IRWIN TRADER'S EDGE

PATTERN RECOGNITION AND TRADING DECISIONS

- IDENTIFY SIGNALS TO PROFITABLE TRADES
- APPLY PATTERN RECOGNITION TO ACTUAL TRADING
- INCLUDES A COMPLETE CHECKLIST FOR TRADING DECISIONS

CHRIS SATCHWELL

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To the memory of my parents
John and Ivy

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DISCLAIMER

The behavior of financial instruments can be unpredictable, and investments in them, or the income they yield, can go down as well as up. This book attempts to describe general techniques used by professional investors to minimize risks and improve returns, but they are based on historical experience, may be subjective, and, at best, work only for part of the time. While there may be an expectation that the techniques will continue to work for enough of the time to be useful, market conditions change constantly, and there is no guarantee that they will do so or that they will necessarily produce a correct or useful result for a specific decision.

Specific securities are referred to in this book for illustrative purposes only, and comments made should not be taken as a guide to their current condition or future prospects.

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CONTENTS

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PREFACE

Many people have a perfectly natural wish to manage their own investments, and the growth of the online brokering industry has helped them to realize that ambition. An awareness of professional decision-making techniques should improve online investors' chances of success, and it is what this book tries to convey. This book has been written in the years following the 1990s boom, when belief in a "new economy" and "new valuation methods" led to a disregard of sound economic principles and resulted in a bubble from which many people suffered. The linkage between investment banking and fund management activities meant that doubters were either disregarded or fired for expressing views considered contrary to their organization's overall interests. The whole situation was made worse by a media whose members often participated in the boom and stood to benefit by telling the public what they wanted to hear rather than unpalatable truths. Mutual fund sales representatives needed performance to sell, which was obtainable only if their fund managers invested in "new economy" companies. Recently formed Internet companies achieved market capitalizations rivaling those of large established defense contractors. For one reason or another, each of the participants in the boom could justify his or her individual actions, but the net result for the average fund investor was that sound economic expertise available to the investment industry was not applied to the management of their money. A postbubble collapse of confidence left many investors feeling that their trust had been betrayed and their best option was to manage their own investments. The problems investors have in managing their money well are often underappreciated, and this book aims to make a contribution to their solution.

Participants in the markets of the late 1990s may have thought then that profitable investing was easy, only to learn later, to their cost, that it may be easy during a bull market but not necessarily at other times. There are books that claim to make investing easy and other books that typically claim that you too can be rich if you follow the guru who wrote it. With respect, the points I make to the guru are that when financial conditions change, exploitation strategies need to change with them, meaning that any single method will not work all the time. Furthermore, investors have such a wide range of preferences, individual circumstances, and needs that a guru's method is likely to be appropriate for only a subset of their population. With regard to those who claim to make investing easy, if they could, professionals would use their methods and perform much better than they do. I would add that there is also a crucial step that is often glossed over. Typically, potential investors are given the address of useful Web sites where they can obtain the information they need to make their decisions. When the new investors go to one of these Web sites, they are likely to be confronted by information in jargon they do not understand, for which they have no background knowledge but from which they are supposed to make a decision.

This book is about market decisions. It offers no empty promises for easy wealth. It aims to help people to understand the methods and terminology used by the investment industry and give background on decision techniques in general, so that they can select those that best suit their needs, or reject them if they feel they have something better. It offers a representative span of the decision processes between understanding financial instruments to managing portfolios. It does not cover other aspects, such as selecting a broker, at any length.

Much received market wisdom has now been captured in software or Web-delivered services. An ever-expanding range of offerings is becoming available to the online investor. Much of this will be discussed in the book, and the accompanying CD ROM contains examples of some of these offerings in the form of illustrative software for technical indicators and portfolio optimization, as well as educational material and a library of trading patterns. Proprietary offerings exist to help the online investor with the processes of stock selection, exploitation strategies, and portfolio management. But, to the best of my knowledge at the time of this writing, these offerings do so in a piecemeal way and fall well short of forming an integrated package from data through to portfolio decision. My vision is that these piecemeal packages will be integrated to offer the online investor an easier road to improved investment decisions, with appropriate interfaces for human inspiration and intervention. Furthermore, my hope is that investors should be able to appreciate and understand the background to the internal workings of these packages and develop the confidence to use them through the content of this book. The essential point is that methods used by professional investors, and a representative sample of their decision techniques, need to be explained to new investors, in a cohesive way, to help them appreciate the risks and rewards of investing and avoid the disappointments that ignorance of these techniques often brings.

To return to the dot-com boom of the late 1990s: This was a time of inflated expectations for a new industry. Many participants knew they were paying too much for their shares, but they did not want to be left out and bought them on the assumption that the boom would continue and that, before any price collapse, they could sell them at a profit to others wanting their piece of the action. Some mortgaged their homes to participate in the boom. That had an uncanny historical parallel with the identical actions of people in Holland in the 1630s, who wanted to participate in an upwardly spiraling market for tulip bulbs—but got caught out just as many investors in the dot-com boom did. This tendency of history to repeat itself, and curiously, the repeated tendency for a new technology to "justify" the invalidation of past financial history during boom times, is a reason why a historical perspective to the markets is unashamedly offered, so that readers can see how decision techniques would have worked at different times in the past to find parallels to decisions they have to make.

Looking at the Dow Jones Industrial Average, it reached 100 in the early years of the twentieth century, and it last revisited that level around 40 years later. It reached 1,000 in the mid-1960s and last revisited that level around 16 years later. It reached 10,000 in the late 1990s, and at the time of this writing, it remains to be seen how long it will oscillate around that level before (it is hoped) it heads upward to a new frontier. The Dow's rise has been complex and promises to be so in the future. Exploiting markets with complex behaviors means that multiple investment strategies are likely to be needed, and one that has worked well over many years may suddenly stop working and need to be replaced by one more suited to the changed financial conditions. Continuing to use a failed investment strategy is just one mistake that those who fail to study financial history are probably condemned to repeat—but those who do study it, to see how decision techniques would have worked in the past, develop an awareness of dangers and opportunities, and they acquire the background and confidence they need to make better market decisions.

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ACKNOWLEDGMENTS

I would like to acknowledge and thank colleagues at Recognia Inc. and Technical Forecasts Limited for their help in the preparation of this book. Thanks are also due to Joaquin Castillo for his help with many practical issues; Recognia Inc. for the use of their software, educational material, and trading pattern library; and to Standard & Poor's for access to their Compustat database and software, advice received on fundamental analysis, and for making their GICS database available to readers.

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PART ONE

Markets and Decisions

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CHAPTER 1

Introduction

To make money in the markets, you need to buy low and sell high, or sell high and buy low. This book is designed to help people do that in a way that is consistent with their preferences and abilities.

Each and every individual is endowed with a unique set of life experiences, preferences, principles, and needs. An observant homemaker might become knowledgeable on supermarkets; a geologist on oil exploration companies; a nurse on health care companies, and a pilot on airlines—and so the list goes on. Some people might prefer to invest for the long term, and others the short; some may be approaching retirement and be risk averse, whereas others, with their lives ahead of them, could take the view that they can afford to fail since they are young enough to start again. It follows that no single approach to exploiting the markets can simultaneously allow all individuals to utilize their unique expertise, accommodate their temperaments, principles, and preferences, and suit their financial circumstances—but an overview of available decision techniques and discussion of the issues should help them to formulate and achieve their goals or at the very least, do better than they would have without it.

Literature on exploiting financial markets tends to be both specialized and diffuse. Many good books have been written on the markets, and I have a number of personal favorites among them—but for a new investor wanting to acquire an overview of market decision techniques, there is the problem of having to absorb the contents of many books, written in many styles, without such an overview in mind. The principal subject clusters in market literature are types of tradable instruments, psychology, fundamental analysis, and technical analysis. One of the aims of this book is to cover all four topics in as far as it is necessary to offer an overview of market decision-making techniques. This approach contrasts with the new investor's alternative of reading excellent but specialized literature—the result of which tends to lead to an archipelago of unconnected islands of specialist knowledge lacking in synergy. The overview to market decisions offered by this book provides a base from which the contents of more specialized books can be much better appreciated; that is, this book provides a skeleton onto which specialist books can usefully add flesh.

Another aim of this book is to enable online investors to make better decisions, which are likely to come through the use of software and Web-delivered services. Many investors are shy of tools they do not understand, and many probably do not want to learn the mathematics to use them anyway. Software and Web-delivered services embed expertise to offer a shortcut through many of these objections, but the fact remains that potential users not only need to know what these tools do but also need to acquire sufficient background knowledge to build up their confidence to use them. The approach used here is to try to describe the formulation of the problems being solved by such tools without getting bogged down in the details of solutions; that is, describe the problems being solved but ask that the reader trust the software or service provider to solve them properly. This is not a mathematics book and assumes only a limited knowledge of the subject, but for clarity, especially for readers who may be challenged in that area, mathematical terms are explained at some length. A bare minimum of mathematical explanation is in the main text, with more detailed mathematical explanations given in appendixes for those wanting to pursue them. Mathematically challenged readers are people I do not want to lose, and so I have tried to write the limited mathematical sections of the main text in a comprehensible way to keep the book intelligible to them.

In addition to commercial services, there are some superb financial Web sites freely available, which many online investors could profit from more than they do at present. Knowledge from this book should help in understanding the content of these sites and offer the investor the key to reaping greater rewards from them. In some respects, the content of this book goes a stage further, to describe software and services likely to become available in the years after these words are written.

Online investors are vulnerable to, but often unaware of, the psychological pressures that afflict professional investors. These pressures are often the cause of bad decisions but can sometimes help in the forming of good decisions, and so they are included to increase awareness and avoid damage to wealth.

The book is divided into four parts. In this first part, market behavior, psychology, and decision theory are covered. For the uncertain environment of the markets, decision theory yields an interesting result, which has a parallel in the reasons why portfolio diversification works. The result is that a decision derived from a correctly integrated portfolio of independent results, from multiple independent solutions to a problem, leads to less error. Translated to market decisions, this means that if a decision can be looked at from multiple independent perspectives, and the results of each perspective properly weighted in any final decision, then that final decision is more likely to be correct than one derived from a single perspective. In consequence, an overview of several decision techniques is likely to be more useful than the specialist knowledge of just one. (The professional investment industry discovered this by trial and error many years ago, and one of its techniques is to examine a potential investment decision using a committee of analysts who use diverse methods to arrive at their individual decisions.) This observation provides an additional reason why this book has been designed to offer such an overview.

Part 2 covers fundamental analysis, and how a mismatch between price and intrinsic value can give rise to an expectation of a price correction.

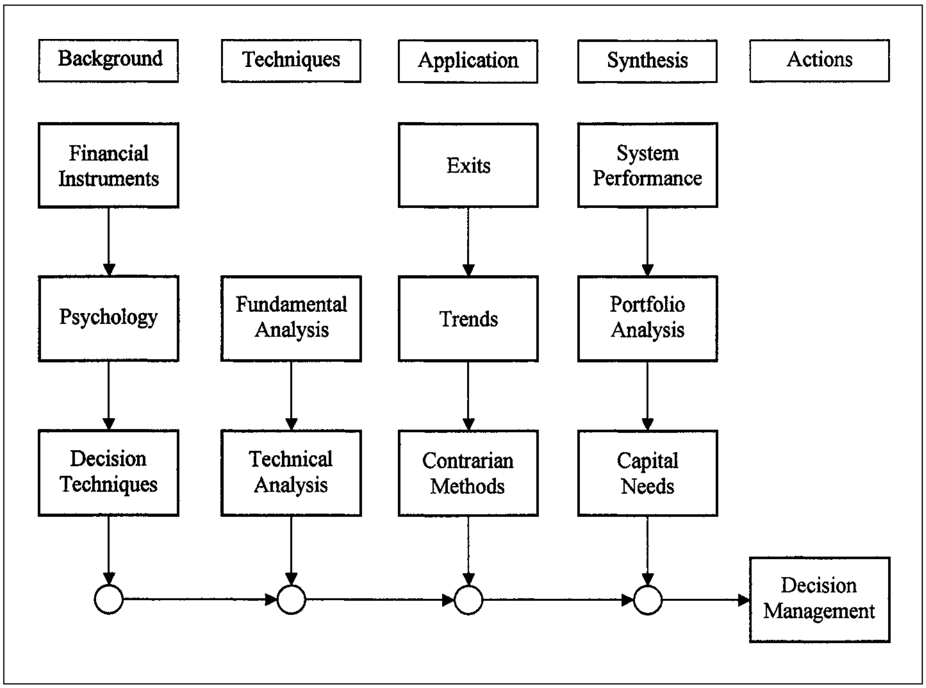


FIGURE 1.1

Flow of content.

Part 3 begins with some basic, but effective, techniques of technical analysis, and gradually increases in complexity all the way to forecasts and what to expect from them.

Part 4 aims to draw on the diverse elements of this knowledge to show how the practical problems that investors face can be addressed. It introduces trading systems and portfolio theory, and it explains why portfolio diversification is needed to preserve safety of capital. The book ends with an account of how to manage the decisions for a job-friendly, lifestyle-friendly portfolio, with some weekend study and orders placed for execution on Monday morning.

A diagram illustrating the flow of content through this book is shown on the previous page in Figure 1.1.

CHAPTER 2

Behavior of Financial Instruments

BASIC MARKET CONCEPTS

FINANCIAL INSTRUMENTS AND PRICE CHARTS

For the purposes of this book, a *financial instrument* is defined as something that is traded on an exchange. Financial instruments fall into various categories and can have differing properties, so the general topic *financial instruments* will be subdivided into *shares* and *futures*, so that their differing properties can be appreciated. The first of these is *price*, which is a common property of all financial instruments.

For each session an exchange is open for trading (usually daily), four prices are recorded and widely reported for each financial instrument traded. These are the prices at the trading session's open and close and the highest and lowest prices reached. They are known as the *open*, *high*, *low,* and *close* (OHLC) *prices*. Each financial instrument has a metric that defines a minimum quantity capable of being bought or sold (a *share* for securities or a *contract* for futures); and for each trading session, the total number of sales (or purchases), expressed in terms of this metric, is recorded. This total is known as the *trading volume for the session*, or more commonly, the *volume*. There are two conventions for displaying this data on a chart, one of which is a *bar chart* (Figure 2.1a) and the other, a *candlestick chart* (Figure 2.1b).

