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TRADING SYSTEMS AND METHODS

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SIXTH EDITION

PERRY J. KAUFMAN

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To my mother, in her 100th year

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PREFACE

What I've learned by trading and studying the markets for many years is that markets do not repeat themselves. Yes, there are similar moves for different reasons, and seemingly the same reasons cause different moves. Where is the common ground? I believe it is in turning specific patterns into generalized ones. For example, is a weekly pattern where there are four days up and one day down on Tuesday different from four days up and a down day on Friday? It's not different if you see it only as four days up and one day down. Successful strategies move from the specific to the general.

Success in trading is in the ability to see the bigger picture, the shape of the price moves rather than the highly specific pattern. That's why long-term moving averages work. You can mix the prices around and still get the same average. Fine tuning was never a good solution. We always return to the idea "loose pants fit everyone." Because we don't know exactly how a price move will develop, we need to build in the flexibility to stay with your strategy through as many challanging scenarios as possible.

THE MOVE TOWARD MORE ALGORITHMIC APPROACH

The algorithmic trader, myself included, is more comfortable having an idea of the risk and reward of a system, knowing full well that future losses can be greater, but so can future profits. What makes traders nervous is the unknown and unexpected risk. Having any type of loss-limiting method, whether a stop loss or just the change in trend direction, means you have some control over risk. It may not be perfect, but it's much better than watching your equity disappear and having to make a decision under stress. "Better to be out and wish you were in, than in and wish you were out."

Institutions such as Blackrock see algorithmic solutions in a different light. It is said that a year ago they eliminated portfolio stock selection by managers in favor

of computerized selection. There are methods, discussed in Chapter 24, that have proved highly successful, and don't require more than a few seconds of compute time (although a substantial database is needed). A computer may not be better than the best trader, but it can compete at a high level.

I know a trading company that is gearing up to provide artificial intelligence support for clients, including portfolio selection and individual trade recommendations. Their approach also includes training for beginning and intermediate traders. Is this the way knowledge is going to be disseminated in the future? It may be clearer to get an answer from a computer than to ask an "expert." And, if you don't yet understand, you can keep asking and the computer won't become impatient.

COMPETITION

Trading has become more competitive. High-frequency trading surged 10 years ago as technology made access faster and easier. Just like program trading, institutions jumped into the space, quickly reducing the chances for making big returns. Many players dropped out, not willing to allocate capital to small returns. The market seems to sort all of it out on its own.

It is the same with the deluge of ETFs. There are multiple ETFs for nearly every aspect of the markets, the S&P 500, S&P high dividend stocks, growth stocks, leveraged, and every sector in the S&P, with inverse ETFs for each one, midcaps, small caps, no caps. Again, the market sorts them out. Simply look at the volume to know which will survive.

What about the trend follower? Can he or she survive? Because major trends are based on fundamentals, usually interest rate policy, growth, or trade, they continue to drive prices with persistence, sometimes lasting for six months, sometimes for six years, and in the case of U.S. interest rates, for most of 35 years. We can't capture all of that move, and there are some volatile periods along the way, but a macrotrend trader will capture enough to be rewarded.

ACCEPTING RISK

One of the most important lessons that I've learned is to accept risk. No matter how we engineer a trading system, adding stops and profit-taking, leveraging up and down, and hedging when necessary, it's not possible to remove the risk. If you think you've eliminated it in one place, it will pop up somewhere else. If you limit each trade to only a small loss, a series of losses will still add to a large loss.

The way to survive is first to understand the risk profile of your method. Then capitalize it so that you won't panic and do something irrational, such as sell out at the lows. As you accumulate profits, you can increase your investment without risking your initial capital. Think of it as a long-term partnership with the market.

THE LONG BULL MARKET

Following the 2008 financial crisis, the U.S. experienced one of the longest bull markets in its history. During these unusual periods, traders try to adjust to low volatility and small drawdowns. Buying any pullback is profitable. But all bull markets end, just as the Internet bubble ended in 2000. They don't all "burst," but they become far more volatile as they revert to their long-term pattern.

Taking advantage of an unusual pattern can be profitable but should only be done with a small part of your investment. The next pattern is not likely to last as long as the 8-year bull market. Watching the way prices move can lead to changes in the way you enter orders. For example, during past few years, stocks that gap much higher on earnings reports tend to close even higher. Stocks that gap much lower tend to close near or above their open. Observations can be turned into profits. There is no substitute for watching price movement.

