

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

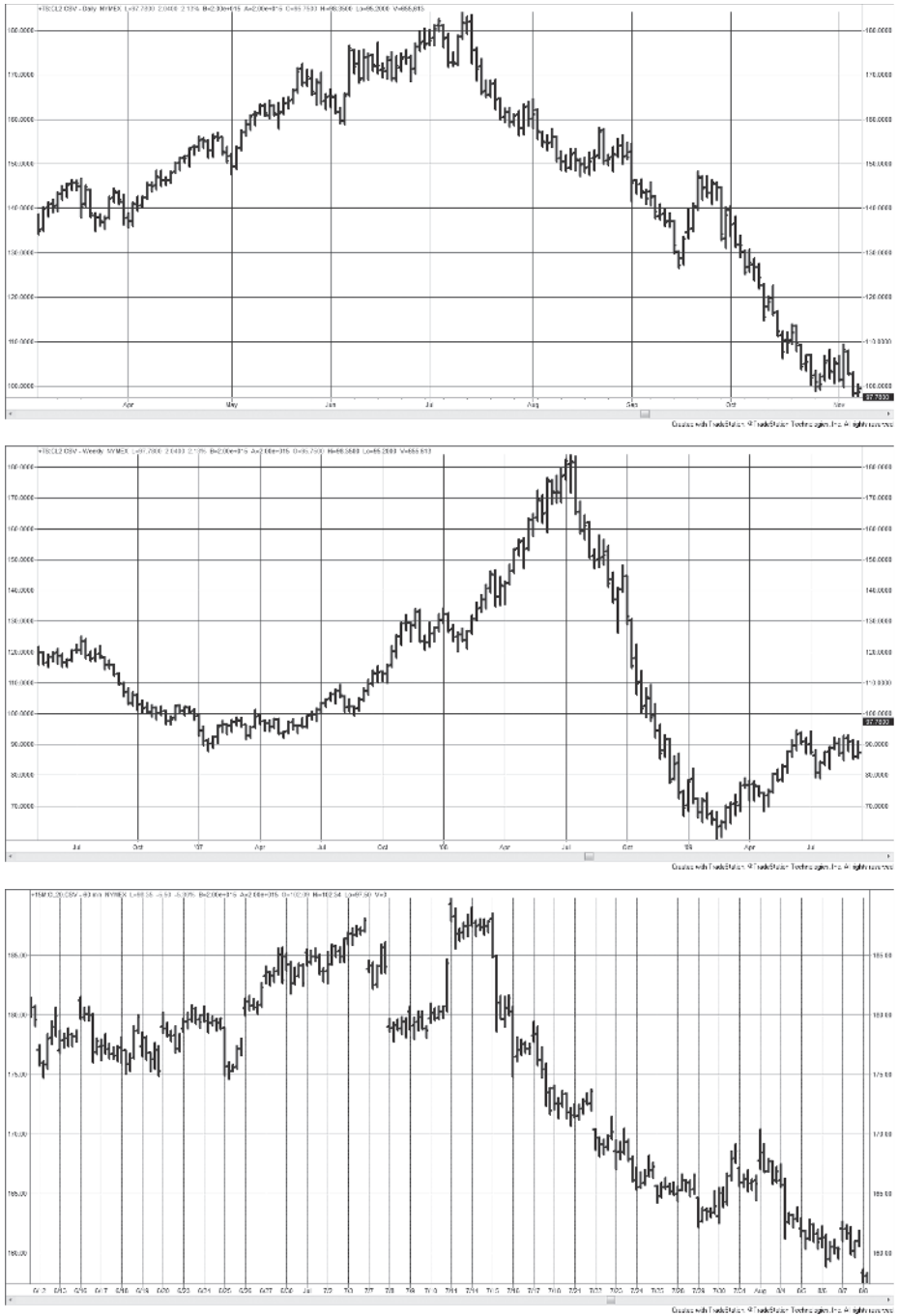


FIGURE 1.1 Crude oil prices weekly chart with July 2008 in the center (top); daily chart with July 2008 in the center (center); 20-min chart with July 2008 in the center (bottom).