In Figure 2.1a, open prices are shown by the short horizontal lines to the left of the vertical bars, closing prices by the short horizontal lines to the right of the vertical bars, price lows by the lowest points of the vertical bars, and price highs by the highest points of the vertical bars. In Figure 2.1b, highs and lows are again shown by highest and lowest points of candlestick bars,

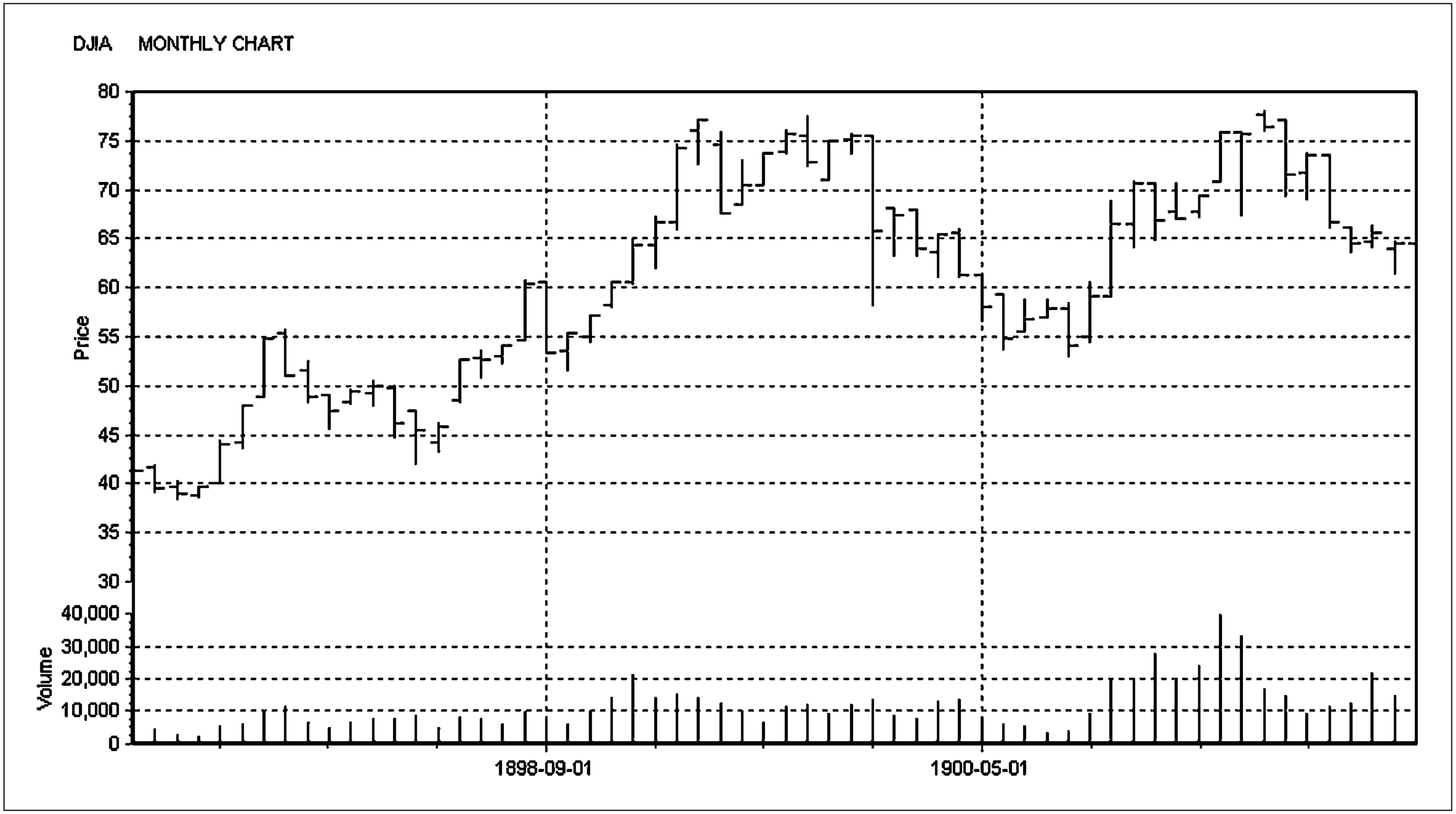


FIGURE 2.1a

This is a typical *bar chart* in which the vertical lines represent the extremities of a period's (in this case month's) trading, the left horizontal bar the open price, and the right horizontal bar the closing price. The volume for a trading period is shown by a vertical line at the base of the chart.

FIGURE 2.1b

This is the same information as in Figure 2.1a but with a middle rectangular region indicating price movement between open and close. Where the rectangular region is colored black, the close is below the open; where it is colored white, the close is above the open. In this display, price information for the period is shown by a *candlestick,* whose extremities reflect the high and low values reached. Volume for a trading period is shown by a vertical line at the base of the chart.

but there is now a rectangular section, which is usually in the middle of the bar. Where this is filled in (black), the trading session closed below the open, and where it is not filled in (white), the trading session closed above the open. Note that where open and close prices are less than a line width apart, the rectangle loses a distinct identity and becomes a line. Both of these charts display exactly the same information, allowing any uncertainty about the information given in one format to be checked with the other. The volume of the trading session is shown by the vertical lines at the base of the charts and is read from its own scale.

PRICE BARS

Price activity within a bar has been studied at length by J. Peter Steidlmayer, who shows diagrams indicating one or more "value areas" where most of the trading takes place and (typically) low-volume trading areas near highs or lows, where price extremes are probed but trading drops off due to a lack of buyers or sellers, respectively. During a trading session, the value area may shift (depending on the balance between buyers and sellers), but usually identifiable clusters of trades will still form around specific price points, from which buyers and sellers will then probe to see if they can move prices in their favor.

The open price is interesting as it may be more of a range than a single price. Some traders spend the first hour or so of a trading session assessing what that range is in the hope of finding guidance on the way prices are heading. Closing prices are again interesting, as they represent a decision time for day traders: either leave a position open overnight (or over a weekend) and accept exposure to price-influencing news, or play safe and exit the position. I think of closing prices as "make-your-mind-up" prices. My studies to date show them to be a more reliable indicator of the future than open, high, or low prices. I should also mention that there is a contrary view held by many analysts that a closing price is just another price on a price bar with no greater significance than any other.

VOLUME

As mentioned earlier, *volume* is simply the number of measurable units of a financial instrument that are bought (or sold) during a trading session. There are two ways of looking at the relationship between volume and price. In low-volume trading, it is often possible to move prices a good deal, which means that low volumes can be associated with high price movements. Equally, low volumes might be associated with a flat market. With the same financial instrument, on another occasion, there might be a high volume of trading in a narrow price range, which means that many people agree that the price is correct. Similarly, a high volume could be associated with a wide price range, which means that there is less agreement on price but some urgency to transact. My conclusion is that there is no consistent relationship between volume and price movement, but volume/price patterns exist that do have predictive value. We will examine some of these later. A point about volume that needs to be appreciated is that it offers a measure of the *urgency* with which people wish to trade. For example, at market tops high volumes sometimes mean that the wise money is leaving the market and the unwise entering.

BID, ASK, SPREAD, LIQUIDITY, AND SLIPPAGE

One of the difficulties of trading is that of finding a buyer or seller offering a trade at a reasonable price whenever something needs to be bought or sold. Techniques to bring buyers and sellers together are evolving, helped now by both computer networks and globalization to bridge the difficulties of distance and protectionism. While this helps, some basic problems currently remain for many investors. First, if they wish to sell an inactively traded security, they are up against buyers' concerns about their chances of selling it later on, which means that buyers are unlikely to offer as much for it as they would for securities that were more actively traded. Conversely, in the absence of many shares being offered, anybody wishing to buy such a security might have to offer a premium to attract a seller. There is therefore a difference between the price at which something is offered for sale (the *ask*, or *asking price*) and the price at which an offer is made for its purchase (the *bid*, or *bidding price*). This difference is known as the *spread*, which is simply the ask less the bid. If an intermediary is needed to keep markets moving, he or she will attempt to profit from the spread by buying at the bid and selling at the ask, unlike conventional investors, who have to buy at the ask and sell at the bid.

Liquidity is the term used to express the ease with which something can be traded. In markets where there are large numbers of buyers and sellers in roughly equal proportions, liquidity is high and so the spread is low. If there are few participants or an imbalance between buyers and sellers, then the spread can be large and liquidity poor. In particular, in a collapsing market, it can be difficult to find buyers, and conversely, in a booming market, it might be difficult to find sellers. Such situations involve poor liquidity on one side of a trade only, with excellent liquidity on the other. In general, high volumes and low spreads reflect markets that are liquid such that financial instruments can be readily traded for roughly similar prices whether bought or sold. For conventional investors, there is one final term of interest in this area: *slippage*, which expresses the loss on a trade due to the spread.

A HISTORICAL PERSPECTIVE ON PRICE BEHAVIOR

The Dow Jones Industrial Average (DJIA) is an index based on the behavior of 30 stocks traded on the New York Stock Exchange (NYSE). Figure 2.2 shows prices for the Dow Jones Industrial Average, from 1897 to 2002, in annual price bars, plotted to a logarithmic scale. This long-term view is presented so that lessons from history can be digested; to provide a context for everything that follows; and to help investors appreciate some of the mistakes made in the past.

One of the features that immediately stands out in Figure 2.2 is the great crash of 1929 and subsequent bear market to 1932, a period in which prices fell from a high of 381 to a low of 41. Previous and subsequent bear markets pale into insignificance compared with this one. By contrast, figures for the bear market of 2000 to 2002 barely register on the logarithmic price scale despite the financial pain they have caused to many investors' savings—indicating the true level of distress that must have existed in the early 1930s. We will return to this later.

From 1903 to 1906, there was a bull market that saw the Dow penetrate 100 for the first time. In 1907 the Dow lost around 50 percent of its value. The Dow then meandered between 50 and 120 until the 1920s—that is, it spent around 20 years at the start of the twentieth century roughly doubling and halving its value. The 1920s saw a bull market, when its value almost quadrupled to over 380, before the bear market, beginning in 1929, took it back down to just over 41 in 1932. In round figures, the Dow lost almost 90 percent of its value during this period. There was then a limited recovery and subsequent decline that saw the Dow back below 100 early in 1942, shortly after the attack on Pearl Harbor. At its simplest, the Dow reached 100 in the early years of the twentieth century and returned there 36 years later.

During World War II, the Dow advanced, then peaked at around 212 in 1946 and collapsed in the same year, and then established a bottom in 1949 just above 160. From there it began a long bull market, with hiccups in 1957 and 1962, before reaching 995 in February 1966. The 1960s and 1970s were in many respects similar to the first 20 or so years of the century, with the Dow roughly halving and doubling its value, but in this case peaking near 1,000 (not 100). One particularly low point followed the Arab-Israeli war of 1973 (and subsequent rise in oil prices) when it dropped below 600. It should also be noted that the late 1970s were a time of exceptionally high inflation, and although the dollar value of the Dow looks fairly stationary on the chart, it probably lost over 50 percent of its value (measured in terms of the purchasing power of 1973 dollars) by 1980. Discounting inflation, this period of just under 20 years can be seen as one in which the gains of the 1949 to 1966 bull market were consolidated. In effect, the market moved sideways, roughly within the range of 500 to 1,000.

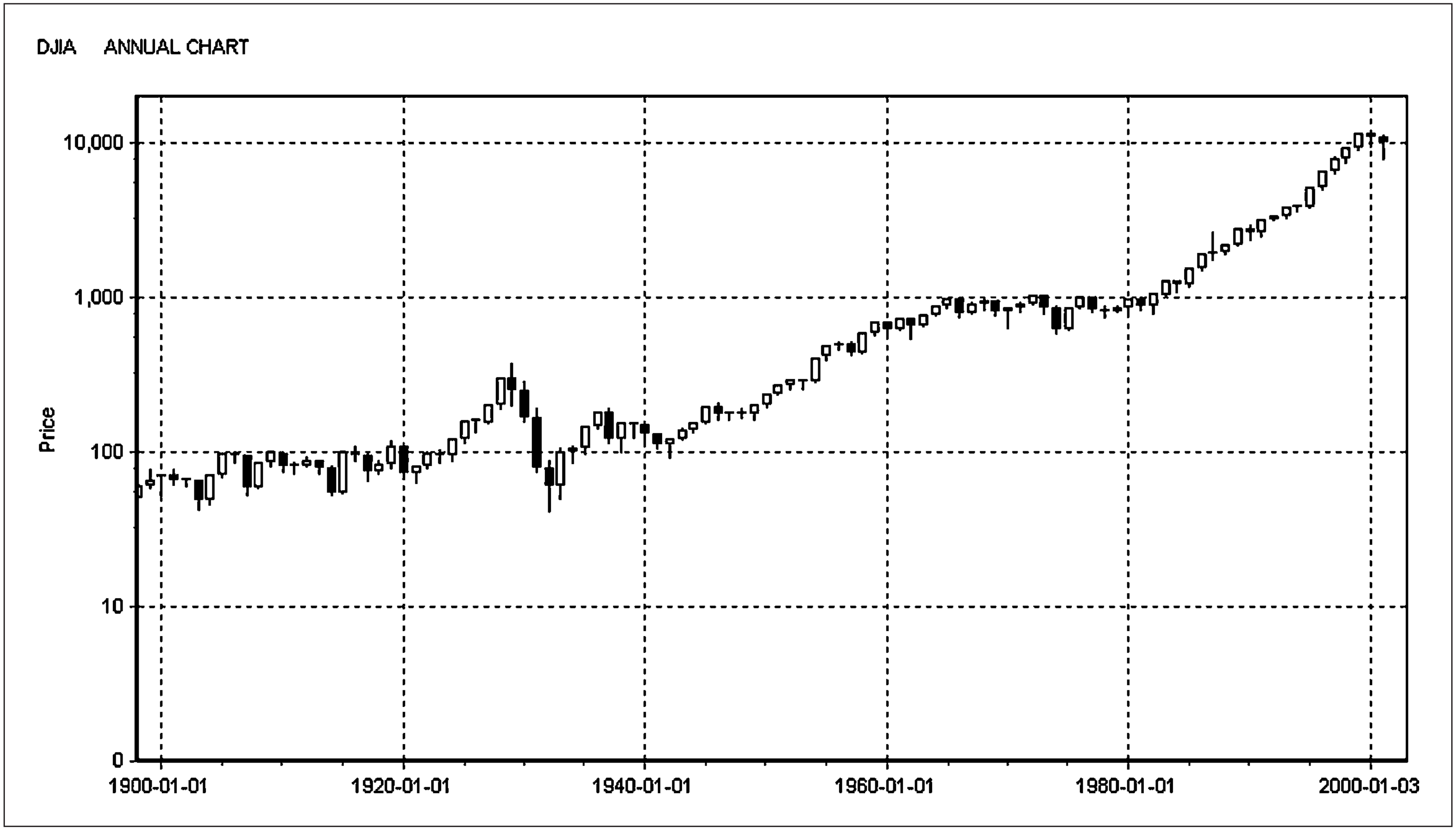


FIGURE 2.2

The chart shows annual candlesticks for the Dow Jones Industrial Average from 1897 to 2002, plotted on a logarithmic scale. Note the bull market of the 1920s and bear market of 1929 to 1932. The Dow spent the early years of the century touching and retreating from a level of around 100. It revisited that level in 1942, shortly after the attack on Pearl Harbor. Its wartime recovery was followed by a collapse in 1946, a bottom in 1949, followed by a rise to around 1,000 in 1966. Once again, it hovered around the same level for many years, before beginning a bull market, leading to a peak above 10,000 in the year 2000.

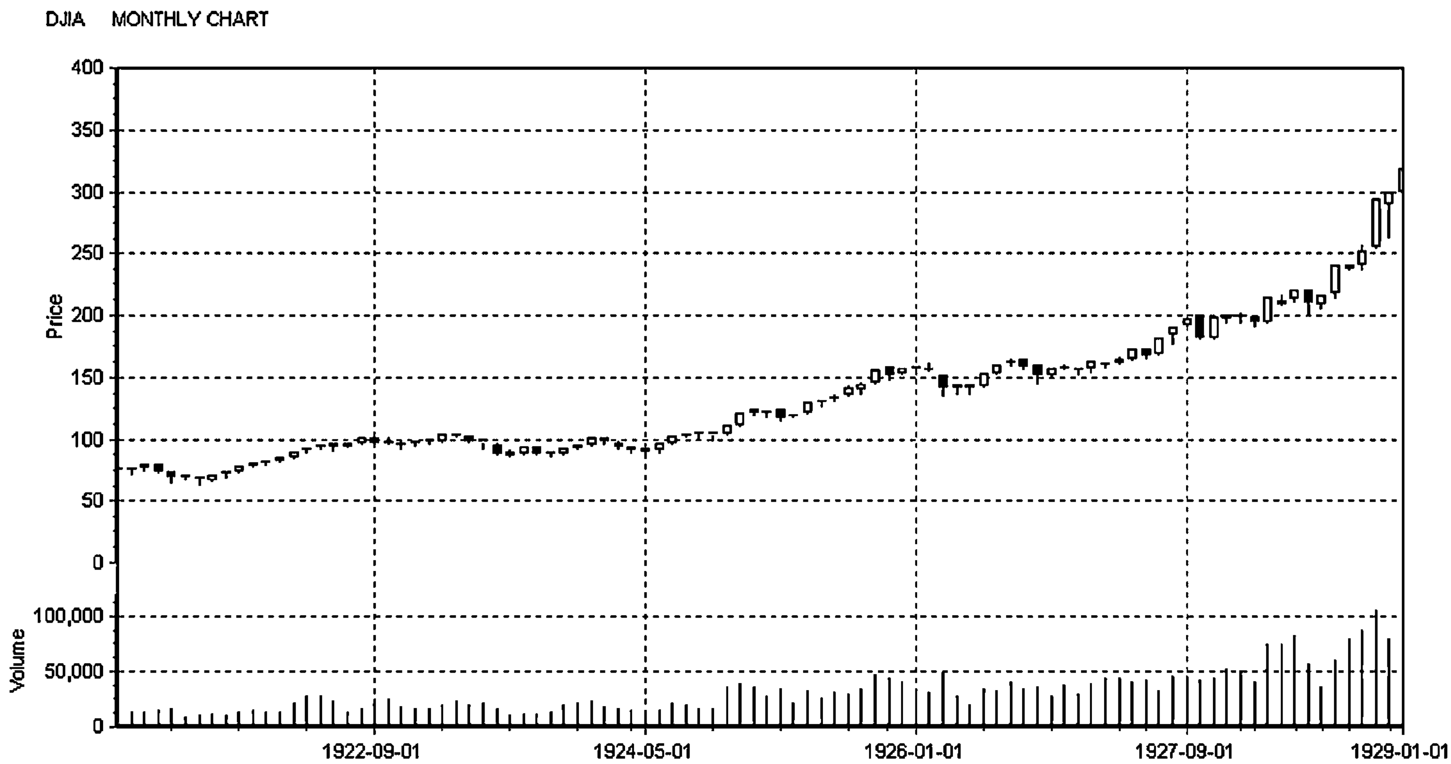
Such markets are variously known as *sideways, congestion, consolidation*, or a *trading range,* and, on a less historical timescale, they can be particularly difficult to exploit. The period from the early 1980s to 1999 represented an exceptionally strong bull market, in which the "crash" of 1987 barely registers on an annual chart. The bear market following 1999 will be capable of comment only after it has had the breathing space to play itself out.