WHAT'S NEW IN THE SIXTH EDITION

Besides updating many of the charts and examples, some of the chapters have been largely rewritten to make them clearer and better organized. Unnecessary detail has been removed to make room for more new material, such as artificial intelligence and game theory. More professional techniques have been added, including volatility stabilization and risk management. There are new systems and techniques, most of which have been programmed and can be found on the Companion Website. Large tables have been removed in favor of putting them online. Many of the tables now appear in Excel format, which I find easier to read. Some of the math has been removed and replaced by Excel functions and other software apps.

I recognize that a large part of the readership in now outside the United States. Some of the new examples use Asian markets. Many of the more technical words familiar to U.S. readers have been replaced by more general explanations. I'm sure that readers in all countries will find this an improvement.

COMPANION WEBSITE

The Companion Website is an important part of this book. You will find hundreds of TradeStation programs and Excel spreadsheets, and some MetaStock programs, that allow you to test many of the strategies with your own parameters. Look for the "e" in the margin to indicate a Website program. There is no substitute for trying it yourself, then modifying the code to reflect your own ideas.

In addition, the Appendices in the previous edition, and the Bibliography, have been moved to the Companion Website to make room for new material.

WITH APPRECIATION

This book draws on the hard work and creativity of hundreds of traders, financial specialists, engineers, and many others who are passionate about the markets. They continue to redefine the state of the art and provide all of us with profitable techniques and valuable tools.

The team at John Wiley have provided a high professional level of support for my work over the past 40 years. It is not possible to name all of those who have helped, from Stephen Kippur to Pamela van Giessen, and now Bill Falloon and Michael Henton. I truly appreciate their efforts.

As a final note, I would like to thank all the previous readers who have asked questions that have led to clearer explanations. They are the ones who find typographical errors and omissions. They have all been corrected, making this edition that much better.

Wishing you success,

Perry J. Kaufman
Freeport, Grand Bahama
December 2019

CHAPTER 1

Introduction

It is not the strongest of the species that survive, nor the most intelligent, but the ones most responsive to change.

—Charles Darwin

Let's start by defining the term *technical analysis*. *Technical analysis is the systematic evaluation of price, volume, breadth, and open interest, for the purpose of price forecasting*. A systematic approach may simply use a bar chart and a ruler, or it may use all the computing power available. Technical analysis may include any quantitative method as well as all forms of pattern recognition. Its objective is to decide, in advance, based on a set of clear and complete rules, where prices will go over some future period, whether 1 hour, 1 day, or 5 years.

Technical analysis is not just the study of chart patterns or the identification of trends. It includes intermarket analysis, complex indicators, and mean reversion, as well as the testing process and the evaluation of test results. It can use a simple moving average or a neural network to forecast price moves. This book serves as a reference guide for all of these techniques, puts them in some order, and explains the functional similarities and differences for the purpose of trading. It includes portfolio construction and multilevel risk control, which are integral parts of successful trading.

THE EXPANDING ROLE OF TECHNICAL ANALYSIS

Quantitative methods for evaluating price movement and making trading decisions have become a dominant part of market analysis. Those who do not actively trade with methods such as overbought and oversold indicators are most likely to watch them along the bottom of their screen. The major financial networks are always pointing out price trends and support and resistance levels. They are quick to say that a price that moves up or down was done on low volume, implying that it

might be unreliable. The 200-day moving average seems to be the benchmark for long-term direction, and the 50-day for short-term.

In 2002 the U.S. government questioned the integrity of the research produced by major financial houses that have a conflict between financing/underwriting and advising retail brokerage. The collapse of Enron caused us to question the earnings, debt, quality of business, and other company data released to the public by large and small firms. When trading equities in other countries, it is never clear that the financial data is either correct or timely. But price and volume are always accurate. It is not surprising that more quantitative trading methods have been adopted by research firms. In March 2017, Blackrock announced that it would eliminate 40 portfolio managers in favor of algorithmic stock selection. When decisions are made with clear rules and calculations that can be audited, those analysts recommending buys and sells are safe from scrutiny.

Extensive quantitative trading exists around the world. *Interest rate arbitrage* is a major source of revenue for banks. *Location arbitrage* is the process that keeps the price of gold and other precious metals the same all over the globe. *Program trading* keeps the collective price of stocks in line with S&P futures and SPY (the SPDR ETF) prices. These fully automated systems are now called *algorithmic trading*.