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.

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

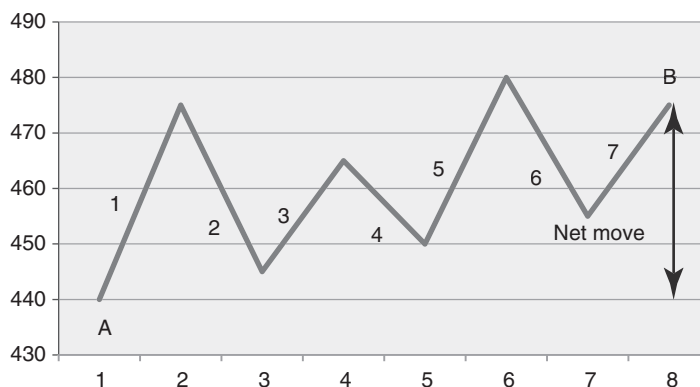


FIGURE 1.2 Basic measurement of noise using the efficiency ratio (also called fractal efficiency).

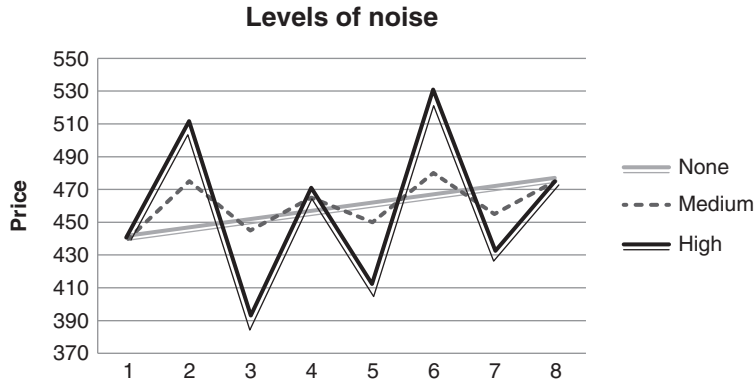


FIGURE 1.3 Three different price patterns all begin and end at the same point. The straight line shows no noise, the smaller variations are medium noise, and the larger swings are high noise.

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.”

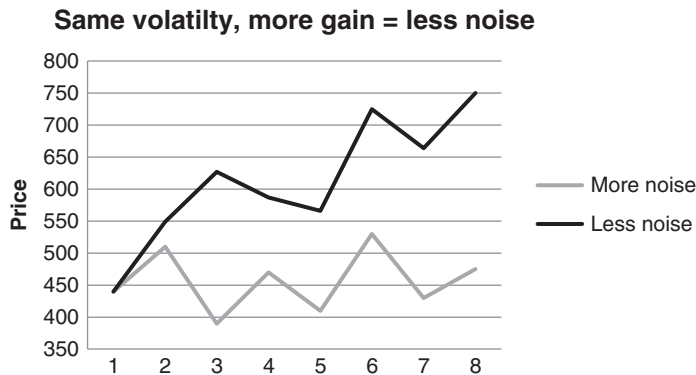


FIGURE 1.4 By changing the net price move we can distinguish between noise and volatility. If the sum of the individual price changes are the same, but the net move is larger, then the noise is less.

TABLE 1.1 These price changes, reflecting the patterns in Figure 1.4, show that larger individual price changes do not correspond to higher noise if the net change over the entire period is much larger.

Day	High noise	Low noise	Diff high	Diff low
1	440	440		
2	510	549	70	109
3	390	627	120	78
4	470	587	80	40
5	410	566	60	21
6	530	725	120	159
7	430	664	100	61
8	475	750	45	86
Net change	35	310	595	554
Noise			0.06	0.56

Other Measurements of Noise

The previous example of noise used the efficiency ratio; however, price density and fractal dimension may also be used. Intuitively, *price density* can be seen as the extent to which prices fill a box. If we take a 10-day period of price movement charted with highs and lows, and draw a box touching the highest high and lowest low, then the density is how much of that box is filled. It is measured as:

$$Price\ Density = \frac{\sum_{i=t-n+1}^{i=t} (High_i - Low_i)}{Max(n\text{-day high}) - Min(n\text{-day low})}$$

