhibit momentum as strong as that in individual stocks and industries. The size and B/M portfolios are well diversified, so momentum cannot be attributed to firm- or industry-specific returns. Further, industry, size, and B/M portfolios are negatively autocorrelated and cross-serially correlated over intermediate horizons. The evidence suggests that stocks covary “too strongly” with each other. I argue that excess covariance, not underreaction, explains momentum in the portfolios.”

Synopsis: In this paper, the author builds the case that RS investment styles work. Lewellen finds that looking at industry momentum for a set of industry portfolios, buying past winning portfolios and selling past losing portfolios generate positive returns for horizons out to about one year. He then explains what he considers to be an anomaly in the standard financial theories by arguing that covariance explains why trends persist over time. Covariance is the tendency for stocks to generally move in the same direction at the same time. While academically sound, testing of RS strategies demonstrates that there is something more than covariance at work in a stock’s movement.

Korajczyk, Robert A., and Sadka, Ronnie (2004). “Are Momentum Profits Robust to Trading Costs?” *The Journal of Finance*, 59 (3), 1039-1082.

Abstract: “We test whether momentum strategies remain profitable after considering market frictions induced by trading. Intraday data are used to estimate alternative measures of proportional and non-proportional (price impact) trading costs. The price impact models imply that abnormal returns to portfolio strategies decline with portfolio size. We calculate break-even fund sizes that lead to zero abnormal returns. In addition to equal- and value-weighted momentum strategies, we derive a liquidity-weighted strategy designed to reduce the cost of trades. Equal-weighted strategies perform the best before trading costs and the worst after trading costs. Liquidity-weighted and hybrid liquidity/value-weighted strategies have the largest break-even fund sizes: $5 billion or more (relative to December 1999 market capitalization) may be

invested in these momentum strategies before the apparent profit opportunities vanish."

Synopsis: Korajczyk and Sadka find that smaller traders have an advantage in using momentum trading. This is most likely due to the fact that smaller traders are trading in position sizes that do not impact the market a great deal. Momentum stocks tend to have wide bid-ask spreads, and larger trades are going to result in fills beyond the spread in many cases. For example, if a stock is quoted at 15, that means the last trade was at 15. The market maker is willing to sell you the stock (ask at 15.10, or he will buy the stock from you at 14.90. The last trade occurred in the middle, in this example, most likely on a stop order. Momentum stocks tend to have a wider bid-ask, maybe a bid of 15.25 and an ask of 14.75. when news hits, the stock moves quickly and stop orders in the middle are rapidly left behind. Large positions will quickly force the stock up or down from that initial range.

Thomas J. George and Chuan-yang Hwang, 2004, "The 52-Week High and Momentum Investing," *The Journal of Finance*, 59 (5, 2145- 2176

Abstract: "When coupled with a stock's current price, a readily available piece of information, the 52-week high price, explains a large portion of the profits from momentum investing. Nearness to the 52-week high dominates and improves upon the forecasting power of past returns (both individual and industry returns for future returns. Future returns forecast using the 52-week high do not reverse in the long run. These results indicate that short-term momentum and long-term reversals are largely separate phenomena, which presents a challenge to current theory that models these aspects of security returns as integrated components of the market's response to news."

Synopsis: This paper validates the idea of "buying high and selling higher." It finds that high RS stocks that are nearer their 52-week high than the middle of the 52-week trading range perform better.

Hvidkjaer, Soeren (2006. "A Trade-Based Analysis of Momentum." *The Review of Financial Studies*, 19 (2), 457.

Abstract: "This article uses transactions data for all NYSE/AMEX stocks in the period 1983-2002 to study how investors trade in Jegadeesh and Titman's (1993) momentum portfolios. Among small trades, there is an extremely sluggish reaction to the past returns. For instance, an initial small-trade buying pressure exists for loser stocks, and it gradually converts into an intense selling pressure over the following year. The results are consistent with initial underreaction followed by delayed reaction among small traders. Moreover, small-trade imbalances during the formation period significantly affect momentum returns, suggesting that underreaction among small traders contributes to the momentum effect. Large traders, by contrast, show no evidence of underreaction, and large-trade imbalances have little impact on subsequent returns. Overall, the results suggest that momentum could partly be driven by the behavior of small traders."

Synopsis: The author finds that momentum strategies work. Institutions make immediate decisions, while smaller investors take time to execute their trades. This in part, in the author's conclusion, indicates that momentum works because small traders react slowly to the unfolding trend.