If you don't think of arbitrage as technical trading, then consider market neutral strategies, where long and short positions are taken in related markets (pairs trading) in order to profit from one stock rising or falling faster than the other. If you change your time horizon from hours and days to milliseconds, you have high-frequency trading. You might prefer to take advantage of the seasonality in the airline industry or try your hand trading soybeans. Both have clear seasonal patterns as well as years when other factors (such as a disruption in energy supply) overwhelm the seasonal factors. Trading seasonal patterns falls under technical analysis.

Technology that allows you to scan and sort thousands of stocks, looking for key attributes – such as high momentum, a recent breakout, or other indicator values – is technical analysis on a broad scale. High-frequency trading has become a profit center for large financial institutions, but involves placing computer equipment as close to the source of the exchange price transmission as possible – a contentious issue. High-frequency trading is credited for adding liquidity by increasing volume in equities, but has also been blamed for spectacular, highly volatile price moves.

Most impressive is the increase in managed funds that use technical and quantitative analysis. Many billions of investment dollars are traded using trend-following, timing techniques, mean reversion, and countless other systematic methods. It is thought that well over half of all managed money uses algorithmic trading. The use of technical analysis has infiltrated even the most guarded fundamental fortresses.

CONVERGENCE OF TRADING STYLES IN STOCKS AND FUTURES

The development of technical analysis has taken a different path for stocks and futures. This seems natural because the two markets cater to investors with different time frames and different commercial interests. At the same time, those markets place very different financial demands on the investor.

The original users of the futures markets were grain elevators and grain processors, representing the supply side and the demand side. The elevators are the grain wholesalers who bought from the farmers and sold to the processors. The futures markets represented the fair price and grain elevators sold their inventory on the Chicago Board of Trade to lock in a price (hopefully a profit). The processor, typically a bread manufacturer or meat packer, used the futures markets to fix a low price for their material cost and as a substitute for holding inventory. Both producer (the sell side) and processor (the buy side) only planned to hold the position for a few weeks or a few months, until they either delivered their product to market or purchased physical inventory for production. There was no long-term investment, simply a hedge against risk. Futures contracts, similar to stock options, expire every two or three months and can be held for about one year; therefore, it is nearly impossible to "invest" in futures.

One other critical difference between futures and stocks is the leverage available in futures. When a processor buys one contract of wheat, that processor puts up a good faith deposit of about 5% of the value of the contract. If wheat is selling for $10 a bushel and a standard contract is for 5,000 bushels, the contract value is $50,000. The processor need only deposit $2,500 with the broker. The processor is essentially buying with leverage of 20:1.

In the 1970s, the futures trader paid a round-turn commission of $50 per contract. This is about 0.3 of one percent, less than the stock market cost of 1% per trade at the time. Now, years after negotiated commissions have become part of the system, the fee is no more than $8, or 0.05 of one percent for either stocks or futures, often less. Commission costs are so low that they are not a consideration when trading futures. The same low costs are also available to equity traders. Low costs allow fast trading, even day trading. It has changed the way we approach the markets.

A Line in the Sand between Fundamental and Technical Analysis

The market is driven by fundamentals. These are often employment, GDP, inflation, consumer confidence, supply and demand, and geopolitical factors, all of which create expectations of price movement. But it is too difficult to trade using those facts, and economists have never been very accurate. Economic reports are

not usually timely, and individual companies are not forthcoming about problems. We have had too many cases where the data we use to make fundamental decisions about individual companies have been unreliable, or a major computer breach isn't reported for months. We can add that to the conflict of interest inherent in the government's calculation of the Consumer Price Index, because an increase in the CPI requires that all those receiving Social Security checks get a cost-of-living increase.

Technical analysis, when used to determine the long-term direction of prices, attempts to objectively evaluate these complex fundamentals. It is no different from the economists who use regression, seasonality, and cyclic analysis to forecast the economy. The technical trader can use those tools as well as chart trendlines, recognize patterns, and calculate probability distributions. Perhaps the economists are doing the same thing.

It is well known that the Federal Reserve monitors trading and prices to decide how to time their interest rate changes and, when necessary, their currency intervention. All monetary authorities know that, when their currency is rising too fast, you don't try to stop it. If the public wants to buy the Japanese yen, the Central Bank doesn't have enough clout to halt it unless it first waits for the move to be exhausted. It must use its resources carefully, and it uses market know-how and price analysis to time its actions.