Fractal dimension cannot be measured exactly but can be estimated over n days using the following steps:

1. Max = highest high over n days
2. Min = lowest low over n days
3. $Range$ = $max - min$
4. $dx^2 = \left(\frac{1}{n}\right)^2$
5. $L = \sum_{i=t-n+1}^{i=t} \sqrt{dx^2 + \frac{p_i - p_{i-1}}{Range}}$
6. $FD = 1 + \frac{\ln(L) + \ln(2)}{\ln(2 \times n)}$

There is a strong relationship between fractal dimension and the efficiency ratio (fractal efficiency), and there is a similarity in the construction of price density and fractal dimension. Of the three methods of measuring noise, the efficiency ratio seems to be the clearest and that will be used in the following analyses.

Impact on Trading

Without preempting the discussion in Chapter 20 (“Trends and Price Noise”), a trend system will be more profitable when the price series has less noise, and a mean reversion strategy will be better when there is more noise. That is not to say the noise is the only factor that determines the outcome; however, selecting the best markets to trade gives you a better chance of success.

Noise applies equally to all time frames because it measures erratic price movement. In that regard, it satisfies the concept of fractals, which are repeated in the same way at all levels of detail.

On a macro level, noise can help choose which markets to trade. On a micro level, it can tell you whether to enter a market quickly or wait for a better price.

■ MATURING MARKETS AND GLOBALIZATION

The level of noise in each market can tell us about the maturity of that market and the nature of traders actively using it. The U.S. equity markets are where companies go to finance their business. Typical U.S. workers participate in the equity markets indirectly through their retirement program, and many are actively involved in making the decisions where to allocate those funds. The most conservative choose government debt obligations, such as 5-year Treasury notes or municipal bonds; more aggressive investors may allocate a portion to professionally managed funds. Some may actively trade their investment using ETFs, individual stocks, or futures.

Workers in other countries are not as involved in their equity markets, even though movement of the equity index in these countries reflects the health of their economy. With less involvement, there is less liquidity and with that, less price noise. However, most world markets are becoming more active, even if that liquidity comes from globalization, where traders from one country buy and sell shares in another country.

We can look at the way price noise has changed over the 20 years from 1990 to 2010 to see the maturity of the world markets, shown in Figure 1.5. As a benchmark, North America shows noise increasing each of the five years, and the highest noise of all regions. Europe and Australia follow close behind. Eastern Europe shows a rapid change from low to high noise, indicating a surge in trading activity. Latin America has the lowest level of noise (the highest value) but is represented only by Mexico. In general, the level of noise has increased as globalization has increased.

For traders, emerging markets have lower liquidity and less noise. Trend systems work well until noise increases. It is only the lack of liquidity, and often difficulty in accessing these markets, that prevent traders from capturing large profits.

Asia continues to be the most important area of world development. China, which holds most of the U.S. debt, has given a great deal of economic freedom