Ising, Jan, Schiereck, Dirk, Simpson, Marc W., and Thomas, Thomas W. (2006). "Stock returns following large 1-month declines and jumps: Evidence of overoptimism in the German market." *Quarterly Review of Economics and Finance*, 46 (4), 598.

Abstract: "We analyze the short-run and long-run performance of the largest 100 German firms that experience monthly stock price changes of more than ±20% between 1990 and 2003. The results indicate that the return patterns following large price increases are consistent with the overreaction hypothesis, but those following price declines indicate underreaction. Thus, our results support an overoptimism hypothesis for the German market. Further, for price decreases we find strong evidence of a size effect, while for price increases, market-to-book-ratios seem to play a role in determining the magnitude of the reaction. No evidence is found supporting the uncertain information hypothesis."

Synopsis: The fact that large declines are not followed by further declines supports the idea that trends persist over time.

That this study isolated this behavior in a market outside the US demonstrates that human behavior and emotion govern stock prices to some degree. The paper did not confirm the fact that stocks can maintain their momentum to the upside after a large price increase. This may be due to a flaw in the way the data was collected. Stocks which are bought out by other companies often see very large one-day price increases with no follow through. That is because the market immediately reacts to the takeover price. Overall, the fact that this paper did not confirm RS should not be considered worrisome, since very few investors would buy stocks that have just been the subject of a takeover.

Glossary

A

Ask: The price a seller is willing to accept for a security, futures contract or other financial instrument. Also called the offer.

B

Bid: The price a buyer is willing to pay for a security, futures contract or other financial instrument.

Beta: A means of measuring the volatility of an individual market (security, future, financial instrument) in comparison with the market as a whole.

Bollinger bands: A method used by technical analysts that indicates if a market is overbought or oversold. The bands are comprised of fixed lines above and below a simple moving average. As volatility increases, the bands widen.

Bond: A debt instrument that pays a set amount of interest on a regular basis. The issuer promises to repay the debt on time and in full.

Book value: The value of a financial instrument as shown by accounting records, often not the same as the instrument is valued by the market.

Broker: An individual or firm that charges a fee or commission for executing buy and sell orders placed by another individual or firm.

Buy stop order: An order to buy a market that is entered at a price above the current offering price and that is triggered when the market price touches or goes through the buy stop price.

C

Closing price: The price at which transactions are made just before the close on a given day.

Commission: A fee charged by a broker to a customer for performance of a specific duty, such as the buying or selling of futures contracts. A commission must be fair and reasonable, considering all the relevant factors of the transaction.

Commodity: An entity of trade or commerce, services, or rights in which contracts for future delivery may be traded. Some of the contracts currently traded are wheat, corn, cotton, livestock, copper, gold, silver, oil, propane, plywood, currencies, Treasury bills, Treasury bonds, and stock indexes.

Consolidation: A technical analysis term. A pause in trading activity in which price moves sideways, setting the stage for the next move. Traders are said to evaluate their positions during periods of consolidation.

Contract date: Date on which the contract is agreed between the parties.

Contract month: The month in which deliveries are to be made in accordance with a futures contract.

Contract: A term of reference describing a unit of trading for a commodity.

Correction: A technical analysis term. A price reaction against the prevailing trend of the market. Sometimes referred to as a retracement.

D

Demand: A consumer's desire and willingness to pay for a good or service.

Discount brokers: Brokers who charge lower commissions than full-service brokers.

Drawdown: The peak-to-trough decline during a specific record period of a trade, usually quoted as the percentage between the peak and the trough.

E

Earnings per share (EPS): The portion of a company's profit allocated to each outstanding share of common stock. EPS serves as an indicator of a company's profitability and is often considered the single most important variable in determining the price of a share.

Equity curve: A chart that plots the ups and downs of the value of an account.

Equity: The dollar value of an account if all open positions were offset at the current market price.

F

Fed: The short name for the U.S. Federal Reserve Banks.

Federal Reserve: The central bank of the United States that sets monetary policy. The Federal Reserve and FOMC oversee money supply, interest rates, and credit with the goal of keeping the U.S. economy and currency stable. Also called the Fed.

Fundamental analysis: An approach to the analysis of markets which examines the underlying factors which will affect the supply and demand of the market, overall economy, industry conditions, etc.

Futures contract: A standardized, binding agreement to buy or sell a specified quantity or grade of a commodity at a later date.

Futures contracts are freely transferable and can be traded only by public auction on designated exchanges.

G

Gap: In technical analysis, a trading day during which the daily price range is completely above or below the previous day's range

H

Head and shoulders: A technical analysis chart pattern that has three peaks resembling a head and two shoulders. A

L

Leverage: The use of borrowed assets to enhance the return to the owner's equity, allowing an investor to establish a position in the marketplace by depositing funds that are less than the value of the contract.