During the twentieth century, a pivotal event was the Securities and Exchange Act of 1933 and 1934, which outlawed the activities of insider traders, tightened reporting regulations, and banned some of the practices thought to have contributed to the 1920s boom and subsequent crash. The act brought greater fairness and order to the markets. Generally, the act seems to have had the effect of diminishing panic price fluctuations from rumors (better reporting regulations gave rumors less scope to be credible) and inhibiting some of the cruder techniques of market manipulation (that we will look at later) such as "pump and dump." Computer programs now exist to identify likely insider trades and provide an autopilot to direct the energies of investigators. My hope is that, in an age when good information is widely available to any participants who are prepared to look for it, the crash of 1929 will never be repeated. However, it would be a braver person than I to declare it could never happen. Despite the subsequent introduction of similar legislation by many other countries, there is no guarantee that all markets, particularly in developing countries, are necessarily well informed or well regulated. Thus lessons from the Dow's behavior during the early years of the twentieth century can have echoes even in these early years of the twenty-first. It looks like it is a lesson from history that we need to study if we are to avoid repeating its mistakes.

In most investment situations, the historical perspective just described is too long for decision making, and shorter perspectives are needed. With a shorter time perspective, the 20-year periods of (historical perspective) sideways markets, when values alternately halve and double, would be seen as a succession of bull and bear markets, punctuated with sideways markets near midtrends and at tops and bottoms. Thus the terms *bull*, *bear,* and *sideways markets* are expressed relative to an associated time or price-movement perspective.

THE 1920s BOOM AND CRASH OF 1929

Figure 2.3 shows a price chart for the 1920s, almost up to the crash. Not for the first time in history, this was a time of financial euphoria, when a long run of rising prices had diminished the credibility of sages who pointed out that the bull market was becoming unstable. In his *Short History of Financial Euphoria*, John Kenneth Galbraith records how such sages were criticized for



F I G U R E 2 . 3

The long bull market of the 1920s led to a euphoria in which wealth seemed obtainable by anybody and poverty had been defeated. Memories of recent gains dominated investment decisions and led to an effect known as "positive feedback," by which recent gains sucked in new investors and demand created further price increases, but only for a while. Sages who pointed out that prices were not justified by fundamentals were dismissed as people who were damaging the nation's wealth. The party ended in October 1929.

their views, which many considered to be damaging to the wealth prospects of the nation (and probably their personal shareholdings; it would not be the first time self-interest has been hidden behind a nation's flag—author's addition).

Toward the end of the 1920s, it was clear that for most companies, prices paid for their shares were many times their realizable assets, and attempts to justify them must have been based on growth prospects or estimates of intangible assets (goodwill, brand names, patents, and so on). In view of the limited financial information reported in those days, it seems more likely that most investors had seen others profit from earlier investments, wanted to get on the bandwagon for their own benefit, and were simply investing in an expectation of future price increases. This effect is known as *positive feedback;*—that is, price increases suck in additional investors who expect those increases to continue. For a while, the extra demand created has that effect. In these circumstances doubters could always be "proved" wrong by price increases of the near past and explanations found to disregard the conventional market wisdom advanced by sages who had seen such conditions before and knew what was coming.

The 1920s were by no means the first time such boom conditions had existed. Many have heard of the tulip fields of Holland, but few are aware that in the 1630s the recent arrival of those flowers created a boom in the market for them, with prices (in today's terms) equivalent to $50,000 paid for a single tulip bulb. People liquidated their real estate and other assets to participate in the boom, which they thought would go on forever but which inevitably burst with consequences that participants of the dot-com boom of the late 1990s will be all too familiar with. This euphoric time in Holland was known as "Tulipmania."

Another, more relevant example occurred in England in the early 1700s, where, in return for assuming responsibility for a government debt, a monopoly was granted to the South Sea Company on trade between England and the Spanish colonies of South America and Pacific coasts of both Americas. The company was founded in 1711, gradually assumed more government debt, and was granted the right to issue stock. The stock increased in value almost eightfold in 1720, making a great many people newly rich and sucking in many others who hoped to be rich. Needless to say, the hype was greater than the earnings potential of the enterprise, and its bubble burst with the usual consequences for the participants. One of those participants was the physicist Sir Isaac Newton, who lost the princely sum of £20,000 at that time ($36,000 at $1.80 to the pound). His comment "I can predict the motion of the heavenly bodies but not the madness of people" is an early acknowledgment that markets can be irrational and rational methods of attempting to exploit them have their limitations.

The reason I believe this boom (known as the "South Sea Bubble") to be more representative than the Dutch Tulipmania is that several would-be promoters saw a public who had become receptive to the idea that fortunes could be made by investing in shares of joint stock companies. These promoters decided to enrich themselves by providing opportunities for the public to invest. Among these were companies offering perpetual-motion machines and an enterprise "for carrying on an enterprise of great advantage, but nobody to know what it is." The Bubble Act was finally introduced to put an end to such promotions, but the observation is: When fortunes are being made, opportunities abound to float enterprises with dubious financial histories and prospects, to a public made gullible by the sight of such profits and wanting some for themselves. Some two hundred years later, in Ben Graham's book *The Intelligent Investor,* a succinct statement was made to the effect that stock market bubbles are accompanied by an increasing number of flotations of diminishing quality. That was the case in the 1720s and 1990s, and I believe it to have been the case in the 1920s, to which we now return.

Toward the end of the 1920s, doubts were being expressed about the ability of the bull market to continue, but despite these, investors continued to buy shares. Many investors probably shared these doubts but took the view that the momentum of the bull market was still strong and that they could get out at, or before, a market top. It seems unlikely that most were participating in the market from any rational assessment of prospects, although a few were, as Janet Lowe's book *Benjamin Graham on Value Investing* clearly shows. When confidence ebbs from a market, there is usually a "flight to quality," which in the 1920s meant that shares in recently formed companies, in new industries, with few tangible assets, such as radio stations, declined sharply and those with more substantial assets maintained their prices for longer. There was an idea, which has since been better developed, that a share price will drop to a level at which a company's assets can be liquidated. Below that level, the company can simply be broken up, its assets sold and money returned to its creditors and shareholders. There is therefore a rational argument that says that a share price should not drop below this level, but in the 1920s it was difficult for the general public to know what that level (net asset value per share) was for each company. Nevertheless, wise investors would have found out and taken their assets out of "growth" stocks, backed more by stories than tangible assets, and moved them into "quality" stocks, backed by assets capable of being liquidated if the worst happened. Such investors were Benjamin Graham and Jerry Newman, who formed the Graham-Newman partnership, part of whose history has been recorded by Janet Lowe in her book *Benjamin Graham on Value Investing*.

Unfortunately the worst did happen in October 1929, as shown by Figure 2.4. Prices that had been driven up by investments based on expectations of future increases now collapsed, as did the public's confidence. Companies had to cut their prices to sell, which meant that the public had little incentive to buy goods today if they would be cheaper in the future, a buying pattern that diminished demand and company revenues. Around this time John Maynard Keynes observed that collapsing prices of securities also made people feel less wealthy, giving them an incentive to save, which resulted in less spending and harder times for the economy. Cash was king—because with diminishing prices, it would be worth more tomorrow than today—giving people little incentive to spend. Industries collapsed, meaning that liquidations turned into distress sales in markets where there was a glut of the plant being sold. This meant that precrash calculations of company values (on which share purchase decisions had been based) became erroneous.

Once again the market had behaved irrationally and defied the best efforts of those who had tried to exploit it rationally. At this time, many companies were selling at a discount not only to their book value but also to the value at which they could be liquidated. Janet Lowe records that the survival of the Graham-Newman partnership during this period was due in large part to profits generated by Jerry Newman's talent for buying troubled companies and liquidating them. Unfortunately, the history of financial collapse is less well recorded than booms, but once again the market had conspired to defeat the best efforts of those who had sought to exploit it rationally. There were those who had been there before and had an inkling of what was coming. Advice was given to Benjamin Graham in 1930 by a 93-year-old sage (John Dix) in Florida. Essentially, John Dix's advice was to get out of markets that were behaving irrationally relative to the logic being used to exploit them. Benjamin Graham did not heed that advice at the time, but he recognized later that he should have listened. This was a learning experience for Benjamin Graham that present readers might heed if similar circumstances are ever repeated.

Just as the prices of the 1920s had been driven ever higher by memories of increases of the recent past, those of the early 1930s were driven ever lower by the experience of recent declines. Once again investors were basing their decisions on expectations of price movements from their recent experience rather than rational assessments of value. The positive-feedback effect that had driven prices up now worked to drive them down. This continued until 1932, when the Dow bottomed at around 40 percent of the value it had reached 26 years previously and less than 11 percent of its 1929 peak. Lack of confidence persisted, but a shaky recovery followed, helped by President Franklin D. Roosevelt with actions to get the economy moving and words such as "We have nothing to fear but fear itself."

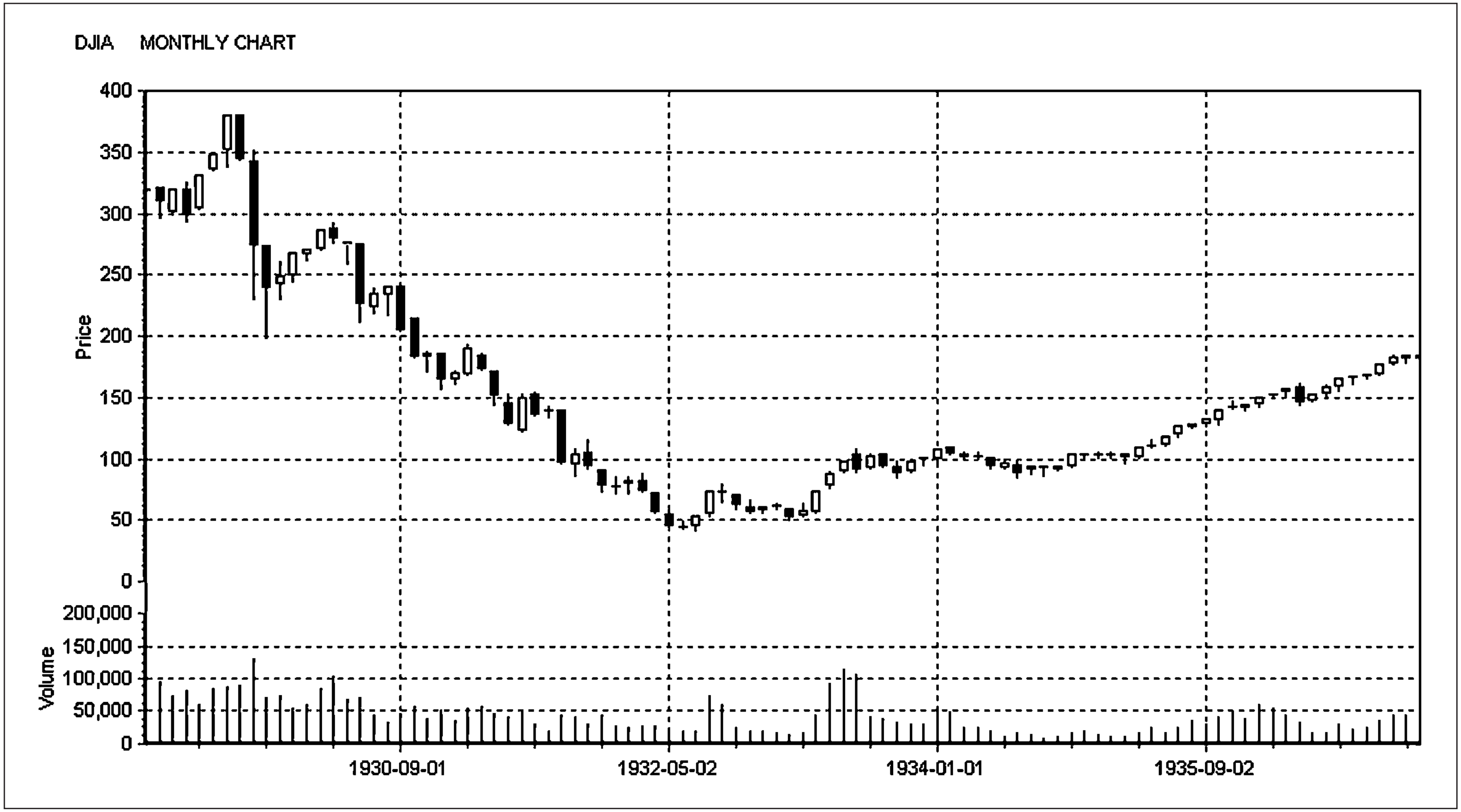


FIGURE 2.4

When it came, it was the bear market to end all bear markets. The Dow lost almost 90 percent of its peak value. Positive feedback now worked to reduce prices, with people selling because prices had fallen in the recent past. Panic set in. The low prices were not justified by fundamentals. Profits were made by buying up companies cheaply for their subsequent liquidation. In the 1933 to 1934 period, the Securities and Exchange Act was passed to tighten up on reporting and end the practices thought to have contributed to the 1920s bull and early 1930s bear markets.

COBWEB THEORY AND SIDEWAYS MARKETS

In the previous example, we saw how bull markets are driven upward by expectations generated by price increases of the recent past and how bear markets are driven downward by expectations derived from price declines of the recent past. We briefly mentioned earlier sideways markets, which cobweb theory can be useful to explain. There are three basic tenets that need to be understood—anchoring, supply curves, and demand curves.

First is the idea known as *anchoring*, whereby expectations of future prices are heavily influenced by current prices, and their estimation based on overconservative assessments of how prices are likely to change with time. Often, uncertainty over future price changes means that decisions that need an estimate of future prices simply use the assumption that present prices will remain unchanged.

Second is the idea that there are efficient and inefficient sources of something that is required. For example, in tin mining, easily extractable Cornish deposits have largely been exhausted. Although less easily extractable deposits remain, it is now more efficient to mine tin elsewhere in the world where it is easier to extract, and so the Cornish tin mining industry has waned. However, if the quantity of tin required in the world were to exceed the capacity of these other sources to supply it, then the price might rise to a level where tin mining could pick up again in Cornwall. The idea can be simply stated that it is nearly always possible to provide the quantity of whatever is required, but as more of it is required, then (assuming no innovations in production techniques), the cost of providing it increases. This can be plotted on a graph of price against quantity and is known as the *supply curve*.

The third and final idea is that the lower the price of something, the greater the number of units of it that can be sold. When plotted on a graph of price against quantity, this is known as the *demand curve*. An example of this would be Henry Ford's innovation of the production line, which allowed automobiles to be produced cheaply for the first time and transformed a market that had previously been confined to a rich few into one for the many. (At first sight this goes against the logic used to define the supply curve, but what Henry Ford's innovation did was to redefine it at lower levels than before; that is, the supply curve for automobiles shifted bodily downward as all manufacturers adopted Ford's techniques.) Simply stated: The lower the cost that something can be sold for, the more units of it that are likely to be sold.