The primary advantages of a technical approach are that it is objective and completely well-defined. The accuracy of the data is certain. One of the first great advocates of price analysis, Charles Dow, said:

> *The market reflects all the jobber knows about the condition of the textile trade; all the banker knows about the money market; all that the best-informed president knows of his own business, together with his knowledge of all other businesses; it sees the general condition of transportation in a way that the president of no single railroad can ever see; it is better informed on crops than the farmer or even the Department of Agriculture. In fact, the market reduces to a bloodless verdict all knowledge bearing on finance, both domestic and foreign.*

Much of the price movement reflected in any market is anticipatory; it results from the expectations of the effects of macroeconomic developments or the outcome of good corporate management and new products. Markets, however, are subject to change without notice. For example, the government may block the merger of two companies, or approve or reject a new drug. A hurricane bound for the Philippines will send sugar prices higher, but if the storm turns off course, prices reverse. Anticipation of employment reports, housing starts, or corn production reports causes highly publicized expert estimates, which may correctly or incorrectly move prices before the actual report is released. Markets then react to the accuracy of the estimates rather than to the economic data itself. By the time the public is ready to act, the news is already reflected in the price.

PROFESSIONAL AND AMATEUR

Beginning technical traders may find a system or technique that seems extremely simple and convenient to follow, one that appears to have been overlooked by the professionals. Most often there is a simple reason why that method is not used. As you learn more about trading, you find that execution is difficult, or the risk is much higher than originally expected, or that the system has too many losses in a row. Trading is a business, not one to be taken casually. As Richard Wyckoff said, "Most men make money in their own business and lose it in some other fellow's." Plan to invest your time before your money, so that when you begin trading, you have more realistic expectations.

That does not mean that simple systems don't work, but that each has a return and risk profile that is typical of that style and difficult to change. One purpose of this book is to present many different trading methods, each with its own risk and reward profile, so that each trader understands the true cost of trading.

To compete with a professional speculator, you must be accurate in anticipating the next move. This can be done by

- Recognizing recurring patterns in price movement and determining the most likely results of such patterns.
- Identifying the "trend" of the market by isolating the underlying direction of prices over a selected time interval.
- Exploiting an unusual divergence in price between two related companies or commodities, called *arbitrage*.

The Tools

The bar chart, discussed in Chapter 3, is the simplest representation of the market. These patterns are the same as those recognized by Jesse Livermore, in the early 1900s, on the tickertape. Because they are interpretive, more precise methods such as point-and-figure charting came into being, which add a level of exactness to charting.

Mathematical modeling, using traditional regression or statistical analysis, remains a popular technique for anticipating price direction. Most modeling methods are variations on econometrics, basic probability, and statistical theory. They are precise because they are based entirely on numerical data; however, they need trading rules to make them operational.

The proper assessment of the price trend is critical to most trading systems. Countertrend trading, which takes a position opposite to the trend direction, is just as dependent on knowing the trend. Large sections of this book are devoted to the various ways to identify the trend, although it would be an injustice to leave the reader with the idea that a "price trend" is a universally accepted concept. There have been many studies claiming that price trends do not exist. The most authoritative papers on this topic are collected in Cootner, *The Random Character*

of Stock Market Prices (MIT Press, 1964); very readable discussions can be found in the *Financial Analysts Journal,* an excellent resource.

Personal money management has an enormous number of tools, many of which can be found in Excel and other spreadsheet software. These include linear regression and correlation analysis. An Excel add-in, *Solver*, can easily be adapted to portfolio allocation. There is also inexpensive software to perform spectral analysis and apply advanced statistical techniques. Trading systems development platforms such as TradeStation and MetaStock provide programming languages and data management that greatly reduce the effort needed to implement your ideas. Professionals maintain the advantage of having all of their time to concentrate on the investment problems; however, nonprofessionals are no longer at a disadvantage.

RANDOM WALK

It has been the position of many advocates of fundamental and economic analysis that there is no relationship between price movements from one day to the next. That is, prices have no memory of what came before – this has been named the *random walk* theory. Prices will seek a level that will balance the supply–demand factors, but that level will be reached either instantaneously, or in an unpredictable manner as prices move in response to the latest available information or news release.

