

## CHAPTER 1

# Uncertainty

The investment world had a rude reminder in August and September of 2008 that forecasts and risk have more uncertainty than it would like to believe. From August 28 to the following March 9, the Standard & Poor's (S&P) 500 dropped 47%. Even more remarkable was that every investment was dragged down with it—hedge funds that were expected to offer diversification, commodity funds where you have the security of so-called hard currency, real estate, art, and of course, every possible stock in nearly every country.

Oddly, the U.S. dollar strengthened against the euro by about 15% during that time. It was odd because it was the United States that originated what we now call the *subprime disaster*. Yet in a crisis, investors still move money to the United States for safety.

What did we learn from this? Mainly, we learned that there is more uncertainty than we thought in the world of investments. Maybe that's not entirely correct. We just tend to ignore the risks when everything goes well for a long time. During the late 1990s, a similar move occurred in the tech stocks, with NASDAQ dropping from 5000 to below 1200. For those a bit older, or students of history, there was the crash of 1987 resulting in a drop of 39.8% in the S&P from October 6 to October 22. But the stock market had recovered by the end of the year, so investors who didn't react to the drop never suffered a sustained loss. By contrast, the recent drop in the S&P lasted from August 11, 2008, to March 3, 2009, far longer than 1987 but not comparable to the Black Monday of 1929.

At the time of this writing, the stock market is down only 15% from its highs. Again, investors who had closed their eyes are still suffering a

loss in their pensions, but nothing devastating. Those who liquidated their portfolios and moved them to money market funds locked in their losses. The right decision is only known afterward.

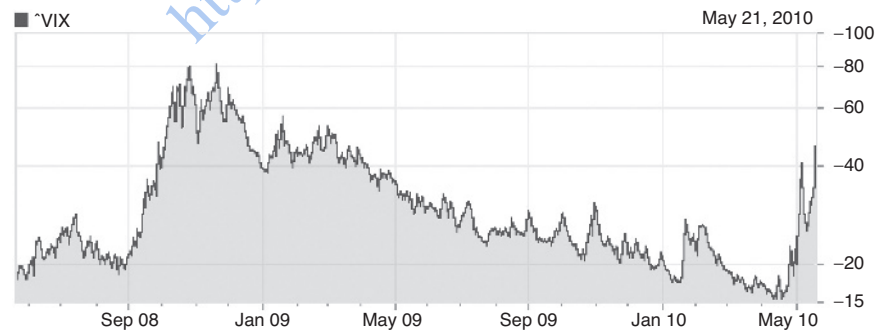
## IMPACT ON TRADING

But this book is about trading, not investing, and 2008 was a banner year for futures traders at the same time the equity markets were collapsing. The same could have been true for someone trading *exchange-traded funds* (ETFs) or any investment in which going short is a natural part of trading. The main beneficiaries were trend followers, who were able to get short (equity index markets), or long (interest rates), and stay with the trend for months, capturing what is known as the *fat tail*.

We can then say that many traders lost money and some profited, but the most important lesson is that the risk was enormous. Volatility rose from under 20% to 80%, a previously unthinkable level (see Figure 1.1). If you can't manage risk, then your interim losses may be too big to ever see the profits.

### Money Moves the Markets

Normally, risk is reduced through diversification, but that wasn't true during this last crisis because the movement of money reversed the direction of all markets at the same time. In a crisis, most investors simply want to get their money out. If they are long equities, then equities fall; if they are long the Goldman Sachs Commodity Index (GSCI), then that falls; and



**FIGURE 1.1** The volatility index (VIX) for S&P 500 from August 2008 through mid-May 2010.  
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if they are short the Japanese yen in the carry trade, the yen rises. Cash, or guaranteed government debt, is the only safe place, provided it's not Greece, Italy, Spain, Portugal, or a variety of emerging markets that may have even greater risk.