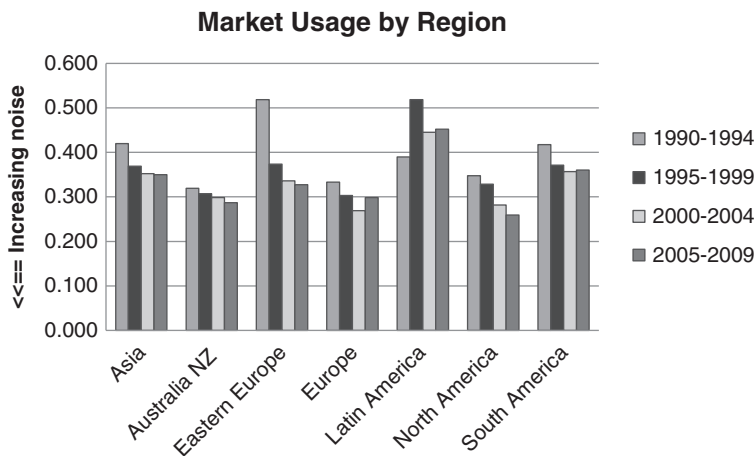


FIGURE 1.5 Relative change in maturity of world markets by region

to its people, but limited access to the equity markets for outside investors. Figure 1.6, which is ranked from higher to lower noise values (less maturity to more maturity) from left to right shows the relative development of the Asian equity markets. It is not surprising that Japan is the most developed, followed by Hong Kong, Singapore, South Korea, and Taiwan. These represent the most open economies in Asia. At the other end are Sri Lanka, Vietnam, Pakistan, and Malaysia, countries without access to global investors. India's Sensex shows greater participation than the China Shanghai Composite, but both are toward the center of the ranking. As more traders have access to these markets, as they should in the future, they will move toward the right in the ranking.



FIGURE 1.6 Ranking of Asian Equity Index Markets, 2005–2010.

■ BACKGROUND MATERIAL

The contents of this book assume an understanding of the stock market and futures markets, such as the S&P 500 and Treasury notes. Futures markets have a great impact on stock patterns and trade 24 hours a day. The rules and mechanics of those markets are not explained here unless they directly relate to a trading strategy. Ideally the reader should have read one or more of the available trading guides and should understand the workings of a buy or sell order and the contract specifications of futures. Experience in actual trading would be helpful. It's an advantage if you enjoy playing competitive games and that you like to win.

There are excellent books available to both the beginning and advanced trader. Jack Schwager's *Complete Guide to Futures Markets* (2017) is a new edition of a classic, as well as the popular *Market Wizards* (updated 2012). For equities, the newest version of Edwards, Magee, and Bassetti, *Technical Analysis of Stock Trends*, remains a favorite. There are too many to name them all, so I'll tell you the technical books that are in easy reach of my desk, in alphabetic order by author's last name (details can be found in the Bibliography): Carol Alexander, *Market Models*; Peter Bernstein, *The Portable MBA*; Thomas Bulkowski, *Encyclopedia of Chart Patterns* and *The Encyclopedia of Candlestick Patterns*; John Ehlers, *Cycle Analytics for Traders*; Mark Fisher, *The Logical Trader*; John Hull, *Fundamentals of Futures and Options*; Andrew Lo, *Adaptive Markets*; Edgar Peters, *Chaos and Order in the Capital Markets*; and Cliff Ragsdale, *Statistical Modeling*. Of course, there are my own books, which I refer to often (see Bibliography).

Your list of worthwhile books should also include John Bollinger, *Bollinger on Bollinger Bands*, and Martin Pring, *Technical Analysis Explained*, as well as Robert Colby, *The Encyclopedia of Technical Market Indicators* (Dow Jones Irwin, 2002), Alex Elder, *The New Trading for a Living* (Wiley, 2014), and Nassim Taleb, *Fooled by Randomness*.

For a constant flow of both classic and new techniques, the magazines *Technical Analysis of Stocks & Commodities* and *Modern Trader* have numerous articles on trading systems and methods. A basic understanding of market phenomena and relationships, often requiring some math skill, can be found in the *Financial Analysts Journal* (CFA Institute).

Books that should be read by every trader, and are also next to my desk, are Edwin Lefevre, *Reminiscences of a Stock*; Sun Tzu, *The Art of War*; Charles MacKay, *Extraordinary Popular Delusions and the Madness of Crowds*; and my favorite, *The Logic of Failure* by Dietrich Dörner. There are also books by Neil deGrasse Tyson because my interest in the universe goes back to my original career path.

Blogs, User Groups, and Associations

Times have changed, and the Internet contains a great deal of material on trading systems not published elsewhere. It requires some sifting to locate information that you find relevant, but there are useful ideas out there. Just don't expect to find the golden chalice. You'll need to take the ideas, develop them, and test them

yourself. Not all will be as good as they first appear. But ideas are valuable. Scan for “Trading Systems blogs.”