We can now apply these ideas to a theoretical agricultural problem in which a crop is grown that is harvested annually. In Figure 2.5, prices are at a level shown by the upper dotted line. Demand is high, selling price exceeds the cost of supply, and so the crop is profitable. Potential producers that can

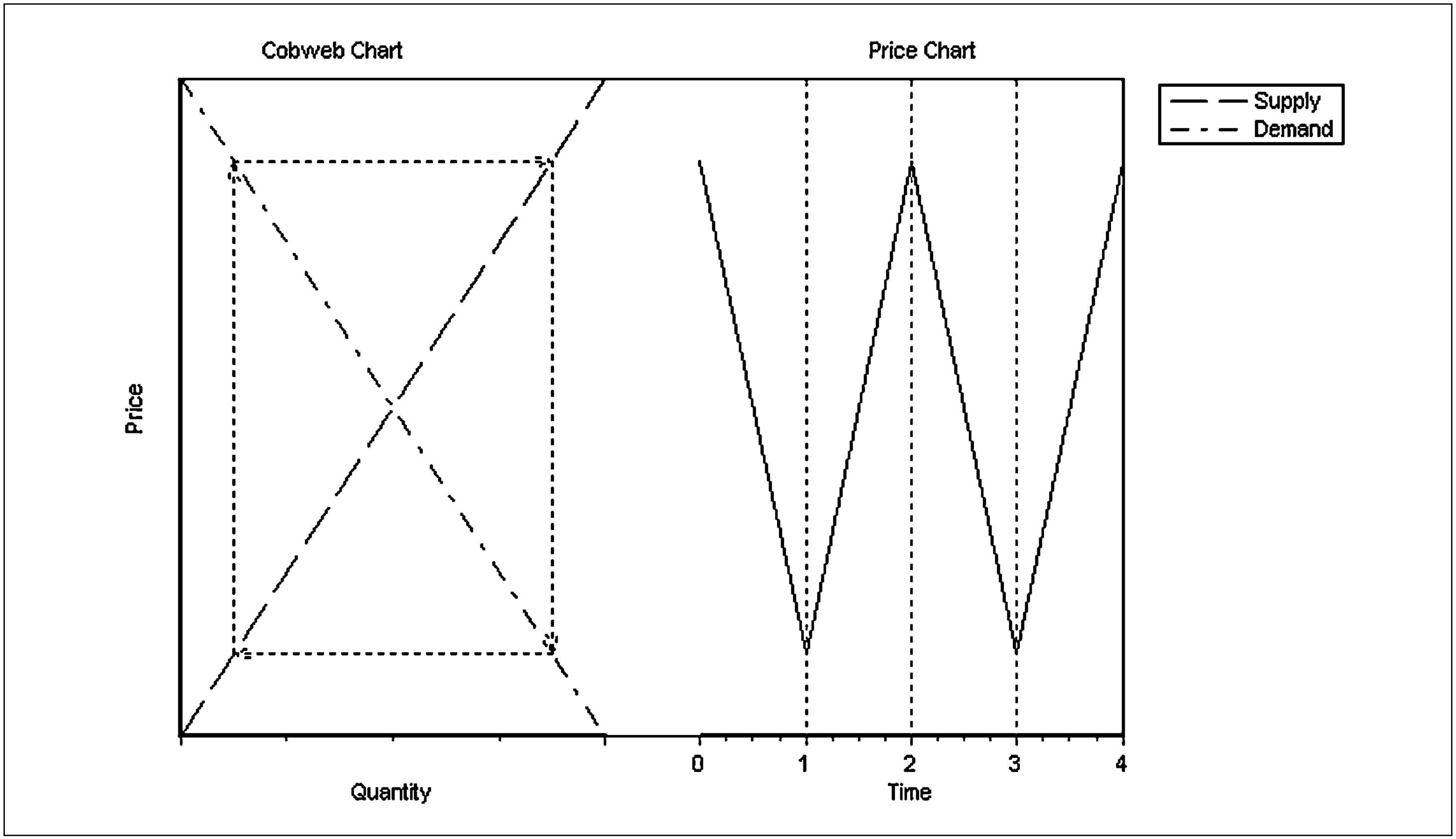


FIGURE 2.5

The sloping lines on the cobweb chart are supply and demand curves. Suppliers are working on the premise that prices will stay at their present levels. Many supply-related decisions, particularly with annually harvested crops, are made from this kind of expectation. Starting from the upper left of the cobweb chart, prices are well above the costs of supply, so more suppliers enter the market until the quantity available corresponds to the intersection of the upper horizontal dotted line and supply curve. The glut in supply causes prices to drop to a level shown by the intersection of the right vertical dotted line and the demand curve. Many suppliers are now unprofitable and exit, causing a reduction in the quantity available, corresponding to the intersection of the lower horizontal dotted line with the supply curve. There is now a shortage of supply, so prices rise back to a level indicated by the intersection of the left vertical dotted line and the demand curve. The price-time variation is shown schematically on the price chart to the right of the figure. Note that in this instance, supply and demand curves have gradients that are equal in magnitude but opposite in sign, and cobweb theory works to explain a price cycle of constant amplitude. Figures 2.6 and 2.7 show what happens when supply and demand curves have gradients of different magnitudes.

operate profitably at these prices assume the prices will continue at the high level, and so they plant the crop. Higher-cost producers stay out if they cannot make money at current price levels, which they assume will continue. None of these producers know what the others' plans are, so the quantity of the crop available at the next harvest can be found from the intersection of the previous year's price line with the supply curve (the right extreme of the upper horizontal dotted line). Given the added supply, prices fall to a level on the demand curve appropriate to the new quantity (the lower extreme of the right-hand vertical dotted line). These prices are now too low for many producers, who decide to grow something else, leaving fewer producers to grow a smaller quantity of the crop at the next harvest (found from the left-hand extremity of the lower horizontal line), resulting in a higher price (found from the upper extremity of the left-hand vertical line). This imbalance between supply and demand results in the fluctuating prices shown on the right of Figure 2.5.

The agricultural problem just posed was theoretical; in practice, such price movements would be well known to experienced farmers. They have memories of previous price fluctuations and usually plan to take advantage of them. In particular, they have good ideas of maximum and minimum prices that are likely to be reached; that is, they know there is a band within which a broad balance of producers and consumers confines prices. Such is the case with a sideways market. Unlike bull markets raging upward to unknown heights or bear markets plunging downward to unreasonable depths, there are expectations that previous price peaks and troughs will continue to be turning points, with the result that many buy or sell orders will be based on that premise, which will constrain prices to stay within the bounds illustrated by the type of cobweb shown in Figure 2.5. We note also that when the gradients of supply and demand curves are altered, then new types of price fluctuations arise. Examples of these are shown in Figures 2.6 and 2.7, which we note have converging and diverging price cycles arising from unsymmetrical gradients of supply and demand curves, to which we will return later in the book.

So far, our example has been a theoretical agricultural one, but the broad principles apply to most financial instruments where buyers are represented by the demand curve and sellers by the supply. Unlike the agricultural example, buyers and sellers of securities are not constrained to acquire or dispose of their assets at fixed harvest times, and so the periodicity of their price fluctuations becomes much more variable. Cobweb theory has its limitations, but it serves as a useful introduction to show how prices can relate to demand, supply, and expectations. Most of the time, in most markets, there is some imbalance between buyers and sellers, resulting in price fluctuations that can be explained by cobweb-type theories. For example, day

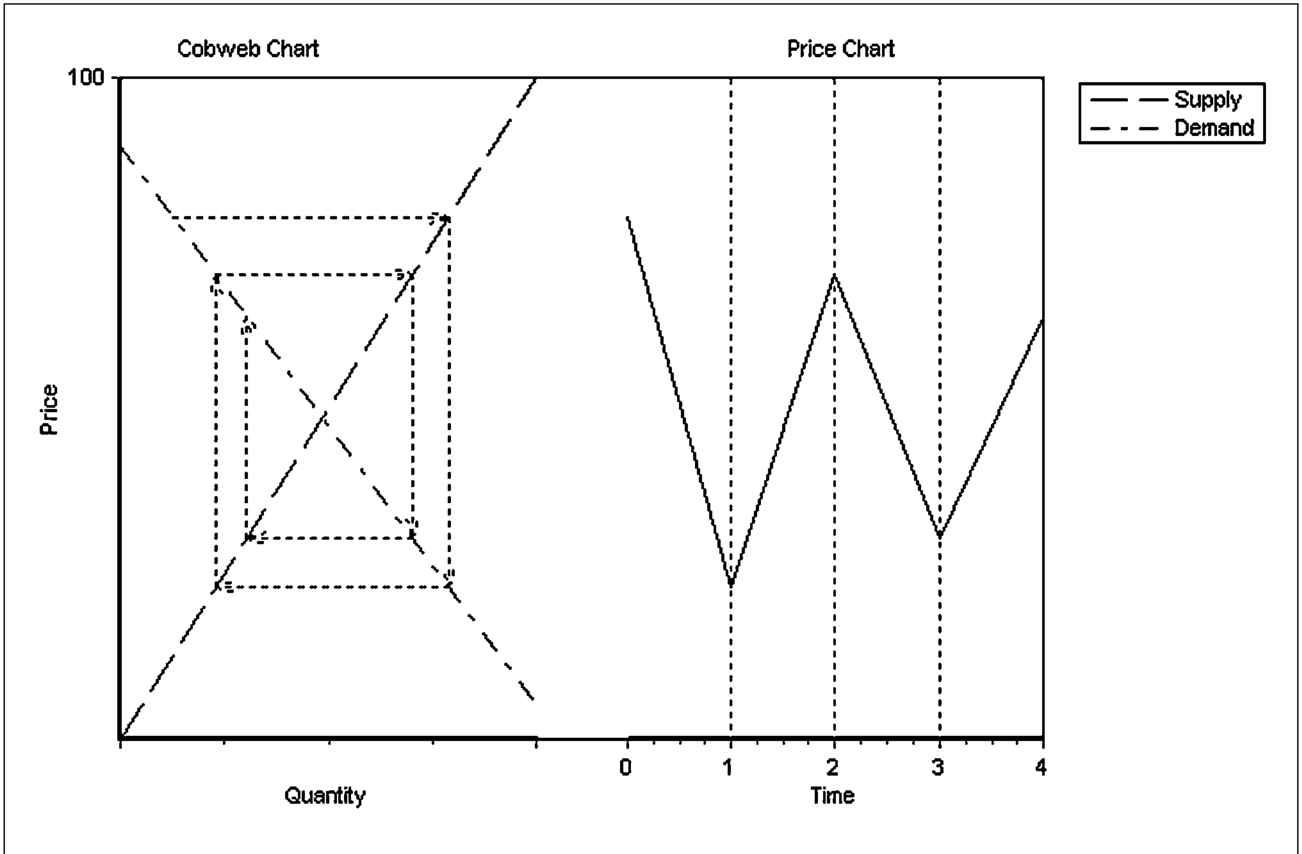


FIGURE 2.6

In this instance the magnitude of the supply curve is greater than that of the demand (that is, the supply curve rises at a faster rate than the demand curve falls) with the result that prices tend toward a cyclical convergence.

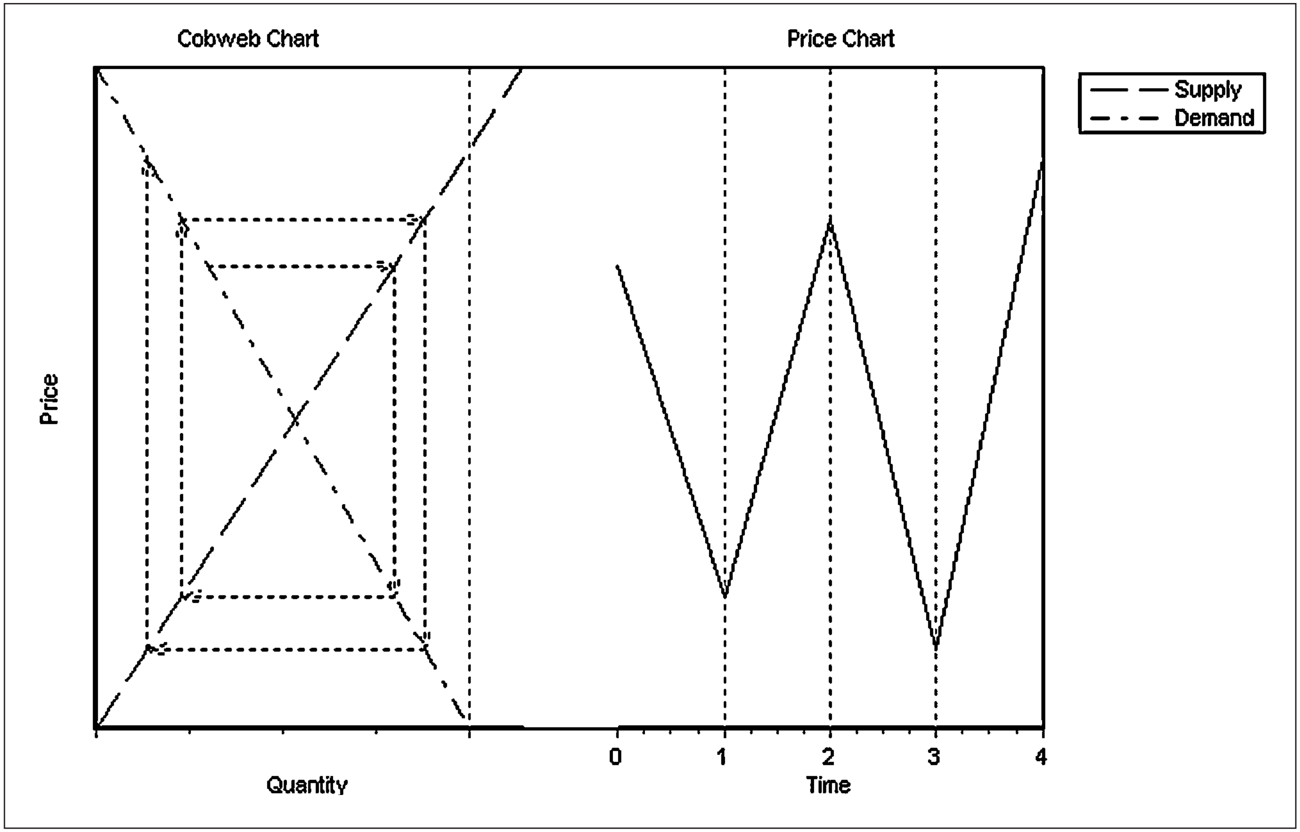


FIGURE 2.7

In this instance the magnitude of the supply curve is less than that of the demand (that is, the supply curve rises at a slower rate than the demand curve falls) with the result that prices exhibit a cyclical divergence.

traders might be quietly trading cocoa downward when the low price attracts a big order from a chocolate manufacturer. If the available supply cannot fill the order, then prices will rise to tempt other sellers. The net result is that prices progress in a series of jerks rather than smooth movements. The response of the famous banker John Pierpont ("J.P.") Morgan to the elevator boy's question made this point. An elevator boy had been waiting for weeks to get J.P. Morgan alone in his elevator. When he finally did, he asked him what the markets would do that day. The famous man replied that they would fluctuate.

COMMON CYCLES

We have seen how cobweb theory can generate cyclical behavior in the markets. Some stocks, such as steel, shipbuilding, and construction, are heavily cyclical, and most are cyclical to some extent. Thus, the understanding of how price relates to supply, demand, and expectation that cobweb theory offers can be useful in assessing where the peaks and troughs of these cycles are so that they can be exploited. Almost all securities show some degree of cyclical behavior—but the cycles are often difficult to see because they are fickle.

Within the economic literature, there have been described some price fluctuations that recur over regular time periods, which produce identifiable and well-known cycles. The first of these was identified by a number of people from ancient times onward, but it is generally credited to its 1920s Russian rediscoverer Nikolai Kondratieff, and it is known as the *Kondratieff cycle*. It is (roughly) a 54-year cycle in commodity prices, and it is usually explained in terms of an imbalance between inflationary and deflationary pressures. At the top of the cycle (the last one being around 1980), commodity price inflation has restricted demand and reduced economic activity. At the bottom of the cycle (most recently around 2000), inflation has been beaten, economic activity has slowed, and economies are going through a period of deflation in preparation for their next inflationary surge. Some observers point out that as information transactions represent an ever-increasing proportion of economies, the dependence of the overall economy on commodity prices diminishes and the relevance of the Kondratieff cycle with it. My interpretation, for reasons explained earlier, is that the greater flow of information reduces the abilities of rumors to trigger panic selling. Thus the worst symptoms previously associated with the Kondratieff cycle may have been alleviated, irrespective of any issue of the extent to which economies are coupled with commodity prices.