Limit move: A price that has advanced or declined the limit permitted during one trading session as fixed by the rules of a contract market.

Limit order: An order to buy or sell as a specified price or better.

Liquid market: A market where selling and buying can be accomplished easily due to the presence of many interested buyers and sellers.

Liquidity: The ease of converting an asset to cash

Long: To own (buy to a security, currency, futures contract, commodity, or derivative.

M

Margin: (1 In the futures industry, the amount of money deposited by both buyers and sellers of futures contracts to ensure

performance against the contract. (2) In the stock market, the amount of cash that must be put up in a purchase of securities.

Market: Any area or condition where buyers and sellers are in contact for doing business together.

Market order: An order to buy or sell securities, futures contracts, or other financial instruments to be filled immediately at the best possible price. A limit order, in contrast, may specify requirements for price or time of execution.

Momentum indicator: A line that represents the difference between today's price and the price of a fixed number of days ago. Momentum can be measured as the difference between today's price and the current value of a moving average. Often referred to as momentum oscillators.

Momentum investment strategy: An investment strategy that seeks to buy stocks that are increasing in value and showing a strong upward trend. The momentum investor believes that large increases in the price of a security will be followed by additional gains, but does not have defined exit rules.

Moving average: An average of prices over a fixed period. The value changes over time, eliminating fluctuations in data. Moving averages emphasize the direction of a trend, confirm trend reversals, and smooth out price and volume fluctuations that can confuse interpretation of the market.

N

Normalizing: Adjusting data, such as a price series, to put it within normal or more standard range. A technique sometimes used to develop a trading system.

O

Offer: An indication of willingness to sell at a given price, also referred to as an ask, or asking price. The opposite of bid.

Online broker: A retail securities, futures or options broker that provides services over the Internet.

Online trading: Using a computer and an Internet connection to place your buy and sell trading orders with an online brokerage firm, without the physical inclusion of a broker. Orders are entered and returned electronically via computer terminals.

Open: The period at the beginning of a trading session during which all transactions are considered made "at the open."

Oscillator: A technical analysis tool that attempts to determine when an asset has become over- or under-priced. As the value of the oscillator approaches the upper extreme value the asset is deemed to be overbought, and as it approaches the lower extreme it is deemed to be oversold.

Overbought: A technical analysis term that the market price has risen too steeply and too fast in relation to underlying fundamental or other factors.

Oversold: A technical analysis term for a market price that has experienced stronger selling than the fundamentals justify.

P

Point and figure charts: A method of plotting price on a chart that eliminates time and better reflects changing market conditions.

Portfolio: A selection of financial instruments held by a person or institution, often designed to spread investment risk.

Price-to-earnings ratio (P/E: A measure of comparison of the value of different common stocks that is calculated by dividing the market price of the stock by the earnings per share.

Protective stop: An order to exit a trade if a price reaches a predetermined level, placed to defend against extreme loss.

Pullback: A fall in price from its peak.

Q

Quote: The actual price, or the bid or ask price, of a security, commodity, futures, option, currency, or other financial instrument at a particular time.

R

Random walk theory: The theory that the past movement or direction of the price of a stock or other market cannot be used to predict its future movement or direction.

Range: The difference between the high and low price during a given period.

Reaction: A short-term countertrend movement of prices.

Relative Strength: A quantitative measure of a stock's price trend that indicates how a stock is performing relative to other stocks.

Relative Strength Index (RSI): A technical momentum indicator that compares the magnitude of recent gains to recent losses in an attempt to determine overbought and oversold conditions of an asset.

Resistance: The price level where a trend stalls. The market stops rising because sellers start to outnumber buyers. The opposite of a support level.

Retracement: In technical analysis, price movement in the opposite direction of the prevailing trend. Also described as a correction.

Reversion to the mean: The concept that most natural fluctuations tend to center around a normal or average value over time.

Risk management: Management to control and monitor the risks of a bank, financial institution, business entity, or individual.

Risk: The potential to lose money.

S

Security: A note, stock, bond, investment contract, debenture, certificate of interest in profit-sharing or partnership agreement, certificate of deposit, collateral trust certificate, pre-organization certificate, option on a security, or other instrument of investment.

Slippage: The difference between estimated transaction costs and the amount actually paid, usually attributed to a change in the spread.

Speculator: One who attempts to anticipate price changes and make profits through the sale and/or purchase of financial instruments.