## **THE INEVITABLE PRICE SHOCKS**

We all know that price shocks are extreme price moves that cannot be predicted. We also understand that they are worse when the investing public is holding the wrong position, that is, when we expect the Fed to lower interest rates to stimulate the economy, but instead they raise rates to prevent inflation. Of course, that's not supposed to happen in our new era of transparency. But what about a military coup in an oil-rich country that cuts off the needed flow of supply to the West? Or an assassination? Or a surprise election result? All of these have happened.

We might think of all price movement as a series of price shocks of different sizes—all reactions to today's news. Most often, these shocks are very small, but some are bigger, and occasionally one is gigantic. Do you ever wonder how these price shocks net against your market positions? Is it different if you are a long-term rather than a short-term trader? Is there something you can do to take advantage of a price shock, or at least not be hurt by it?

### **Biased against You**

First of all, understand that you can't change the odds to have better than a 50% chance that you will profit from a price shock. Realistically, you would be lucky to have 50% of the price shocks in your favor. However, it does seem clear that when more people hold the same positions, any surprise that is contrary to that direction will have a greater impact while surprising news in a favorable direction will have little effect. But that information is not enough to make money because we still don't know when the next price shock will come.

Very few traders, professional or amateur, recognize the importance of price shocks and the effect that they have on profits. Given how ill-prepared and undercapitalized many traders are, one large price shock is all they need to be forced out permanently.

**Price Shocks and Your Position** Do price shocks hurt the short-term or the long-term trader more? To find out, we ran a moving average

test of a few different markets and totaled the value of the price shocks that caused profits or losses. Specifically,

- The moving average calculation periods ranged from 10 days to 200 days, in steps of 10 days.
- A *price shock* was defined as any day in which the ratio of today's price change to the standard deviation of the previous 10 day price changes was greater than 2.5. That means, if the standard deviation of the S&P daily price changes was 6 big points, then a gain or loss of 15 points would trigger a price shock. Specifically, if the threshold for a price shock  $t = 2.5$  and  $n = 10$ , then if

$$|P_t - P_{t-1}| > \text{stdev}(P_i - P_{i-1}) \text{ where } i = t - 1, \dots, t - n$$

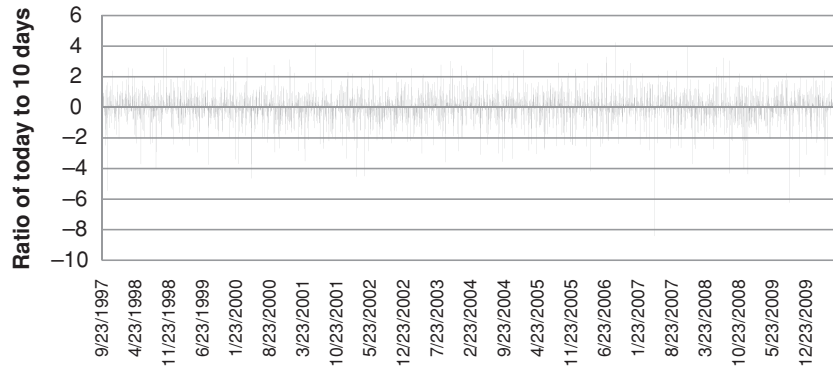
we can say that day  $t$  is a price shock.

By using the standard deviation of the daily changes, we can test using either the cash index or back-adjusted futures. Back-adjusting does not change the price differences or the standard deviation, although it will change any percentage calculation because the divisor is scaled to an artificial price. When working with futures, it's best to use price differences, and with stocks or stock indices, we should use returns.

**S&P Price Shocks** The impact of price shocks on the S&P is unique. We believe that there is an upward bias in the index markets, caused by favorable tax treatment of capital gains as well as legal restrictions in some pension plans, which results in investors holding long positions. Short sales are limited to a far smaller group of professional traders, perhaps a few more now that inverse ETFs and bear funds (inverse mutual funds, such as ProFunds) allow easy access. Investors also seem to gravitate toward a clear bull market in any investment, whether the stock market or gold or oil. It should not be a surprise that downside shocks would hurt most investors. Our moving average system, however, is unbiased because it goes long or short according to the direction of the trend and not because of tax consequences.