There are a number of associations and user groups that can be very helpful to traders at all levels. The CMT Association (renamed from the Market Technician’s Association) offers a Certified Market Technician credential, and the CFA Institute (previously the Association for Investment Management Research, AIMR) offers the Charter Financial Analyst credential. For those with higher math skills, the International Association of Financial Engineers (IAFE) offers excellent resources. There are also *user groups*, sometimes called *forums*, for all of the popular development platforms, such as TradeStation, MetaStock, and Ninja Trader. These groups usually meet in larger cities, but can be reached on social media and are a valuable resource for solving a difficult problem.

As for this book, a reader with a good background in high school mathematics can follow everything but the more complex parts. A basic course in statistics is ideal, but knowledge of the type of probability found in Edward Thorp’s *Beat the Dealer* (Vintage, 1966) is adequate. Fortunately, computer spreadsheet programs, such as Excel, allow anyone to use statistical techniques immediately, and most of the formulas in this book are presented in such a way that they can easily be adapted to spreadsheets, if they are not already presented that way. Even better, if you have a computer with trading software, you are well equipped to continue. If you have a live data feed, such as Bloomberg, Reuters, or Thinkorswim, you will also have access to technical studies that you will find very helpful. Bloomberg and Reuter’s are also excellent sources of global data.

■ SYSTEM DEVELOPMENT GUIDELINES

Before starting, there are a few guidelines that can help make the task of developing a trading system easier.

1. **Know what you want to do before you start.** Base your trading on a sound premise. It could be an observation of how prices move in response to government policy, a theory about how prices react to economic reports, or simply a pattern that shows up at the same time each day or each month. This is the *underlying premise* of your method. It cannot be *discovered* by computer testing. It comes from the experience of observing price movement, reminiscent of Jesse Livermore, and understanding the factors that drive prices. If that’s not possible, then select ideas from credible books or articles.
2. **State your idea or premise in its simplest form.** The more complex, the more difficult it will be to evaluate the answer and to understand the interaction of the parts. Simple methods tend to have more longevity. Remember *Occam’s razor*.
3. **Do not assume anything.** Many projects fail on basic assumptions that were incorrect. It takes practice to avoid making assumptions and to be critical of certain elements that you believe to be true. Verify everything.

4. **Try the simplest and most important parts first.** Some of the rules in your trading program will be more important than others. Try those first. It's best to understand how each rule or technique contributes to the final system. Then build slowly and carefully to prove the value of each element of the system. The ability to readily understand the operation of each part of your system is called a *transparent solution*, rather than a *fully integrated* or *complex* one. Transparent solutions are very desirable.
5. **Watch for errors of omission.** It may seem odd to look for items that are not there, but you must continually review your work, asking yourself if you have included all the necessary costs and accounted for all the risk. Simply because all the questions were answered correctly does not mean that all the right questions were asked.
6. **Question the good results.** There is a tendency to look for errors when results are bad, but to accept the results that are good. Exceptionally good results are just as likely to be caused by errors in rules, formulas, or data. They need to be checked as carefully as bad results. "Surprisingly good" results are often wrong.
7. **Do not take shortcuts.** It is sometimes convenient to use the work of others to speed up the research. Check their work carefully; do not use it if it cannot be verified. Check your spreadsheet formulas manually. One error can ruin all your hard work.
8. **Start at the end.** Define your goal and work backward to find only the necessary input. In this way, you only work with information relevant to the results; otherwise, you may expend a lot of unnecessary effort.
9. **Be tenacious.** Not all ideas work the first time, or the second. If you believe that your idea is good, keep working at it. There might be a "bug" in your code, or you might have omitted a rule that will make it successful.

■ OBJECTIVES OF THIS BOOK

This book is intended to give you a complete understanding of the tools and techniques needed to develop or choose a trading program that has a good chance of being successful. Execution skill and market psychology are not considered – only the strategies, the methods for testing those strategies, and the means for controlling the risk. This is a goal of significant magnitude.