Standard Deviation: (1 A statistical measure of the dispersion of a set of data from its mean. The more spread apart the data, the higher the standard deviation. (2) In finance, standard deviation is applied to the annual rate of return of an investment to measure the investment's volatility. Standard deviation is synonymous with volatility.

Stop limit: An order that becomes a limit order once the specified price is hit.

Supply: The total amount of a good or service available for purchase by consumers.

Support: A price level at which, historically, a declining market has difficulty falling below. Once this level is reached, the market trades sideways for a period of time or rebounds. It is the opposite of a resistance price range.

T

Technical analysis: An approach to analysis of markets that anticipates trends of market prices based on mathematical patterns. Technicians normally examine patterns of price range, rates of change, changes in volume of trading, and open interest. Data are charted to show trends and formations which serve as indicators of likely future price movements.

Traders: Individuals who negotiate prices and execute buy and sell orders, either on behalf of an investor or for their own account.

Trading system: A method of buying and selling stocks according to a screen based on results from predetermined indicators and other criteria.

Trailing stop: An order to exit a trade at a predetermined price level. Trailing stops automatically follow the stock tick-by-tick by a specified amount as the market moves in a trader's favor, ensuring that a winner does not turn into a loser.

Transaction costs: (1) The costs of negotiating, monitoring, and enforcing a contract. (2) The total cost of executing a financial transaction.

Trend line: A line that connects either a series of highs or lows in a trend. The trend line can represent either support (a positive trend line) or resistance (a negative trend line).

True range: A determination of range (high of the bar minus the low of the bar) that accounts for price gaps by adding the range of the gap to the calculation.

V

Volatility: (1) A measure by which an exchange rate is expected to fluctuate over a given period. (2) A measure of a commodity's tendency to move up and down in price based on its daily price history over a period of time.

Volume: The number of contracts, shares, or other financial instruments traded during a specified period of time.

W

Whipsaw: a short-term trade with a small loss.

Y

Yield: The annual rate of return on an investment, as paid in dividends or interest. It is expressed as a percentage.

Footnotes

1. The South Sea Bubble and Investing — An Historic Example of a Stock Market Bubble, "The South Sea Bubble," http://www.thesouthseabubble.com/

2. The concept of creative destruction is fully detailed by Schumpeter in *Capitalism, Socialism, and Democracy* originally published in 1942. The book was republished in 1994 by Routledge (New York).

3. Edwin Lefèvre, *Reminiscences of a Stock Operator* (New York: John Wiley & Sons) 89.

4. H. M. Gartley, "Relative Velocity Statistics: Their Application in Portfolio Analysis," *Financial Analysts Journal* (April 1945) 60-64.

5. James P. O'Shaughnessy, *What Works on Wall Street* (New York: McGraw Hill, 1997).

6. Oscillators, such as Wilder's Relative Strength Index (RSI), stochastics, and many others, are especially successful when trading individual stocks which are in well defined trading ranges. They are excellent tools to define overbought/oversold conditions in a stock or a market average. It is difficult to adapt these techniques to manage a portfolio, which is the objective of an RS investment strategy.

7. A web site providing continuously updated data for the technique of applying a moving average to the ROC of the

NASDAQ Composite Index and the NYSE Composite Index is maintained by market analyst Tim McMahon of Financial Trend Forecaster (www.fintrend.com).

8. The add-in to download stock quotes from MSN Money into Microsoft Excel can be downloaded for free from the Microsoft web site (http://www.microsoft.com/downloads/details.aspx?FamilyID=485FCCD8-9305-4535-B939-3BF0A740A9B1&displaylang=EN)

9. The book, Winning The Performance Game, may be downloaded at no cost from the Market Dynamics web site, www.clayallen.com.

10. Although it was published in 1933, deVilliers' book, *The Point & Figure Method of Anticipating Stock Price Movements*, is still considered an important work in the field and should be read by anyone seeking to learn more about P&F charting.

11. Robert Levy identified this technique in his 1966 *Journal of Finance* article "Relative Strength as a Criterion for Investment Selection."

12. An interesting and readable summary of research into stock selection strategies that beat the indexes, and challenge the core principles of the EMH is "What Has Worked in Investing: Studies of Investment Approaches and Characteristics Associated with Exceptional Returns," prepared by Tweedy, Browne Company LLC. This report is available from http://www.tweedybrowne.com/content.asp?pageref=reports.

13. Kirkpatrick's paper received the Charles H. Dow Award in 2001, recognizing it as a significant contribution to the body of knowledge in the field of technical analysis. This paper, "Stock Selection: A Test of Relative Stock Values Reported over 17 ½ Years," fully discloses the stock selection techniques and is available for download, free of charge, at https://www.mta.org/eweb/docs/2001DowAwardb.pdf.