Figure 1.2 shows the daily price changes of the S&P futures as a ratio of the standard deviation of the previous 10 days, as given in the previous formula. The data cover 13 years, ending in May 2010. Even though prices were well off the lows of the subprime crisis by February 2009, it is easy to see that there is still a bias toward downward price shocks. By looking at the  $\pm 4$  lines on the left axis, we see that only seven events came close to that level, and not many moved above the 2 level, while there were many more both crossing  $-2$  and penetrating  $-4$ . We might have expected that more computerized trading, and perhaps more investment sophistication,

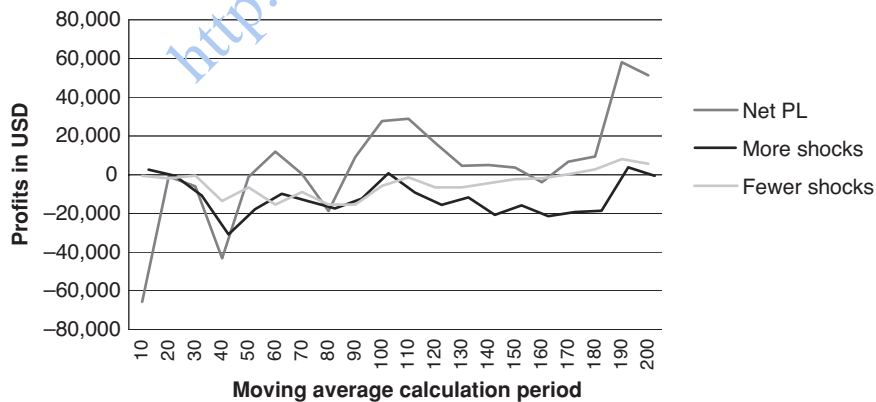
Uncertainty



**FIGURE 1.2** S&P 1-day volatility as a ratio to the standard deviation of the previous 10 days.

would cause shocks to be more symmetrical in recent years, but that doesn't seem to be the case.

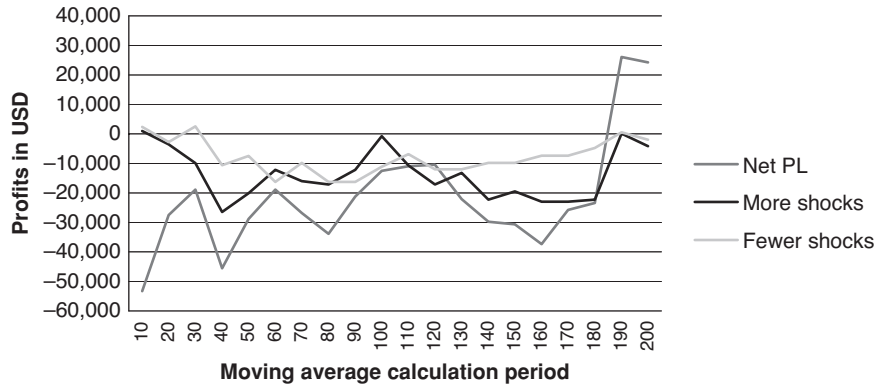
Using this chart, we choose two price-shock thresholds, 3.0 and 4.0, to compare the impact of what we will call *more shocks* and *fewer shocks*. The *fewer* case is also larger shocks. We run a test of moving averages using calculation periods from 10 days to 200 days over the past 10 years. The rules are that a long position is entered when the moving average turns up, and a short is entered when the moving average turns down. The system is always in the market. A \$25 round-turn commission is charged to cover all costs. Results are shown as Net PL in Figure 1.3, along with the net results of the 1-day price shocks. The performance pattern of the S&P begins with



**FIGURE 1.3** Comparison of the net returns for S&P moving average systems through May 2010 and the contribution from "more" and "fewer" 1-day price shocks.