There are other cycles that could be described, but to find a cycle for a specific tradable instrument, take a long-term price chart and look for the major highs and lows that form its peaks and troughs.

SHARES (OR SECURITIES) AND COMPANY BONDS

Companies tend to be born from a combination of a business idea, access to a market, and access to capital. In their formative stages, access to capital typically involves family, friends, or an *angel investing community*. The next stage can involve *venture capitalists*, who usually work on the principle that 80 percent of their investments will fail but the 20 percent that succeed will keep them profitable. The final stage to maturity is an *initial public offering* (IPO), during which a company is listed on an exchange and its shares made available for the public to buy. Usually, there are restrictions to prevent the founding shareholders from cashing in on their investment until an orderly market has had a chance to develop. Typically, this involves their having to endure a one-year holding period following the IPO. Companies may be capitalized in a number of ways (for example, preferred stock, common stock, and/or company bonds), but what is usually traded and generally referred to as a "share" or "security" is *common stock*. Without markets for such instruments and people prepared to invest in them, companies would have little access to capital, with the result that severe boom and bust cycles would follow, with inevitable adverse social and economic consequences. One point to note about common stock is that it carries no guarantees of dividend payments. These are paid at the discretion of a company's board of directors and are calculated on net earnings, investment requirements, financial reserves, and a number of other factors. The absence of any dividend guarantees is something that distinguishes common stock from bonds and preferred stock.

To continue with the evolution of a company: At some point the company is likely to need to raise cash, which it can do by issuing more common stock, preferred stock, or bonds. *Bonds* are instruments that promise to pay a certain principal at a future date and interest on that principal both before and at that date. In other words, bonds are IOUs that offer interest. The price at which they sell depends on the interest offered and the chances of the principal being repaid. Credit rating companies, such as Standard & Poor's, publish opinions on the relative probability of default. Opinions come in the form of a letter-based code by which AAA, AA, A, and BBB represent investment-grade bonds, issued by corporations judged to have a good capability of meeting their obligations. Bonds graded as BB, B, CCC, and CC are judged to be more speculative, sometimes ignominiously referred to as "junk." Bonds graded as C are currently not paying interest, and those graded as D are in default. It should also be mentioned that credit rating companies' opinions sometimes differ. Bonds may be *convertible*, usually to common stock, meaning that if the conversion option is exercised, the company will no longer have to repay principal or interest since that obligation has been traded for a predefined quantity of its common stock.

In rising markets, conversion can be an attractive option since the value of the common stock obtained might exceed that of the principal to be repaid at the future date. When share prices are falling and the value of the bonds is at or above the value of the common stock to which they can be converted, it usually pays to hold on to the bonds.

Preferred stock may also be issued. This is a hybrid instrument, which is like a bond in that a predefined dividend payment is guaranteed (comparable to a bond's interest payment) but unlike a bond in that the dividend payments continue in perpetuity. There is no guarantee that capital will be repaid, and often, there will be an option to convert preferred stock into common. From a company's point of view, such conversion means a reduction in its fixed financial obligations. There is a sting in the tail of most preferred stocks, in that they are usually issued on the basis that when it is in the company's interest to do so (and generally the stockholder's interest for the company not to do so), the company has a right to call in the issue. This means that just when the investment looks most profitable to the preferred stockholder, the company may exercise its right to buy it back—that is, "call" it. Specifically, if a company can borrow the money to call in the issue, at an interest rate that is less than that paid out in guaranteed dividends to preferred stockholders, then it is likely to call the issue. Such preferred stocks are said to be "callable."

To continue with our life cycle of a company: If the company dies and cannot meet its financial obligations, then there is a pecking order for claims on its assets. This usually begins with banks but eventually works its way down to people who have invested in it in various ways. Of these, claims of bondholders are paid before those of preferred stockholders, which are paid before common stockholders.

Share (or security) prices are quoted in newspapers, on Web sites, through price feeds, and an ever-increasing number of varying media. The idea of a share (as a fraction of a company to be owned) is generally well understood and will not be dwelt on at greater length. However, one point that is important and a feature that distinguishes shares from futures is that when prices are rising, all shareholders tend to profit, and when prices are falling, all shareholders tend to lose. In contrast, people who "borrow" shares from their brokers at one price in the hope of repaying the shares to their brokers at a lower price profit from falling prices. This is known as *short selling*, and it is subject to regulations designed to preserve orderly markets. Typically, rules on short selling stipulate that prices must have increased by a specified amount immediately before a short sale is allowed.

Increasingly, stock market price movements around the world are becoming ever more correlated, making it more difficult to achieve diversification in a portfolio of assets. However, one way diversification may still be achieved is to look at other asset classes, many of which are traded on futures markets.

FUTURES, HEDGERS, AND SPECULATORS

In contrast to shares, concepts in futures trading are generally less well understood and need introduction. Imagine you are a farmer wanting a bank loan to grow wheat. You visit your bank manager who asks you the questions, “What price will you get for your wheat, and what will you do if prices are low?” The bank manager then goes on to explain that if you do not have a buyer for your wheat at a fixed price when you harvest it, he will refuse you the loan since he prefers to loan against a closed deal, not an open one. The bank manager then introduces you to a broker, who arranges for you to take a position in the futures market, where you undertake to *deliver* at harvest time a certain quantity of wheat of a specific quality for an agreed price. You now have an obligation to *make the delivery* of wheat, and you are said to be in a *short position*. The bank manager’s next visitor is a flour miller who wants a loan for new machinery. The bank manager asks, “What happens to your mill if the price of wheat goes up?” Once again, our bank manager is unhappy about exposure to a fluctuating price of wheat, and the miller is refused a loan unless he reduces his exposure. The miller then goes to a broker and agrees to *take delivery* at harvest time of a certain quantity of wheat of a specified quality at an agreed price. Since our miller is obligated to accept delivery, he is said to have a *long position*. With these deals in place, the farmer, miller, and bank manager have all reduced their exposure to the fluctuating price of wheat, the loans are made, and the wheels of commerce roll.

Points to note about this are the following:

1. Participants have a real need for the instrument (wheat) being traded and are hedging against price fluctuations and said to be *hedgers*.
2. On delivery, if the prevailing price differs from the agreed price, one of the participants would have done well out of the deal and the other less well—that is, one person’s profit always comes at the expense of another person’s loss, unlike the situation in securities where, if the markets rise, all shareholders benefit.
3. The situation described assumes that for every seller there is a buyer. In practice, other participants such as *speculators* (who have no intention of either delivering or accepting delivery of anything) and warehousing facilities are needed to ensure that there is sufficient activity in the market for farmers and millers

(that is, hedgers) to find buyers and suppliers for wheat, at a fair price. While speculators are in the market to make money for themselves, they do serve a useful function of accepting risks of price fluctuations, and therefore they dampen down fluctuations that would occur naturally if they did not participate.

4. Our example of the farmer and the miller has loosely referred to a specified quantity of wheat. Futures markets have defined contract quantities for whatever is being traded. For example, in currencies, the contract size for Japanese yen might be $70,000. With agricultural products there may also be complications of quality and crop date that we will mention but not distract ourselves with here.
5. Our example of the farmer and miller has loosely referred to delivery being due at harvest time. Futures markets have specified delivery dates. This results in differing contracts for differing delivery dates being traded at differing prices. The contract corresponding to the next delivery date is referred to as the *near contract* and that for the following delivery date the *far contract*. Typically, there are four delivery dates in a year—in March, June, September, and December—but it varies according to what is being traded.
6. It was mentioned earlier that speculators do not want to take delivery of anything (except profits), so to avoid delivery obligations but retain a market presence, they will exit a position in a near contract before its delivery date to take a similar position in the far contract. This process is known as a *rollover*. Strategies for rollover vary, but two common ones are to roll over on the first day of the delivery month or to do so when the open interest (defined in the next paragraph) of the far contract exceeds that of the near.
7. With the exception of bonds (which are usually sold at a discount to their face value), somebody has to carry the cost of financing the commodity to be delivered at the future date. This means that futures prices are generally higher than cash prices, with a difference that is usually consistent with the prevailing interest rate. This is not a universal rule. For example, a newly harvested crop may be more valuable than a warehoused crop, and this may be a greater influence in the futures prices than the interest rate.
8. There is much more to futures than this briefest of introductions allows for, and a good source of information is Jack Schwager's book, listed in the bibliography.

OPEN INTEREST

There is one additional characteristic of futures that does not exist with securities. In securities, a company has a known number of shares outstanding that are potentially available for trading. With futures, if one speculator wishes to take a long position and another a short, they balance each other out, and they can therefore take their positions irrespective of whether the commodity exists to fulfill the delivery obligation. (The same is not true of hedgers, who do require delivery.) Provided that the delivery intentions of the participants are known, then an orderly futures market can be devised in which hedgers either provide or accept the underlying instrument and speculators damp down the price fluctuations that would otherwise be generated from imbalances of hedging participants. Most futures markets consist of a significant proportion of speculators trading against each other who wish to know the total number of contracts outstanding at any given time. Note that when positions are first taken, the contracts will be registered as volume, but then they remain open until they are closed out either by purchase (covering), sale (liquidating), delivery, or acceptance of the commodity. The total number of futures contracts outstanding at the end of any trading session is known as the *open interest* and recorded for posterity but usually not made publicly available for a day or so. Open interest offers an insight into futures markets that is not available with securities. Whenever two speculators take futures positions against each other, they are disagreeing about the future direction of the market. Consequently when speculators form a large proportion of a market's participants, every additional contract that is still open at the end of a trading session represents an increase in disagreement and open interest, *meaning that open interest is a measure of disagreement*. If a market is trending and open interest is rising, conditions are generally healthy since sufficient disagreement exists to sustain the trend. If the trend then reverses and open interest falls, there is more agreement about price direction, and the fall in open interest is likely to be interpreted as a confirmatory sign that the price reversal will continue.

ASSET CLASSES

Having given the background to how different types of assets are traded, we can now examine classes of assets available for trading. Earlier we mentioned the long-term Kondratieff cycle for commodities. During the 1970s oil, gold, silver, and some other commodities increased in strength until (right on Kondratieff's schedule) their bubble burst in 1980 and they entered a decline. At the time of this writing, their dollar prices are lower or little changed from their 1980 levels despite more than 20 years of inflation. We saw from Figure 2.2 that the Dow increased more than tenfold during this period, but what is of more interest is that the Japanese stock market increased seven times between 1980 and 1990 before declining to around a fifth of its peak value in the early years of the twenty-first century. We observe therefore that there is usually some asset class, be it shares, commodities, real estate, or something else, that is booming and others that are moving upward more slowly, are static, or are declining or collapsing. A balanced portfolio with good returns should seek asset classes with favorable price movements having the weakest absolute correlations, meaning that a price movement in one instrument should have the minimum possible connection with, or relationship to, any price movement in any direction in any other. Historically, combinations of securities, bonds, and real estate have formed good portfolios, but history is a poor guide as to what the future "best" asset classes are going to be. This is true because positive feedback has the effect of driving any previous "best" to extreme levels from which they either decline or languish until other asset classes have a chance to catch up.

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CHAPTER 3

Investment Psychology

WHY STUDY PSYCHOLOGY?

The idea of an efficient market is that when prices are no longer justified on economic grounds, corrective action will occur as a result of "rational" economic appreciations of a situation. This frequently does not happen, and some of the reasons for it not happening can be explained qualitatively in terms of psychological observations and concepts. Like economics, psychology is a "soft" science whose observations may not be capable of scientific proof but which nevertheless provide useful insights into processes that influence prices. Experimental psychologists such as Robert B. Cialdini offer useful empirical support for their ideas and provide a template for the kind of future experimental support needed to understand psychological issues for markets and investors. In my view, Karl E. Wärneryd's book is a very creditable interpretation of the relevant, sparse, market and investor psychological data that do exist; and Martin J. Pring is an experienced and well-known market commentator whose book on investment psychology is likely to find support from future data. At present though, there is more in the way of unsupported ideas than experimentally supported hypotheses, and so this chapter needs to be treated as tentative and subject to change as future experimental evidence arrives.

There is an adage in the markets that a position should not be taken in a market that is not understood. Psychological perspectives have the effect of extending understanding to market situations that cannot otherwise be explained, and so, in turn, they extend the number of positions that can be taken with the comfort of some understanding. An understanding of the role of psychology in explaining market behavior is also useful for an individual wishing to take and monitor a position. This activity can involve emotional and psychological pressures, which impair the ability of the investor to achieve his or her full potential. If these pressures are understood in advance, practices can be adopted to accommodate investment activity within the normal pressures of everyday life, enabling mistakes to be avoided.

PSYCHOLOGY AND THE MARKETS

FEAR AND GREED

The psychological aspects of the markets are commonly dismissed as consequences of fear and greed. We seek a deeper understanding, which we can cross-check against market movements.

CROWD BEHAVIOR

There is often confusion between crowd behavior and herd behavior, both of which have elements in common but also some that are not. Those that are not are important because much crowd behavior is subconscious, which results in a failure to appreciate its irrelevance and potential damage to wealth. A classic book on crowd behavior was written many years ago by Gustave Le Bon (1841–1931), which is widely cited as being relevant to markets. In view of the widely accepted relevance of crowd behavior to the markets, a summary follows, for which Le Bon's book has had a major influence:

- Crowds tend to form when a body of people strongly wish to support or oppose something.
- Crowds have a mental unity, or, when courts make examples of their members, they and it are said to have a common cause.
- Self-aggrandizement within a crowd is often attempted, and can sometimes come, from outspokenness in support of its cause(s).
- Crowds do not express doubts.
- Crowds are credulous and therefore suggestible to exterior influences, whether correct or not.
- Crowds see situations in caricatures of black and white rather than the shades of grey of an individual's perspective.
- Within a crowd there is equality of membership, and wealth and education confer no privileges.
- The mind of a crowd is generally less intelligent than those of the majority of its membership.

- Crowds are not influenced by reason but by their unconscious sentiments.
- Crowds are intolerant, and individuals within them are fearful of what the crowd might do to them if they express views that are contrary to the crowd's will.
- Crowds facilitate unlawful acts in support of their cause(s) because they let the perpetrators hide within their ranks and implicitly spread the blame for such acts among their members, making it difficult for individual perpetrators to be identified or to carry enough of the blame to bring them to justice.

Note that in market situations, there is little need to be fearful of a crowd's reaction, but there are needs to appreciate a crowd's lack of intelligence, its suggestibility, and its penchant for thinking in caricatures. If a crowd's leaders appear to be on ego trips, their views are probably best ignored, as are those seeking self-aggrandizement by articulating the crowd's cause(s). So, if any of these traits are subconsciously and adversely affecting your investment decisions, a reexamination of their relevance should be made. In contrast, what is termed "herd behavior" is a softer form of crowd behavior and in my view much more relevant to investment decisions.

HERD BEHAVIOR

Wärneryd offers a useful account of herd behavior that has had a major influence on the summary that follows:

- Herds can form from groups that see it as being in their (self) interests to do so. Such groups can range from criminal gangs all the way up to "professional" societies wanting to maintain their members' interests (often hiding behind the pretext of maintaining and regulating standards, but self-policed by officers chosen from among the members whose interests are being protected).
- Herds provide an individual with a freedom from having to develop independent opinions since by following the actions of the herd, the argument that "so many people cannot be wrong" provides a justification for going with the herd and not forming one's own opinion.
- Belonging to the herd offers a reduction in any criticism associated with failure. If you fail when inside the herd, there will be many herd members who fail with you, which will dilute an individual's share in any blame for getting things wrong. (Note also that avoidance of blame can be a stronger motive for action than the prospects for success.)