14. The work of McClellan and Kliminski is detailed in a three part report published by Nelson Freeburg in his newsletter, *Formula Research*. Volume VII, issue numbers 2 – 4,

published in 2003, contain the details of this method, and several others. Reprints are available from http://www.formularesearch.com/.

15. "Invest in the Best, Not the Bargain,' an article by Stephan W. Poser, published in the March 2006 issue of *SFO Magazine*, applied this model to a group of ETFs.

16. The complete investment strategy employed Pierce was published in *MTA Journal*, Summer-Fall 1997, in an article entitled, "A Practical Application of Alpha and Beta to Portfolio Construction."

17. Wilder, J. Welles, N*ew Concepts in Technical Trading Systems*, Trend Research, 1978.

18. 'It's Like Spreading Peanut Butter & Jelly,' Christopher P. Hendrix, CMT, *SFO Magazine*, November 2006.

19. Dickson is Chief Market Strategist at regional brokerage D. A. Davidson & Co. His model is detailed in "Predicting Rank Order Stock Price Performance Using a Multi-factor Relative Price Strength Model," published in *MTA Journal*, Winter-Spring 2000.

20. Frazzini, Andrea & Lamont, Owen A (2005). "Dumb Money: Mutual Fund Flows and the Cross-Section of Stock Returns.: NBER Working Paper No. 11526.

21. Fosback, Norman (1993). *Stock Market Logic*. The Institute for Econometric Research, Fort Lauderdale, FL. 80-84.

22. Additional details on this report are available directly from Market Dynamics (www.clayallen.com).

23. Interested readers should see Modigliani, F. & Pogue, G., "An Introduction to Risk and Return, I." *Financial Analysts Journal*, March-April 1974 and "An Introduction to Risk and Return, II." *Financial Analysts Journal*, May-June 1974 for the seminal demonstration of this idea.

24. Fisher, Philip (1996). *Common Stocks and Uncommon Profits*. Wiley, New York City. 118.

25. Professional trader Larry Williams has demonstrated the trading the equity curve technique in his seminars. He has written about it extensively, and any of his many books offer a wealth of information on money management techniques such as this. Software packages such as Genesis Trade Navigator (www.GenesisFT.com) and Monocle II (www.monoclesystems.com) include the ability to add a moving average to the equity curve as a default system feature.

26. The experiment and details of the trading system are provided in *Way of the Turtle: The Secret Methods that Turned Ordinary People into Legendary Traders* by Curtis Faith, a participant in the program. The book was published by McGraw-Hill in 2007.

27. Richard Dennis denies that the Turtle experiment served as the inspiration of the Eddie Murphy/Dan Aykroyd movie "Trading Places" which was released at the same time. However, the movie plot does closely parallel the Turtle experiment.

28. Lowenstein, Roger (2000). "When Genius Failed: The Rise and Fall of Long-Term Capital Management. Random House.

29. The relationship between gold and the CRB Index, a broad-based measure of commodity performance, is detailed in Murphy, John (1991), "Intermarket Technical Analysis," Wiley, pages 68-70.

30. At the time this is being written, complete details of the Chandelier Exit can be found at LeBeau's web site, The Traderclub Forum (http://www.traderclub.com/discus/messages/107/477.html?FridayDecember319991048pm). The exit is also detailed in Elder, Alexander (2002), "Come Into My Trading Room," Wiley.

31. http://www.traderclub.com/discus/messages/107/477.html?FridayDecember319991048pm

32. Tharp, Van (2006). "Trade Your Way to Financial Freedom" McGraw-Hill.

33. Full details about Monocle II software are at http://www.monoclesystems.com/new/monocle/.

34. Many investment software packages capable of managing a portfolio with RS are beyond the reach of individual investors. In addition to Monocle, TechniFilter Plus (www.technifilter.com) and Stock Investor Pro, available through the American Association of Individual Investors (http://www.aaii.com/stockinvestor/intro/), offer affordable options. At a slightly higher price, Value Line (http://valueline.com/freedemo/productsamples.aspx) can also be used. Other solutions are available.

35. Kirkpatrick uses Value Line's data service and custom programming to derive his stock selection list. The data is also available with AAII's Stock Investor Pro. Using this software, the data needs to be exported into a spreadsheet program to complete the screening process. Any other data service which includes fundamental data can be used to implement this strategy.

36. Miffrea, J. & Rallisb, G. (2007). Momentum strategies in commodity futures markets. *Journal of Banking & Finance*, 31 (6), 1863-1886.