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ALPHA TRADING



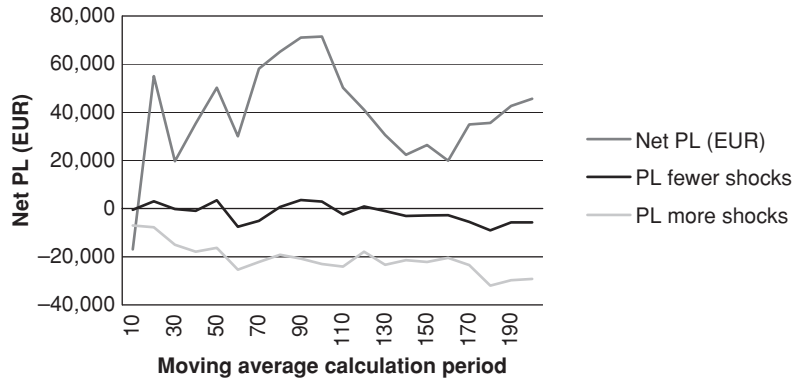
**FIGURE 1.4** S&P price shocks for the period beginning January 1991 and ending on the last day of 2007, to avoid the effects of the subprime crisis.

large losses for faster trends and finally shows profits for trend periods approaching 200 days.

The lines representing the contributions from 1-day price shocks show that in nearly all cases, the net impact of price shocks are negative returns. This can be attributed to most investors holding the same long position when there is a sustained bull market. We would caution traders not to believe that price shocks will contribute to short-term profits, even though the chart shows some net gains for the 10-day average and again for the longest calculation periods. At best, you can assume a 50% chance of a price shock in your favor. Anything else is strictly luck.

We thought it would be interesting to compare the results of these tests without the impact of the subprime crisis; therefore, we retested the data beginning at the same point, 1997, when the e-mini S&P began trading, and ending on January 1, 2008. The results are shown in Figure 1.4. The results are actually very similar for the contribution of price shocks because only a few shocks would have been added. In addition, the measurement of a price shock is relative to the previous 10 days, so that the sustained high volatility during the months from August 2008 through February 2009 made it difficult to have any shock that would have been 3 times larger. Instead, we see that the S&P was a poor performer, using a simple moving average system, and that the large downward move and the following rally from August 2008 through the current mid-2010 boosted the profits from \$25,000 for the longest trends to nearly \$60,000. Simple systematic trend following can perform well when traders can't.

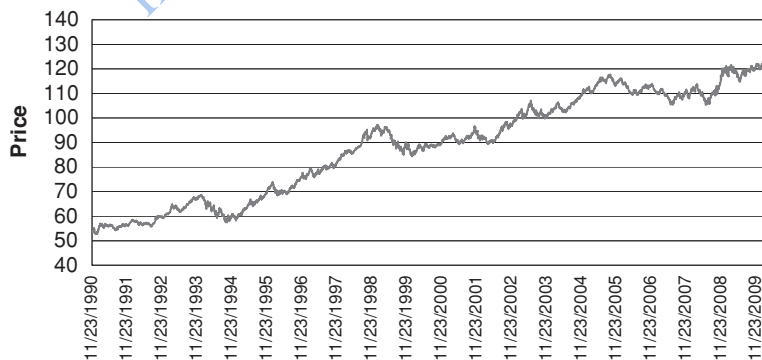
**Interest Rates** Interest rates are a far less volatile and more orderly market than any equity index. Using the Eurobund as the representative,



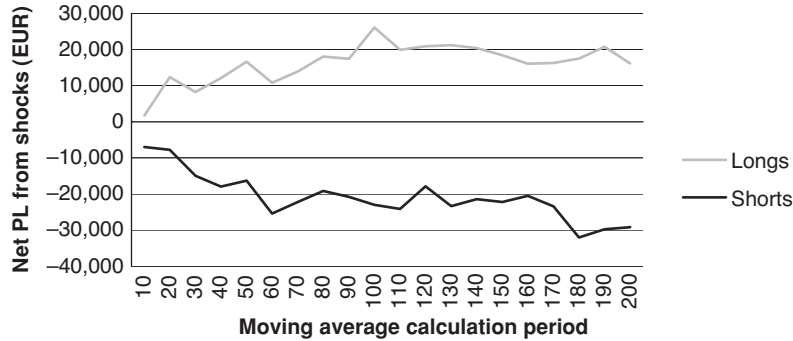
**FIGURE 1.5** Impact of price shocks on Euro bund moving average returns.

we run the same tests as we did for the S&P, using €25 as the round-turn cost for each trade, and beginning in 1991. The results are shown in Figure 1.5. They differ considerably from the S&P results because more shocks total very negative returns, averaging about half of the net profits. The fewer, larger price shocks netted an impact closer to zero, but the more frequent shocks, the results of periodic economic reports, move consistently against the trend position.