- If success comes by following the herd's actions, the reasons for belonging to it are reenforced.
- The herd shields the incompetent and, through its defensiveness and inertia, inhibits reform, imagination, and the adoption of new practices.
- If you fail publicly outside the herd, you carry a much greater share of any blame and are exposed to the herd's ridicule.
- If you succeed publicly outside the herd, you carry a greater share of any success, are subject to the herd's envy, and may become a target for their future ridicule. Note also that unlike the herd, there is little to be gained from an individual's attempting to ridicule the herd for failing when the individual has succeeded.
- In an employment situation, the net result of being inside the herd tends to be survival and, outside the herd, if you are lucky, short-term stardom that accompanies success outside it, followed by disappointment (and a greater probability of ridicule by the herd, particularly from members wanting to aggrandize their own positions inside it) that accompanies failure outside it.
- Whether inside the herd or not, investors look at the actions of others and tend to be influenced more by a majority than by a minority view. This may be a case of "actions speak louder than words" whereas the real issue should be whether "actions speak louder than an individual's considered evaluation of the facts."
- In a market situation, there are specific times when a herd's view may change abruptly; that is, it can undergo a simultaneous reaction to the same stimuli.
- When considering the opinions of "experts," it is well to bear in mind that nobody is right all of the time and that an expert's reputation tends to be safer if he or she operates inside the herd rather than out, since there is nothing more damaging to reputation than the ridicule that accompanies being wrong when outside the herd. It should also be born in mind that when asked an unfamiliar question in an interview, such "experts" are most likely to revert to a herd's view rather than the opinion they might have given had they had enough time to gather the relevant facts and give the question the consideration it deserved.
- In a market situation, the biggest money-making opportunities tend to come when positions are correctly taken immediately prior to the herd's having an abrupt change of mind. For that reason, whether you agree with them or not, it is a good idea to monitor herds' attitudes. This may not be easy to do, but it is Wärneryd

> once again who offers evidence that British analysts' opinions exhibit a lack of diversity that suggests herdlike behavior. While such evidence is not offered for analysts from other countries, the same behavior would probably be found in most big company employment environments, where committees and rules designed to ensure the company's output is "safe" have the effect of encouraging herdlike behavior. Such concerns may be particularly relevant for countries with litigious cultures and big companies fearful of becoming targets. Apart from correlated analysts' reports from big companies, it is possible to make inferences from monitoring news and the market's reaction to it. In particular, when a herd's experts profess to feel compelled to make statements about the value of investments "in the public interest" or for some other allegedly altruistic reason, conditions are probably about to reverse from whatever scenario or established situation they are talking in support of. When dignitaries talk about the market or attack the views of those contradicting the herd, the question is, why do they feel compelled to speak? As an example of the herd defending its position, Galbraith records that fellow bankers and investment houses responded bitterly, even viciously, to Paul M. Warburg early in 1929 for his (correct) warning of the impending bear market.

The simultaneous common actions of large numbers of investors move markets. Sometimes, during low volume trading, the simultaneous actions of a small number of investors can begin a price movement, onto which a herd subsequently latches and propels.

THE HERD AND EXPECTATIONS OF PRICE MOVEMENTS

The importance of expectations was brought out in cobweb theory, which maintains that actions based on the expectation that future prices will remain unchanged interact with the supply and demand curves to cause price fluctuations. Cobweb theory is based on the simple expectation that future prices will be the same as present. A more sophisticated expectation model is illustrated in Figure 3.1. More complex and accurate models could undoubtedly be developed, but this serves our present purpose of seeking insights into market behavior. This model anticipates price changes (ΔP) from three influences: (A) ΔPa, based on extrapolation from the recent past, (B) ΔPb, based on longer-term experience, particularly of turning points, and (C) ΔPc, reflecting the effect of new information. Ultimately, it is the herd's response to each of these stimuli that will govern future prices. For example, where previous upsurges have failed to climb significantly above a

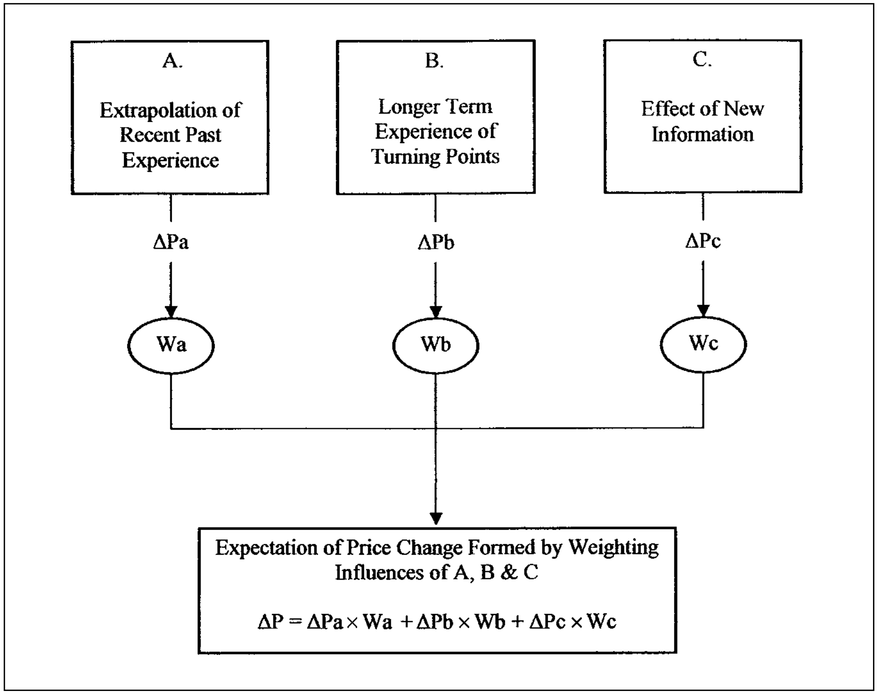

FIGURE 3.1

Three main influences on how we formulate expectations are thought to be (A) extrapolations from recent past experience, (B) longer-term experience of turning points that might produce contrary results to extrapolations of the recent past, and (C) new information. These three influences are weighted to a greater or lesser degree in different circumstances and an expectation of price change (ΔP) assessed from their weighted sum. In the diagram, price change expectations ΔPa, ΔPb and ΔPc are generated from each of these influences. These are then weighted by Wa, Wb and Wc, to form an overall expectation of price change (ΔP) equal to $\Delta Pa \times Wa + \Delta Pb \times Wb + \Delta Pc \times Wc$.

resistive price level, that level of influence B (past experience) can outweigh that of A (extrapolation from the recent past). But at such points, these influences may be finely balanced, and influence C (new information) may determine the subsequent direction. An example where this happened occurred in 1910 and is shown in Figure 3.2, with the outcome in Figure 3.3. Within a bear market, there can be price rallies that last for a while and then fail. One such rally started in December 1929, and it looked as if it might fail in February 1930, but it continued. With regard to experience represented by influence B, the questions for investors were whether the crash of 1929 was a temporary correction from which the market was now recovering (much like the situation in early 1988, shown later in Figure 3.8), or was it a temporary rally destined to collapse into a full-blown bear market? Figure 3.4 shows the situation they faced in April 1930, and Figure 3.5 the outcome.

Influence C, news, has a highly variable effect. Sometimes, for example, in 1941 when World War II was intensifying with Japanese conquests in the Far East and Hitler's invasion of Russia, many observers must have expected America to become a combatant. In Figure 3.6, the news of America's entry into the war barely created a ripple in a bear market, suggesting that the markets had already anticipated America's entry into the war so that the news, when it came, had already been discounted. In contrast, al Qaeda's attack on the Twin Towers was not anticipated by the markets, and despite its having a lesser social, political, and economic impact than the attack on Pearl Harbor, its immediate impact was to trigger a much larger proportionate price fall, as is shown in Figure 3.7. When other influences on the market are finely balanced—for example, when prices are moving sideways in a narrow range—then they become more suggestible to news. As a general principle, a single item of news is discounted only once, but the markets periodically reassess the totality of their available information with prices sometimes moving as a result.

In the euphoria of a bull market soaring upward to unknown heights, there are no examples of price levels at which previous surges faltered. Thus the positive feedback effect (represented by influence A) can be strong, and experience (represented by influence B) is bound to be uncertain since there is no historical guidance of prices at which the surge will end. In this situation there will usually have been failed attempts to short-sell the market, which serve to confirm that influence A is stronger than B. For this reason, market tops of this type are notoriously difficult to call. A situation at the market top of August 1987 is shown in Figure 3.8. There had been an attempt to short-sell the market in the spring, which had failed. The market had advanced by almost a third during the first eight months of 1987, so a correction could quite reasonably have been expected (influence B). It started

FIGURE 3.2

Which way will prices go? This is a typical situation in which a decision needs to be made. Extrapolation of short-term trends (influence A) suggests that prices should go upward, whereas past experience (influence B) shows that prices have difficulty going above their latest level and are likely to reverse. This is a situation in which the market could become suggestible to news (influence C) and tip one way or the other, depending on what that news is.

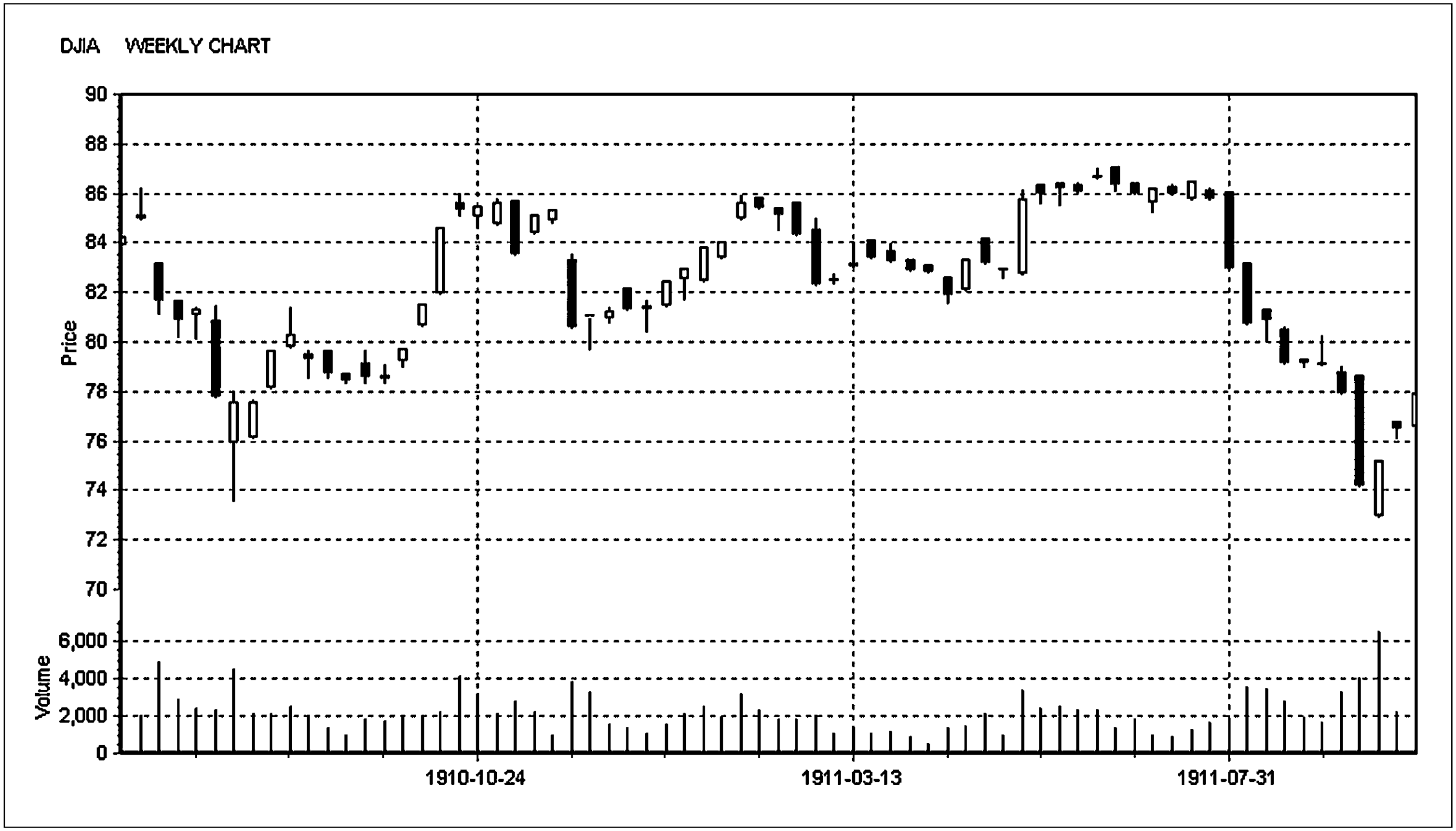

FIGURE 3.3

Prices failed to rise much above 86, and they jogged along at that level for a few weeks before plunging down to 73—a 17 percent fall in nine weeks. The herd was clearly not going to accept the upward move, instead jumping on the bandwagon for the downward ride.

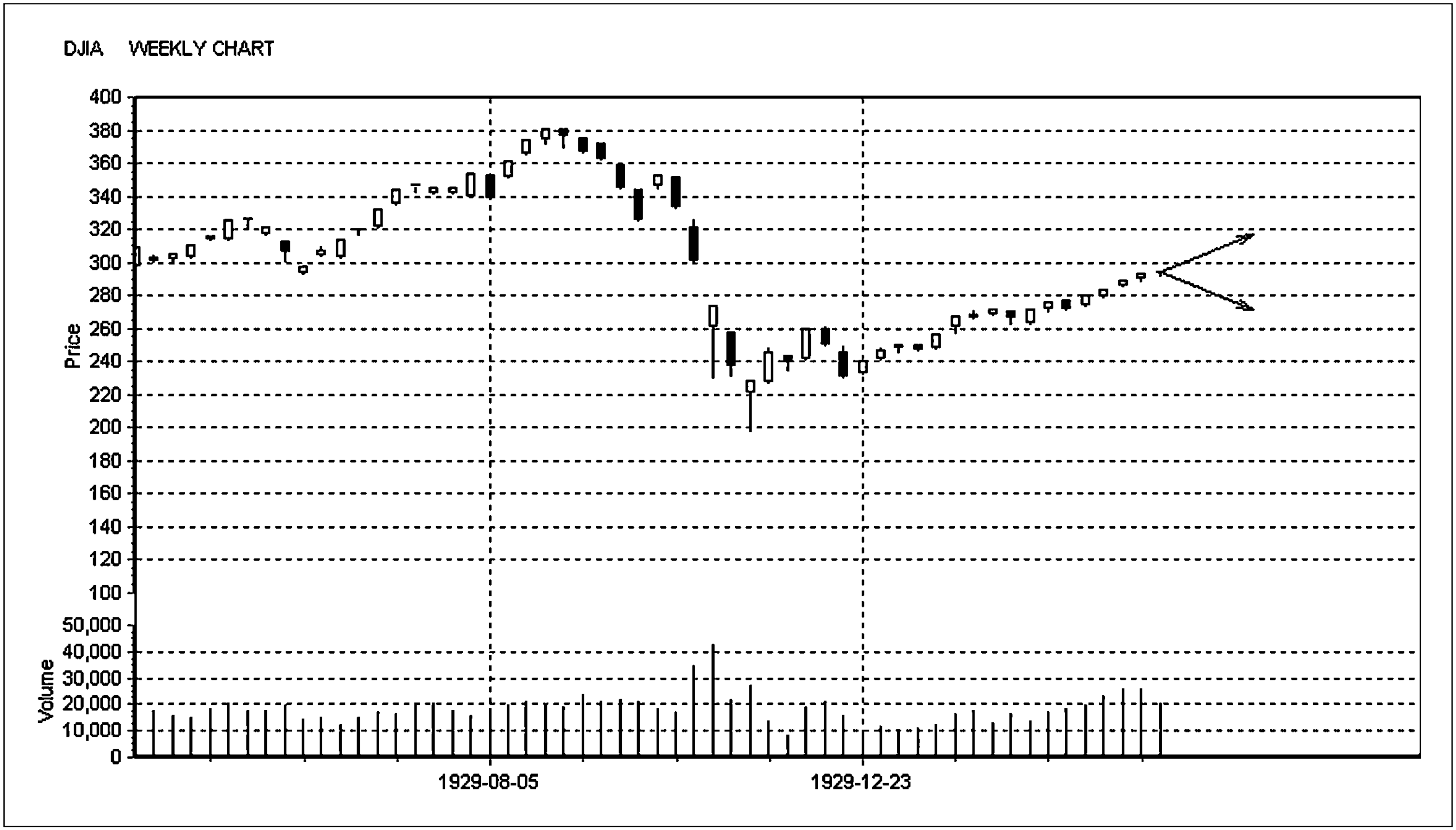

FIGURE 3.4

After the collapse of 1929, the market staged a gradual recovery during the first few months of 1930. By April, this was the position. Extrapolation of recent experience (influence A) suggested a continuation of that recovery, but experience in previous bear markets (influence B) led to a suspicion that this might be a bear market rally, which speculators would sell against. A previous (minor) downturn eight weeks previously had failed to develop into a bear market. No details of news (influence C) are available. What happened next?