If the random walk theory is correct, the many well-defined trading methods based on mathematics and pattern recognition will fail. There are two arguments against random price movement.

The first argument is simply the success of many algorithmic trading strategies. There is definitive documentation of performance for systematized arbitrage programs, hedge funds, and derivatives funds, showing success for upward of 40 years. This is not to say that all technical programs are successful – far from it. But neither are fundamental methods. You still need a sound strategy, whether discretionary or systematic, in order to be profitable. Not everyone can create and implement such a strategy.

The second argument against the random walk is that prices move on anticipation. One can argue academically that all participants (the "market") know exactly where prices should move following the release of news. However practical or unlikely this is, it is not as important as market movement based on anticipation of further news. For example, if the Fed lowered rates twice this year and the economy has not yet responded, would you expect it to lower rates again? Of course you would. Therefore, as soon as the Fed announces a rate cut you would speculate on the next rate cut. When most traders hold the same expectations, prices move quickly to that level. Prices then react to further news relative to expectations, but only to the degree that investors have confidence in their future forecast. Is this price movement that conforms to the random walk theory? No. But the actual pattern of price movement can appear similar to random movement.

Excluding anticipation, the apparent random movement of prices is dependent on both the time interval and the frequency of data observed. Over a longer time span, using lower frequency data (for example, weekly), the trending characteristics become more obvious, along with seasonal and cyclic variations. In general, the use of daily data shows more noise (random movement) than weekly or monthly data.

In the long run, prices seek a level of equilibrium. Investors will switch from stocks to bonds to futures if one offers better return for the same risk. Investors are, in essence, arbitraging the investment vehicles. To attract money, an investment must offer more.

Prices do not have a normal distribution, another fact that argues against random walk. The asymmetry of the index markets, in particular those built on traditional stocks, is easy to understand because the public consists overwhelmingly of buyers. When looking at price movement in terms of "runs" – hours or days when prices continue in the same direction for an unusually long sequence – we find that price data, and the profits that result from trending systems, have a *fat tail,* representing much longer runs than can be explained by a normal distribution. The existence of a fat tail also means that some other part of the distribution must differ from the norm because the extra data in the tail must come from somewhere else. When we discuss trending systems, the fat tail plays a critical role in profitability.

Price movement is driven by people, and people can buy and sell for nonrandom reasons, even when viewed in large numbers. People move prices and create opportunities that allow traders to profit. The long-term trends that reflect economic policy, normally identified by quarterly data, can be of great interest to longer-term *position traders*. It is the shorter-term price moves caused by anticipation (rather than actual events), frequent news releases, unexpected volatility, prices that are far from value, countertrend systems looking for price reversals, and shifts in supply and demand that are the primary focus of this book.

DECIDING ON A TRADING STYLE

It may seem backward to talk about a trading style in advance of reading all the material, but many traders have already decided that they want to day trade or hold long-term positions because it suits their disposition, their belief of what moves prices, or their time schedule. That's important because you must be comfortable with the way you trade. With that in mind, short-term and long-term traders will focus on different strategies and markets while portfolio structure and risk control will be much the same for either approach.

To understand how markets and different trading styles work together, consider a daily chart of any market, an individual stock, a short-term interest rate futures contract, or the sector SPDR SPY. There are periods of trending and sideways patterns. However, if you change that chart from intraday to daily, and from daily to weekly, the longer-term trend emerges. Lower frequency data makes the trend clearer. Figure 1.1 shows crude oil weekly, daily, and 20-minute charts, centered