The large losses due to price shocks can be attributed to the Eurobund trend over the test period, as seen in Figure 1.6. With prices moving higher over the past 18 years, we would expect most investors to be holding long positions. Then price shocks to the downside would most often generate losses. As the trend calculation period increases, the time holding a long position increases; therefore, price shocks to the upside become a larger profit component, and shocks to the downside a larger losing component.



**FIGURE 1.6** Eurobund futures prices, nearest contract, back-adjusted from 1990.

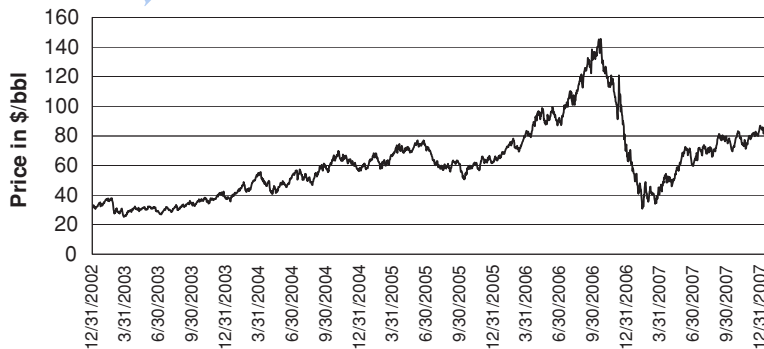


**FIGURE 1.7** Net effect of price shocks on Eurobund long and short positions.

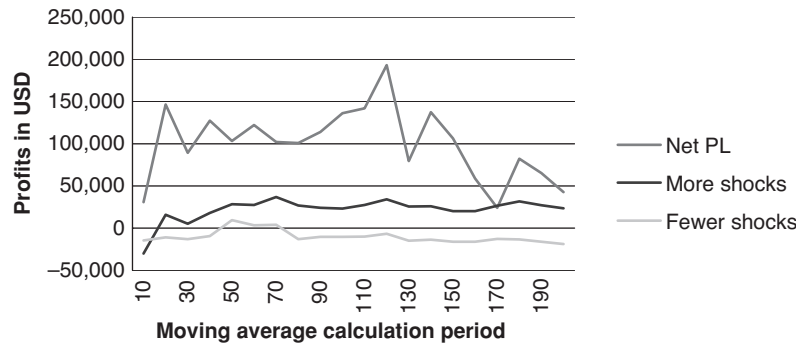
These can be seen in Figure 1.7, where the losses due to short-side shocks far outweigh the gains from upside shocks.

**Crude Oil** Another market that has attracted a great deal of attention is crude oil, rallying from \$40 per barrel to nearly \$150 before falling back to \$30 in just over three months, shown in Figure 1.8. A breakdown of the price shocks (Figure 1.9) shows that more shocks added to profits, while the largest shocks moved against the positions being held. This was a remarkable period for oil, and any news (more shocks) was taken as bullish. While there were big downside surprises, the market ignored them.

The profits from varying the calculation period of the moving average show that the slowest trends held the long position too far into the reversal that followed the peak of \$150, giving back most of the gains. In hindsight, the perfect trend was about 110 days, but it's not likely we would have been trading it. Most macro trend programs would have chosen something in the



**FIGURE 1.8** Crude oil, back-adjusted futures from 2003.



**FIGURE 1.9** Crude oil effect of price shocks on the profits of a moving average strategy.

range of 60 to 80 days, all of which performed well and had small or some positive effect from price shocks.