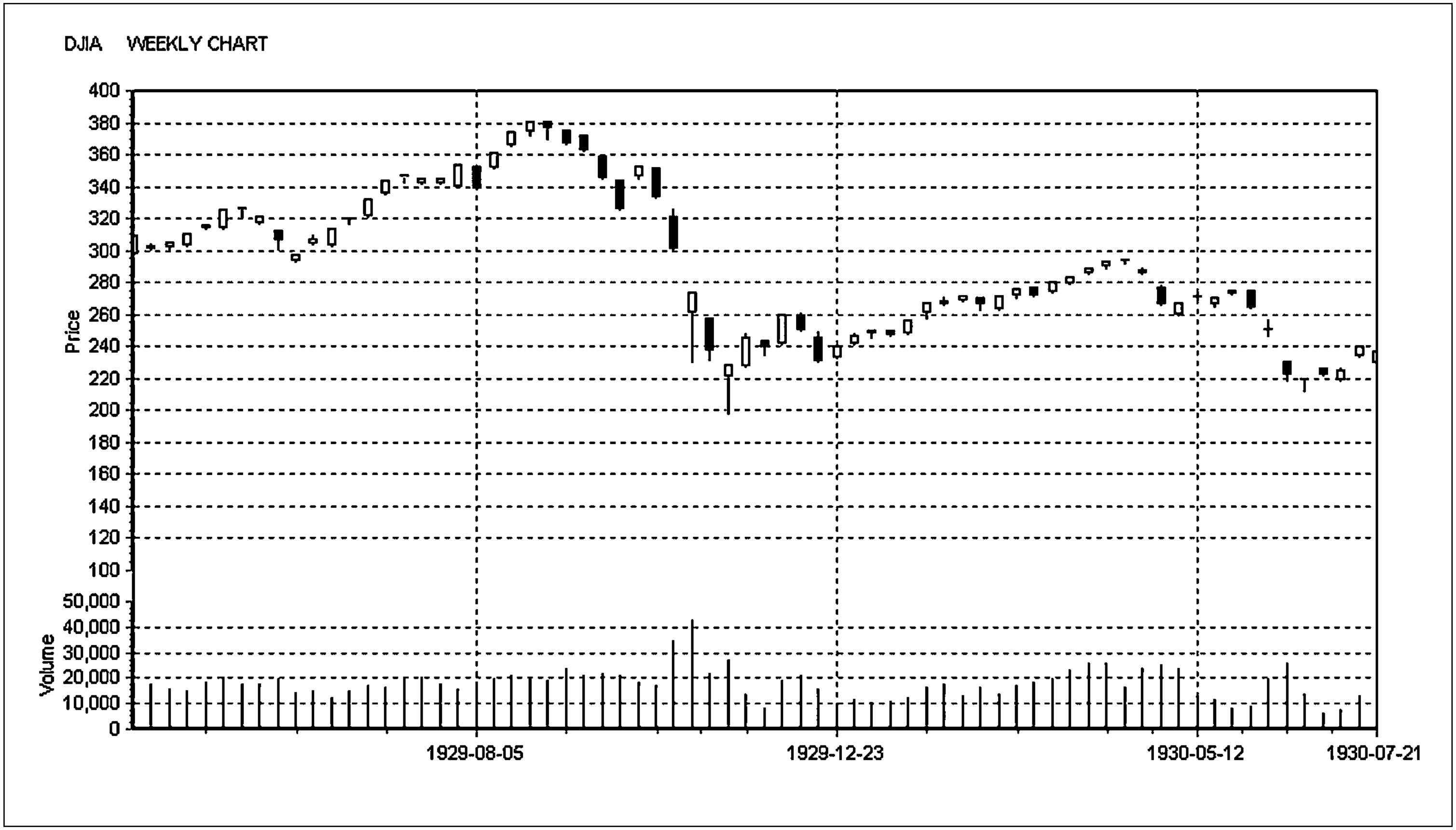

FIGURE 3.5

The suspicion that the price increase up to April 1930 was a bear market rally was justified by events, and prices tumbled once again. This was another case of experience triumphing over short-term extrapolations. However, note that those extrapolations had worked in the early part of 1930.

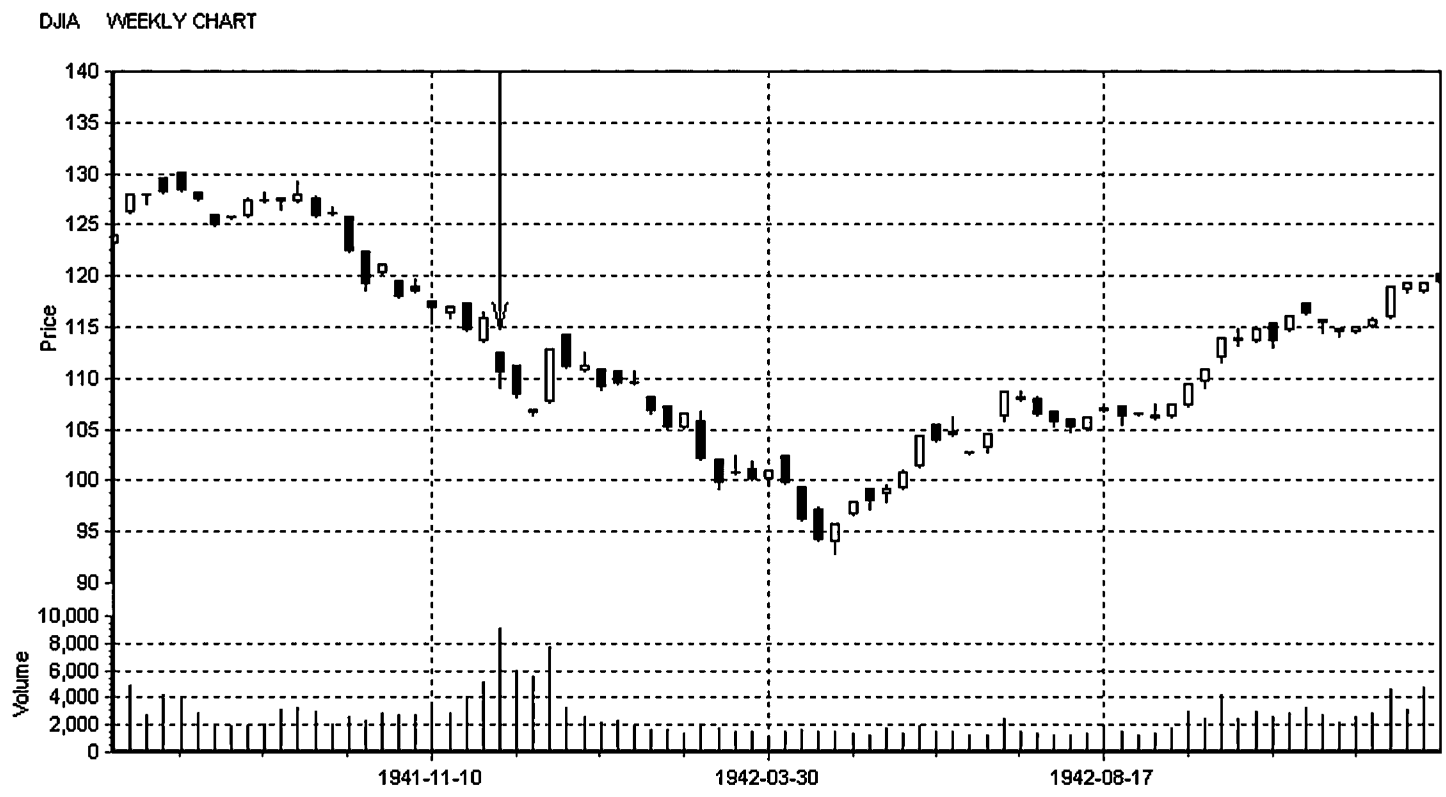

FIGURE 3.6

The market's reaction to the attack on Pearl Harbor (7 December 1941, indicated by the arrow on the chart) and America's entry into World War II register as a blip in a bear market. One reason for this may have been that the world political situation had created an expectation that America would enter the war, and so when the attack came, it was news that had already been discounted by the market.

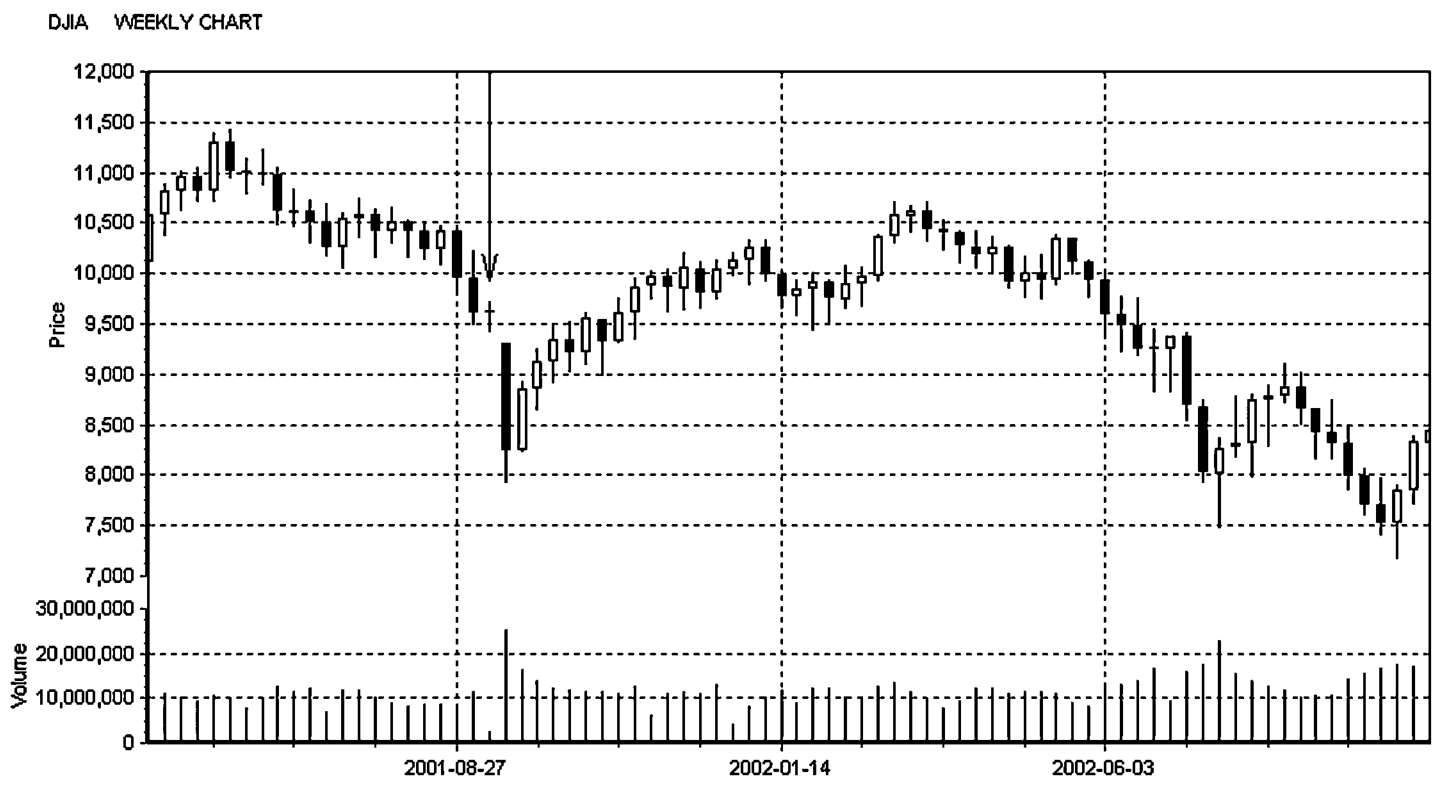

FIGURE 3.7

Al Qaeda's attack on the Twin Towers on September 11, 2001, was unexpected, and the markets closed for the week immediately after. The event is marked on the chart by an arrow. Despite a full 1 percent cut in base rate prior to the market open of the following week, declines of 16 percent were recorded. This news was not discounted beforehand.

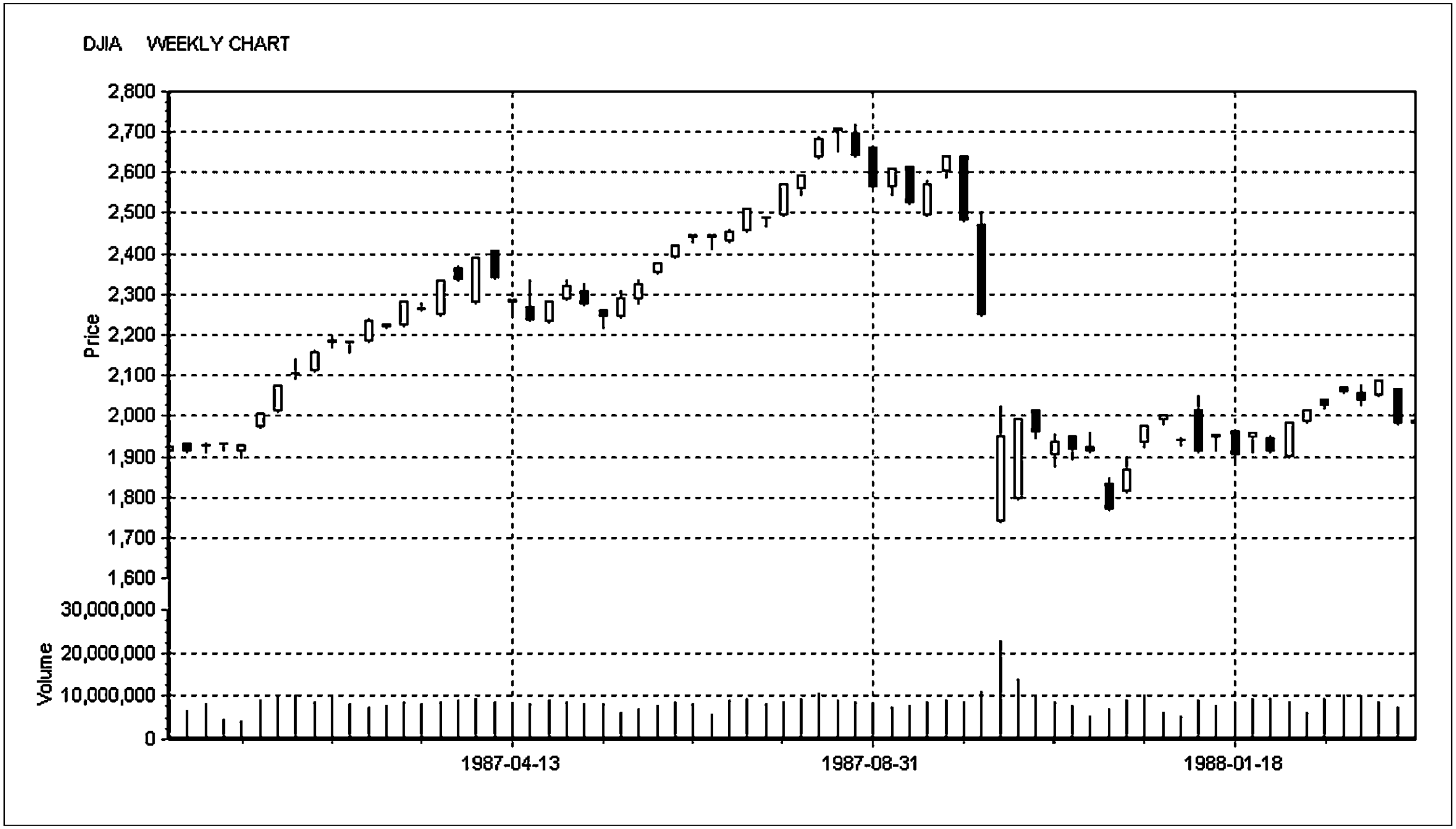

FIGURE 3.8

Conditions at new market tops are notoriously difficult to call. There is no prior experience of price levels at which resistance is likely to be met, the intrinsic value of whatever is being traded may be well below the market, and many participants in the market have no experience of a crash. In the market top shown, at the end of August 1987, the market had advanced to almost three times its level of three years previously, and extrapolation of past trends (influence A) was triumphing over experienced doubters (influence B). In October 1987 it was the short sellers who won out.

in August but hit home with a vengeance in October, when markets fell by around 25 percent in a single day.