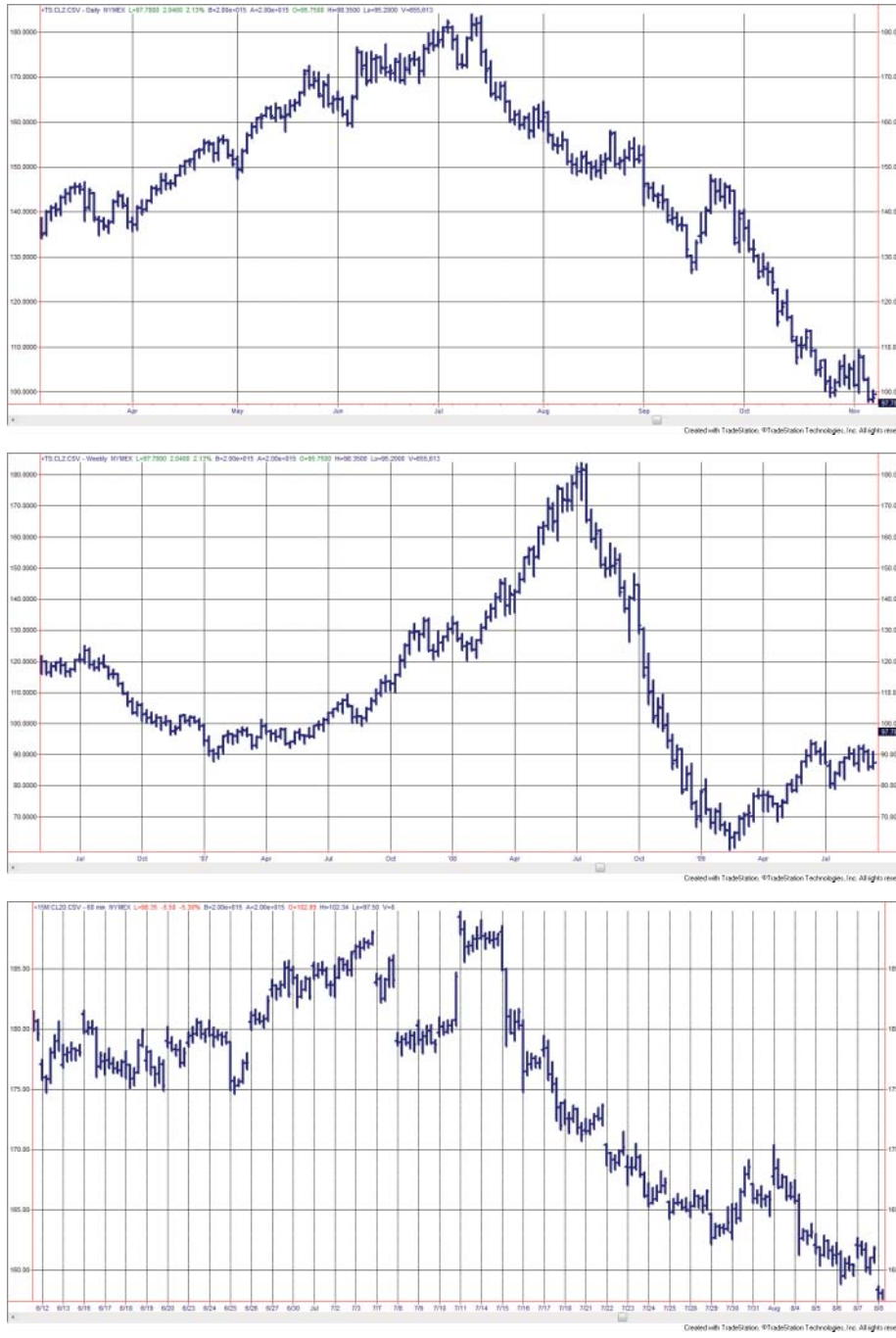

FIGURE 1.1 Crude oil prices weekly chart with July 2008 in the center (top); daily chart with July 2008 in the center (center); 20-min chart with July 2008 in the center (bottom).

around July 2008. The weekly chart shows the smoothest pattern, the daily adds a few extra reversals, and the 20-minute chart has some abrupt changes on the open of the day.

Selecting a price frequency that complements your trading strategy is important. If you are a long-term, macrotrend follower, then you want the price series that shows more trends, which is improved by weekly or daily charts. Short-term traders focus on mean reversion or fast directional price moves, and those strategies are enhanced using higher-frequency data, such as hourly or 15-minute bars.

MEASURING NOISE

Noise is the erratic movement that makes up the pattern of any price series. High noise can be compared to a drunken sailor's walk while low noise is a straight line from the starting to the ending point. Understanding the effects of noise can give you a trading edge. A market that has high noise is good for mean-reverting and arbitrage strategies. One with low noise favors trend-following. By selecting markets correctly, you increase your chances of success.