Not everything can be covered in a single book; therefore, some guidelines were needed to control the material included here. Every technique in this book qualifies as systematic; that is, each has clear rules. Most of them can be automated. We begin with basic concepts, including definitions, how much data to use, how to create an index, some statistics and probability, and other tools that are used throughout the book. The next several chapters cover the techniques that

are most important to trading, such as the trend and momentum. All chapters are organized by common grouping so that you can compare variations of the same basic method. Although charting is an extremely popular technique, it is included only to the degree that it can be compared with other systematic methods, or when various patterns can be used in a computerized program (such as identifying a key reversal day). There has been no attempt to provide a comprehensive text on charting; however, various formations may offer very realistic profit objectives or provide reliable entry filters.

Neither stock options nor options on futures are included in this book. The subject is too large and too specialized. There are already many good books on options strategies. The exception is that there are strategies using VIX, and comparisons of implied volatility versus historic volatility.

This book does not attempt to prove that one system is better than another, because it is not possible to know what will happen in the future or how each reader will cleverly apply these techniques. Instead the book evaluates the conditions under which certain methods are likely to do better and situations that will be harmful to specific approaches. By grouping similar systems and techniques together, and by presenting many of the results in a uniform way, you should be able to compare the differences and draw your own conclusions. Seeing how analysts have modified existing ideas can help you decide how to personalize a strategy and give you an understanding of why you might choose one path over another. With a more complete picture, common sense should prevail over computing power.

■ PROFILE OF A TRADING SYSTEM

There are quite a few steps to be considered when developing a trading program. Some of these are simply choices in style while others are essential to the success of the results. They have been listed here and are discussed briefly as items to bear in mind as you continue the process of creating or choosing a trading system.

Changing Markets and System Longevity

Markets are not static. They evolve as does everything else. The biggest changes continue to be in technology, participation, globalization, new markets, and the cost of doing business.

Technology includes communications, trading equipment (primarily computers and handheld devices), electronic exchanges, data access, and order entry. These innovations have accelerated the trading process. Electronic markets have changed the nature of the order flow and made information about buyers and sellers more accessible. They have changed the speed at which prices react to news, and they have facilitated high-frequency trading and smart executions.

Globalization is mostly the result of the advances in communications. Not only can we see the same news at the same time everywhere in the world, but we can

pass on information just as quickly. Equally important, we do not think about the reliability of our equipment. We expect our computers, telephones, and Internet connections to work without question. When we trade, we are willing to bet on it.

The dramatic reduction in commission cost has been a major influence on trading, opening opportunities for the fast trader. For institutions, stock transactions can be done at a fraction of a cent per share, and the individual investor will pay no more than \$8 per order and as little as \$1. This not only facilitates fast trading but encourages greater participation. Everyone wins.

The challenge for the trader is to find a system that will adapt to as-yet-unknown changes in the future. Most changes are not sudden, but are gradually reflected in price patterns (alternating with an occasional price shock). Biogenetic research has increased crop production while global warming may do the opposite. The rising middle class in China and India will change the demand for energy and retail goods. The increase in trading choices – ETFs, mutual funds, stocks, futures, options – causes a complex interdependence of markets. Index arbitrage and the trading of sector ETFs force the component stocks to move in the same direction regardless of their individual fundamentals. It is both challenging and rewarding to create a program with longevity.

The Choice of Data

System decisions are limited by the data used in the analysis. Although price and volume for the specific stock or futures market may be the definitive criteria, there is a multitude of other valid statistical information that might also be used. Some of this data is easily included, such as price data from companies in the same sector or industrial group, or the current yield curve relationship. Other statistical data, including the wide range of U.S. economic data and weekly energy inventories, may add a level of robustness to the results but are less convenient to obtain and less timely.

Diversification

Not all traders are interested in diversification, which tends to reduce returns at the same time that it limits risk. Concentrating all your resources on a single market that you understand may produce a specialized approach and much better results than using a more generalized technique over more markets. Diversification may be gained by trading two or more unique strategies applied to the same market, instead of one strategy used on a broad set of markets. On the other hand, overdiversification can introduce marginal returns with greater risk. It will be important to find the right balance.