### WHY SO MUCH ABOUT PRICE SHOCKS?

Price shocks represent the worst-case scenario for traders. They are unexpected, violent, and most often generate losses. Even more important is that most traders don't plan for a price shock. You can plan to survive a price shock by holding large reserves so that a 4-standard deviation event will not produce a loss that you can't handle. But to do that, you need to give up leverage. More often than not, without the leverage, the result will be returns that are not justified by the risk.

Algorithmic traders are also guilty of ignoring price shocks. They test their programs on historic data that contain past shocks, and when they design their strategies and risk controls, the accumulated result of the way they traded during those past shocks can often produce net gains—a situation not likely to happen in real trading. The biggest offender was Long Term Capital Management, which, we are told, removed the price shocks from the data history because they believed them to be unrealistic (in the context of their trading) and not likely to be repeated. While it's true that the next shock is never a repeat of another past event, there are countless new market surprises.

What can you do to avoid price shocks, even if you can't predict them? The practical solutions are:

- Don't trade.
- Stay out of the market as much as possible.

- Choose a faster system so that you're not holding the same position as everyone else.
- Trade a hedged or market-neutral position.

Of course, no one reading this book would choose not to trade, so we'll ignore that point. On the other hand, staying out of the market as much as possible is very practical. That can be done easily with faster trading systems, where you target profits and have specific timing requirements to entering a new trade. If you end up holding positions for one-third of the number of trading days, then you have a 66% chance of missing a price shock.

Trading a faster system is also better. By not holding the same position as everyone else, and getting net long or short frequently, you have a good chance of a positive price shock 50% of the time.

Our choice is the last point, trading a spread or market-neutral position, which takes price shocks out of the picture completely. Of course, there is a chance that the two markets that are spread will not react as expected, but that is a very small chance. In addition, mean reverting strategies, which represent most of the market-neutral programs, are fast trading and require two or more markets to diverge; therefore, they are in the market for a relatively short period of time. As we will discuss later, long holding periods are not compatible with a mean reverting method because you then fight with the trend.

## COMPLEXITY AND CONTAGION RISK

This generation of traders has recently experienced a series of contagion risks, where one seemingly modest financial event causes another seemingly controlled financial event, and in the end, we have a very large event. The first of these was the subprime meltdown. It first appeared to be limited to the U.S. housing market, then started to affect lending liquidity, and then moved to bank reserve requirements, until it had spread throughout the United States, Europe, and finally Asia. Equity markets all plunged, and investors ran to the safety of government treasuries.

We are now teetering on the problem of sovereign debt, first with Greece and probably some other countries in the European Union, but possibly spreading back to the United States. It's not yet a reality, but that's not because the financial news networks aren't trying to scare everyone into believing that it will happen.

The problem stems from a structural change in the way markets are used. Investors now diversify into a wide range of programs, placing money in hedge funds, bond funds, and real estate trusts. If one link in the chain

fails, then investors must liquidate other holdings to cover losses. That leads to further liquidation. It is the complexity of the markets that we don't understand, the way money interacts with it all, causing the possibility of sequential failures.

## **THE UGLY SIDE**

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No discussion of uncertainty would be complete without recognizing that a different type of price shock occurs when we find out that we've been fooled. Of these, the greatest of all scams was Bernie Madoff, who fooled everyone into thinking that he had a lock on trading profits. Of course, he refused to discuss the specifics of his trading method because it was proprietary.

That brings up the issue of *black boxes*. A black box is usually a fully systematic, algorithmic trading model that is used for trading but not disclosed to anyone outside the company. Naturally, we can understand why a money manager would need to keep the specifics of a strategy secret. But then we don't really know what they're using or if they are using anything systematic at all. Fortunately, most investment managers, hedge fund operators, and commodity trading advisors (CTAs) are very credible. They give investors a general idea of what methods they use for trading and how they control risk. These can most often be verified by watching their performance under various market conditions. Unlike Madoff's results, which were up 15% each year regardless of market conditions, we expect to see periods of loss but more gains than losses over time.