Noise can be measured as *price density*, *efficiency ratio* (also called *fractal efficiency*), and *fractal dimension*. It is important that these measurements do not reflect volatility because noise should not be confused with volatility. In Figure 1.2 a short, hypothetical period of price movement gives an example of noise measured by the efficiency ratio (ER). ER is calculated by dividing the net move (the change from point A to point B) by the sum of the individual moves during that period, each taken as positive numbers.

$$\textit{Efficiency ratio} = \frac{\textit{Absolute Value}\,(\textit{Net change in price})}{\textit{Sum of individual price changes}\,(\textit{as positive numbers})}$$

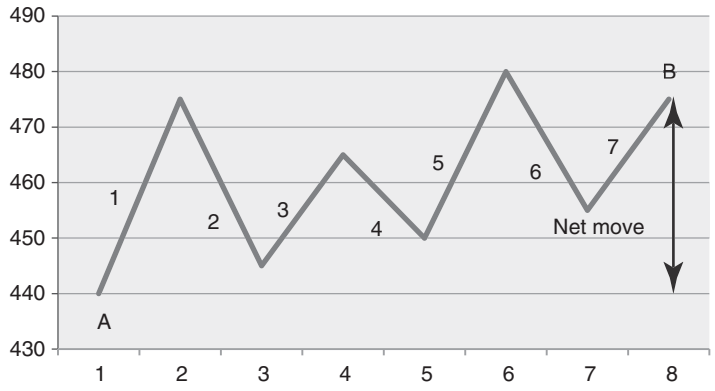

FIGURE 1.2 Basic measurement of noise using the efficiency ratio (also called fractal efficiency).

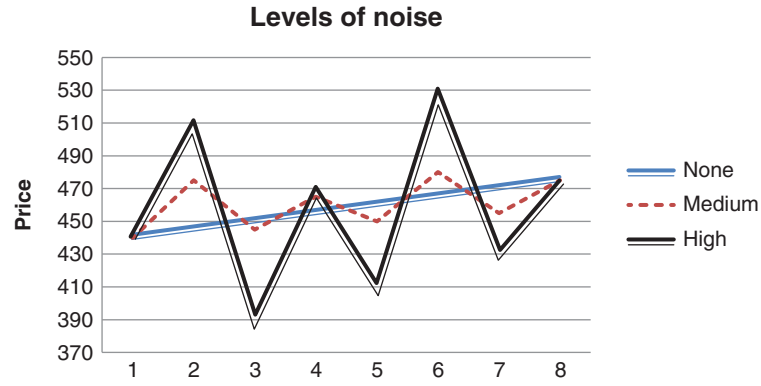

FIGURE 1.3 Three different price patterns all begin and end at the same point. The straight line shows no noise, the smaller variations are medium noise, and the larger swings are high noise.

or

$$ER_t = \frac{|P_t - P_{t-n}|}{\sum_{i=t-n}^{i=t} |P_i - P_{i-1}|}$$

where n is the calculation period.

Figure 1.3 illustrates the relative level of noise that might occur with a price move of the same net change. The straight line indicates no noise, the smaller changes that move above and below the straight line would be medium noise, and the large swings are high noise. However, in this example it is not possible to distinguish the level of noise from volatility, yet they are not the same. In Figure 1.4, the net change in price is from 440 to 475 in one case and from 440 to 750 in the other, yet the sum of the individual component changes is similar, 595 and 554. The efficiency ratio is 0.06 for the first and 0.56 for the second, showing that the first is very noisy while the second has relatively low noise (see Table 1.1). Noise is always relative to the net price change. If prices are moving up quickly, then even large swings may not be considered "noisy."

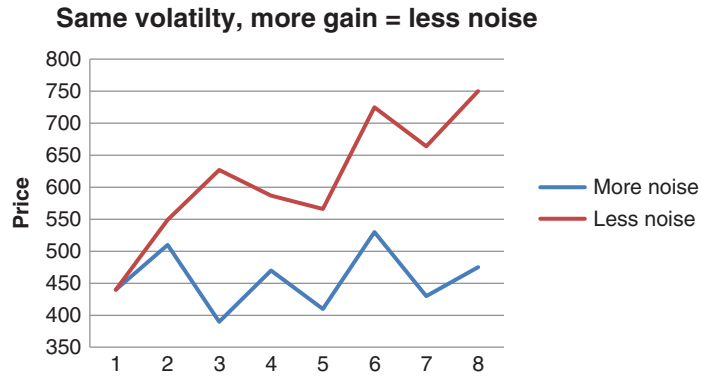

FIGURE 1.4 By changing the net price move we can distinguish between noise and volatility. If the sum of the individual price changes are the same, but the net move is larger, then the noise is less.