Trade Selection

Although a trading system produces signals regularly, it is not necessary to enter all of them. Selecting one over another can be done by a method of filtering.

This can be a confirmation of another technique or system, a limitation on the amount of risk that can be accepted on any one trade, the use of outside information, or the current volume. Many of these additional rules add a touch of reality to an automated process. You may find, however, that too many filters result in overfitting or no trading.

Testing

A mistake in testing may cause you to trade a losing strategy or discard a profitable one. Back-testing is the only option available to confirm or validate your ideas. Testing is misguided when it is used to “discover” a trading method by massive scanning of techniques. A robust solution, one that works on many stocks or across similar markets, will never appear as good as an optimized result of a single stock. But using the same system for all stocks in the same sector exposes it to more patterns and will give you a more realistic assessment of expectations, both risk and reward, and a much better chance of success.

Risk Control

Trading survival requires risk control. Risk must be addressed at all levels. It begins with the individual trade, but must also balance the risks of all markets in a common sector, the risk of those sectors in a portfolio, and finally the risk of multiple systems traded together. Trade risk can be controlled using a stop-loss but can effectively be managed by volatility. Futures traders must also pay attention to leverage. Risk management does not need to be complex, but it cannot be overlooked.

Transaction Costs

A system that performs well on paper may be dismal when actually traded. Part of a trading program is knowing how to enter and exit the market, as well as having realistic expectations about the transaction costs, both commissions and slippage. Short-term, fast trading systems are most sensitive to transaction costs because the expected profit on each trade is small. Directional trading strategies, those that buy as prices are rising and sell when they are falling, have larger slippage than mean reversion techniques.

There is equal damage in overstating costs as there is in underestimating them. By burdening a system with unrealistic fees, tests may show a loss instead of a profit, causing you to reject a successful trading method.

Performance Monitoring and Feedback

A system is not done when you begin trading; it is only entering a new phase. Trading results must be carefully monitored and compared with expectations to know if the system is performing properly. It is very likely that knowing the true execution slippage will cause you to make some changes to the system rules or to

the size of the positions. Performance monitoring provides the essential feedback needed to be successful. It can be an early warning that tells you something is wrong, or it can give you added confidence that everything is going well.

■ A WORD ABOUT THE NOTATION USED IN THIS BOOK

To make the contents of this book more useful for trading, some of the traditional mathematical formulas are also shown as Microsoft's Excel notation, as well as TradeStation's *EasyLanguage*. *EasyLanguage* can be understood by anyone who has experience with a programming language, and is easily converted to other development platform code. You will find hundreds of examples on the Companion Website, with references to them noted in the margins throughout the book.



Some of the examples are more complex systems and indicators, written in either, or both, Excel and *EasyLanguage*. Although these programs have been carefully tested, there may have been occasional errors introduced during final editing. Recent market activity may also produce combinations of price movements that did not occur during the test period. Readers are advised to check over the code and test it thoroughly before using it.

Be aware that the statistical functions may have slightly different names in different platforms. For the standard deviation, Excel uses *stdev* while *EasyLanguage* uses *stddev*. One program expects the mean to be *avg* while another requires *average*. Excel uses *log* when it's really *ln* (natural log). Please check the notation in each formula and solution so that it reflects your needs.

■ A FINAL COMMENT

Throughout this book the *principle of unnecessary plurality*, better known as *Occam's razor*, will be stressed. The principle states that, *given more than one explanation or solution, the simplest one is the preferred*. (Smart people have been around for a long time.) When developing or choosing a trading strategy, it is normally the case that adding complexity for the sake of a few extra basis points increases the potential problems and risk more than it increases returns.

Pluralitas non est ponenda sine necessitate.

William of Ockham (c. 1285–1349)

The goal here is to provide the tools and the understanding to help both aspiring and experienced traders develop systematic ways to trade that satisfy their inherent risk preference and their investment objectives. It is unlikely that any two traders will develop the same system, but the greater their knowledge, the more likely it will be profitable.