Even in the best times, investing in someone else's trading program involves added risk—what we would normally call *counterparty risk*, the risk of one of the parties failing to perform their fiduciary responsibility. If you are the investor, that could be the stock or commodity exchange, but more likely the person or company managing your money.

If it is at all possible, you need to manage your own investment portfolio. Your common sense is enough to keep it on a safe track. If you're a trader, then all the better, because you can decide what strategy and how much leverage to use. And there is no penalty for stopping and withdrawing your money, and no waiting period. During the subprime crisis, many hedge funds refused to allow investors to withdraw their funds "for their own good" and because there was no market to liquidate their positions.

## **TAKING DEFENSIVE ACTION**

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We propose that the solution to all this risk and uncertainty is to trade in a way that removes exposure to directional risk. That include all forms

of statistical arbitrage (stat-arb), from spreads to yield-curve trading to program trading, and from the simplest pairs trade to large-scale market-neutral strategies. These methods extract *alpha* from the market, profits over and above what might be gained, or lost, by a passive investment in the stock or bond market. Alpha is considered a measure of cleverness, although you will see that some of the methods do not require much more than common sense.

### Not High-Frequency Trading

There has been a lot in the news about high-frequency trading, by which the major investment houses, such as Goldman Sachs and Morgan Stanley, trade hundreds or thousands of times each day to extract tiny but consistent profits. Much of this is conceptually simple but done on a massive scale only achievable by computerized trading. In fact, one of the main sources of success is pairs trading, which capitalizes on distortions between two related markets. Besides computerization, the edge in this method is that the cost of trading is near zero for these investment houses. We can't possibly compete with that, but we can compete in a different time frame.

In this book, we spend considerable time on pairs trading, but instead of holding a trade for microseconds, we will be looking at larger moves of one to three days. We will begin with the stock market but then look at futures markets and combinations of stocks and futures. Futures markets are more limited in selection but easy to trade, and they offer exceptional leverage.

The price movements of stock and futures markets are related for many reasons. Some of them are driven by common, long-term economic factors, and some are based on current geopolitical events. We often find ourselves commenting on how the S&P is moving with bond prices, or gold is moving with the EURUSD exchange rate, or that gold and crude oil are closely tracking one another. During extreme stress, markets move together, and we can take advantage of those opportunities, even if they last only three months or a year.

The methods discussed in this book are based on sound theory but are what we call *data driven*. Fundamentals play a role only in defining the strategy, such as *relative-value trading*, which is actually all relative and no value. But without a sound premise, we cannot expect to be profitable. On the other hand, we need to act often and precisely, which can be done only with a computerized trading program continually evaluating price changes. While it is possible to trade a few pairs using a simple spreadsheet, the true advantages come from a large-scale application which reduces risk due to diversification.

All of these methods fall into the category of *statistical arbitrage*, or *stat-arb*. Because they are computerized, they are also in the larger group of *algorithmic trading models*. Most important, these models are not exposed to price direction, so a shock to the market that moves all stocks in one direction will not itself cause an arbitrary profit or loss. Only the relative strength or weakness of one market compared with another will do that. Given the surprises of the past few years, that seems to be a much safer approach to trading.

### ACCEPTING PERFORMANCE FOR WHAT IT IS

One final but important point: We cannot eliminate risk, no matter how clever we are or what powerful tools we use. Even when we express risk in terms of annualized volatility, we don't really believe that we will see that risk. A 12% *target volatility* means there is a 2.5% chance of losing 24% in one year. But if you lost 10% or 15%, then you would be looking to change trading systems or somehow alter your risk exposure, yet your returns are still within the range that you defined.

The only way to remove future risk is by reducing leverage. Unfortunately, lower leverage means lower returns. If you find a past situation that caused exceptionally large risk, and create rules to eliminate it from future trading, you'll be following in the steps of Long-Term Capital Management. These risks never repeat in the same way and may even get bigger.

Throughout this book, we will discuss ways to manage individual trading risk as well as portfolio risk. None of these approaches tries to eliminate risk. The methods are simple and should appeal to common sense. They are also very important for long-term success.

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