Putting all of this together, the following questions might usefully be considered when judging likely price movements:

- Where is price relative to the intrinsic value of the instrument being traded?
- Is the market in an overoptimistic or overpessimistic mood?
- What does the herd think?
- Do I agree with the herd?
- Where does past experience of the market in this situation suggest prices will head next?
- Is the market suggestible to news it has not already discounted?
- Is there any price-influencing news?
- Do I agree that the market price reflects a proper assessment of information available?

The answers to these questions will be subjective, but when used with the model shown in Figure 3.1, they provide a framework for your own considered judgment as to where the market is heading and what the risks of a price reversal are. This dialogue on herd behavior is now brought to a close because we need to move on to examine some of the psychological pressures that investing exerts on the individual and ways to cope with them.

PSYCHOLOGY AND THE INVESTOR

There is a tenuous thread that weaves its way through a number of disparate psychological gems that investors can usefully be aware of. This thread begins with an examination of the motives for investing.

MOTIVATIONS FOR INVESTING

People's motives for investing vary, but surveys suggest they include one or more of the following:

- A desire to make profits
- A necessity to make decisions about stock options obtained as part of a remuneration package from an employer
- A desire for a sense of achievement through investment success, possibly replacing that previously derived from employment

- A hobby
- A group activity associated with social contact, such as an investment club
- A desire to gamble

For the purpose of this book, the first motivation (of making profits) is assumed to be the primary one. It usually features as a motive (although perhaps not the primary one) with all involvement in the markets. Employee stock options are held by people who may have little or no interest in the markets, but it is usually worth their while to monitor how well their employer's company is doing relative to its peers and get a sense for any cyclical behavior in the relevant business sector. From this information, they should be able to make a judgment on when to exercise their options (at the bottom of a cycle) and sell their shares (at the top of a cycle)—always bearing in mind that if their employer folds, they stand to lose both their job and any savings invested in shares in the company they work for. A desire for achievement through investment success is not in itself wrong, but it can lead to actions that seriously damage the chances of the very success being sought. More will be said on this later, in the discussion on pride and its effects on untimely exits; so if a sense of achievement is a motive, those sections should be read with particular care. There is little to be said about the final three motivations, but there are a few words on the desire to gamble in the section on emotion. To continue, we make a very brief diversion into an area of psychology known as *group dynamics.*

GROUP DYNAMICS

This is an aspect of psychology that occurs in many situations—for example, in the armed services recruits are taught to take a pride in their service and not let their compatriots down; in a sports team, group dynamics are used to encourage players to do better so that they do not let their team down. When joining a group, people usually make commitments to the group's objectives, which can later be at variance with the actions they might take if they had no such commitments. For example, if a company for which one worked had shares that were suffering in the markets, the sale of such shares at that time by an employee stockholder could be seen as disloyalty to the company by their colleagues. There are other situations in which actions are constrained by the need to balance commitments to a group with prudent individual investment decisions. In this regard it is useful to bear in mind that professional traders have little or no loyalty to any bullish or bearish position they might hold—meaning that individuals should be aware of, and aim to keep themselves free from, such group encumbrances.

Investors often find themselves in situations in which a friend or family member seeks capital for a new business venture—sometimes with an implication that refusal will imply lack of commitment to the friendship or family. The sad truth is that new ventures usually fail. The stark facts are that of the subset of opportunities objectively selected as worth backing by venture capitalists, 80 percent fail to meet expectations. Set against those odds, it is quite reasonable for an investor to point out to the friend or family member that they invest only if certain risk criteria are satisfied. There is of course the chance that the venture may succeed, but an independent opinion to that effect would first have to fight against the heavy odds of failure.

INDEPENDENCE OF OPINION

It was noted in the discussion on herd behavior that succeeding or failing publicly outside of the herd was likely to generate an adverse reaction. Taking great care with who knows about your market activities is generally a good thing for a number of reasons. Some of those reasons are obvious from observations on herd behavior, but later it will become clear that such knowledge in the hands of others can bring pressure to make untimely exits. Note also that at major turning points, markets have a tendency to react in a way that trips the majority of their participants, meaning that the best results are likely to be achieved by loners operating outside the herd's received "wisdom." This means that to achieve their full potential, individuals need to develop their own opinions and reject the specious argument of the herd that "so many people cannot be wrong." Some professional traders are very selective with their reading and carefully manage the sources of information they use for their investments—both to maximize its usefulness and exclude extraneous influences. The implied message is that developing and maintaining an independent viewpoint needs careful thought and cannot just be left to chance. This is likely to consist of (1) surveying sources of information available, (2) deciding which are useful and which should be avoided, and (3) deciding which of the useful ones are so closely correlated that they can be excluded. The whole subject of the information needed for independent thinking is bound up with drawing the right level of inference from it; that is, not inferring too little or too much from it.

INFORMATION, DECISIONS, AND OVERCONFIDENCE

To some extent, information can help to improve an investment decision, but a point is rapidly reached where the inherent uncertainties surrounding an

investment decision mean that further information no longer helps to predict price movements. Too much information creates a false sense of confidence from the mistaken belief that more information automatically leads to an improved ability to look into the future. In investment decisions, too much information leads to too much confidence in decisions based on it without increasing the accuracy of the decision. Overconfidence may also arise from overrating past successes and underestimating the significance of (and failing to learn the lessons from) past failures. Wärneryd offers credible evidence that this is the case—so please be warned—overconfidence, from whatever source, can be damaging to your wealth and generate adverse emotional reactions.

EMOTION AND INVESTING

The emotion involved in trading depends on the individuals, the degree to which they can afford losses, the profits and joys they get out of succeeding, the pain they suffer from losses, and the risks they either seek to take or to avoid. High levels of emotional arousal reduce the ability to make good decisions, and many stock market scams are specifically designed to produce such arousals so that the bad decision the scam requires can be achieved. The exception to this are the gamblers, who derive arousal (or thrill) from taking the risk in the hope (usually not realized) of their expected reward. It is important to appreciate that decisions that are rushed (for example, in response to a breathless broker's phone call about a hot stock) are likely to be poor decisions. Similarly, decisions that are made when the investor lacks the time for proper consideration are likely to be emotional rather than rational. In particular, if your investment activity is keeping you awake at nights, consider exiting your positions and taking a holiday, reducing the money at risk, or reconsidering the time frames needed for your investment decisions.

TIME FRAMES FOR INVESTMENT DECISIONS

It is important to be honest with yourself about both the time needed and the amount of time available to make investment decisions. There are news junkies who delight in spending all day absorbing news and prices, watch their interactions, relate these interactions to their trading logic, and make their decisions. For somebody holding down a demanding job, it can be difficult to compete with such junkies. On the other hand, if nonprofessionals were to invest using a weekly time frame, their information would be available on Friday evenings; arguably it would have less noise in it than daily or intraday data. These investors would have a weekend to think about their investment decisions and be free from any pressures to act just because the market was moving. Furthermore, one of the major causes of loss, overtrading, would automatically be reduced by their extended time frame. If such weekly investments were accompanied by appropriate (*good-till-canceled*, or GTC) stop-loss orders, then the entire investment process could be reduced to weekend consideration of investment decisions and Monday morning placement of orders (to include stops). Whether you trade monthly, weekly, daily, or intraday, the point is that the time you need to make good investment decisions should be made available, worked into whatever other commitments you have, and if this demands a new investment time perspective (for example, weekly rather than daily), then it should be adopted. Competition with peers, pride, or anything else must not be allowed to get in the way of the consideration you need for your investment decisions. Of these, pride is the most dangerous and needs careful examination.

PRIDE

Professionals know that markets can turn rapidly, which means that a previous investment decision may need to be reversed rapidly. That being the case, there is no point in taking an excessive pride in any individual investment decision, and there is no point in boasting about it. Professionals also know that they cannot be right all the time, and there is but a limited chance of any investment decision succeeding. The old maxim of diversifying to spread risk is an implicit acknowledgment that investment is an uncertain process since if it were a certain one, everything could be invested in the best-performing instrument.

Needless to say, success in the markets brings pride in acumen and sets you up for a subsequent fall—especially if that "acumen" (which may be due to transient market conditions) is known and talked about. In the Roman Empire, a conquering general would ride into Rome to the cheers of crowds but with a slave whispering in his ear that all fame is transient. I watched a television program once where an extremely knowledgeable investor (for whom I have the utmost respect) was talking about his business failure. His words were, "When people constantly tell you you are right, you come to believe it." Market behaviors change regularly, which trips the majority of their participants. So if you achieve success, ignore any cheers and imagine yourself (like the conquering Roman generals) to have somebody whispering in your ear that all success in the markets is transient and avoid the pitfall of pride. Be mindful that Sir Isaac Newton lost £20,000 ($36,000 at $1.80 to the pound) in the South Sea Bubble, and (arguably) the world's greatest economist, John Maynard Keynes, lost heavily in the 1930s. There is no guaranteed link between success in the markets and intelligence. So while failure may be due to a lack of intelligence, experience tells us that failure does not automatically imply there is any such lack. This should offer some solace to those investors who are seeking, but not finding, the sense of achievement they once had with their employment and encourage others who are thinking of entering the markets to do so with realistic expectations. One of the effects of having too much pride in investment decisions is that it leads to failures to make timely exits, which we now look at.

FAILURE TO MAKE TIMELY EXITS

When an investment decision is wrong, pride in its correctness inhibits that admission (who likes being proved wrong?) and is one of the main reasons why positions are held for too long and losses are taken. In the uncertain conditions of the marketplace, there is no shame in admitting that a decision was wrong and a loss had to be taken. However, within professional circles, it is viewed as incompetence not to admit to such failures early enough and suffer the heavier losses that timelier action could have avoided. This is a difficult issue to describe as it is inevitably bound up with the breathing space needed for an individual investment style. (Styles using frequent investments, exited for small losses, risk death by a thousand cuts whereas longer-term investment styles risk death by a few strokes.) The main message is that you should develop appropriate exit criteria for your style of investing and not let pride get in the way of exiting from positions that are not working out. If there has to be pride, let it be directed toward correctly interpreting data that arrive after an investment is made in such a way as to identify and exit from failing positions. For people motivated to invest for a sense of achievement, particular care should be paid to the last sentence.

Another reason for holding on to a position for too long is that most responsible people believe they should be consistent with their decisions and so it goes against their principles to be inconsistent. In the case where investments have been discussed with people who do not understand the rapidity with which changes in market positions are needed, there can be the additional problem of not wanting to appear inconsistent in their estimations. The solution is to be careful with whom you discuss your investments, and also to remember that professionals appreciate that rapid reversals of decisions are sometimes needed and that the main sin is not to take action when it is called for by market conditions. The other side of this coin of timely exits is resolution, which we now examine.

RESOLUTION

Having made an investment decision, it is usual to give it a "breathing space" to see if it will work, and exit if it does not. However, as every sales assistant will tell you, once something is sold, doubts set in about the wisdom of the purchase decision and attempts are often made to return the goods for spurious reasons. In the case of financial instruments, if the investor is prone to this kind of reaction, where the grass always looks greener on the other side of the street, the temptation is to succumb to the weakness, exit the position, and take the one on the other side of the street where the grass looked greener. Once there, a similar reaction can set in and something else appear more attractive. The result is overtrading as a consequence of changes in expectations brought on by self-doubt after acquiring a position. If you are prone to such doubts, acknowledge them and do not allow them to influence your decisions because if they do, your potential as an investor will never be realized.

Another problem affecting resolution is that of carrying out a routine review of opportunities and feeling that some action is needed to justify the time spent doing the review. If possible, give yourself the time to have second or third thoughts about any investment decision and acknowledge that, if you do nothing and leave your investments intact, then there will be no commission payments, no capital gains tax payments, and no slippage. In short, all other things being equal, it pays to stay with existing investments rather than chop and change to justify the time spent doing a review. Finally, if the investments are not working out or, after taking everything said here into account, better opportunities exist elsewhere, it is time to exit the position.

Mention was made earlier of the need to avoid having a greater sense of resolution than the market needed because of personal principles regarding inconsistency or an appearance of inconsistency to others. The message is that the degree of resolution needed depends on a combination of the market and your style of investing and has nothing to do with personal principles or appearances. Successful professional investors understand this, and their methods of working can be usefully examined.

SUCCESSFUL PROFESSIONAL INVESTORS: CHARACTER TRAITS AND METHODOLOGY

I have been privileged to meet perhaps three people I would include in this category and a much larger number of others that I would not. Of the successful ones, none court publicity or are well known. In my view, none suffer from the weakness of pride, all are realists, all are cognizant of risks at least as much as (if not more than) potential profits, none brag about their prowess, all are independent thinkers but receptive to the views of certain other people when making up their own minds, and all have a clarity of vision.

Successful professional investors identify and ignore chaff, have a methodology for gathering sufficient information relevant to their decisions (Lord Keynes, who made a fortune after his reverses, used to spend half an hour in bed each day reading selected newspapers), an execution process that minimizes commission and slippage costs, and antennae that are sensitive to any situation likely to lead to a change of market direction. This means that they must stay outside any herd, as without independence of thought they cannot identify turning points. Their realism makes them monitor their positions sufficiently and ask themselves candidly whether, after all costs are taken into account, better opportunities exist elsewhere. They will have well-considered criteria for what they are prepared to invest in, which will usually involve markets that are liquid and they are familiar with. They will also have their criteria for deciding the extent of any investment and when it will be exited. They avoid the encumbrances of group loyalties referred to earlier, and they may be willing to change their minds as rapidly as the market changes direction. They appreciate that market behaviors change in such a way as to nullify the effectiveness of what was, until recently, their optimal investment logic. In consequence, they will be ready either to withdraw from the markets or apply a different investment strategy in the event of any such change. Pride in any particular investment decision is either absent or not permitted to influence a prudent exit. They have well-developed senses of timing and are aware of certain common confidence tricks that we might usefully examine.

THINGS TO BEWARE OF

A number of well-known tricks are used to make investors part with their hard-earned cash in return for a worthless investment. The SEC has a Web site that deals with these and also provides an opportunity for investors to make complaints. The following is a list of some of the more common ruses.

The Pump And Dump

In the 1920s, in an age of poor company reporting, pump and dump was not illegal. It consisted of a wealthy person's having a number of financial journalists on his payroll. He then bought a large quantity of cheap stock in a company and got his tame journalists to write favorable reports about it (pumping). The reports increased the demand for the stock, which increased its price, at which point the wealthy person dumped it at the higher price and walked off with a profit. The practice was outlawed in the Securities and Exchange Act of 1933 and 1934, but there is probably a country somewhere where it is not outlawed and where an Internet site can be set up to pump and dump.

The Boiler Room

Stephen Leather's book *The Vets* contains a fictional account of a Mafia-controlled boiler room operation, and a film has been made titled *The Boiler Room* describing a fictional example based on a typical scam. Subsequent press reports suggest that these works of fiction are closer to the truth than many would care to admit. The boiler room is a modern version of pump and dump, and it consists of high-pressure telephone salespersons striking up telephone friendships with investors to "pump up" their expectations of worthless stock, which they subsequently try to "dump on" them at inflated prices. In its latest manifestation, it is being operated by expatriate westerners from developing Far Eastern countries, probably with an accommodation address in Chicago, New York, or London and with return calls diverted from those cities to wherever the scam is being operated from. The operators are slick; they offer "sure things," question the intelligence of those who refuse such "sure things," demand an immediate decision, can be evasive when asked to provide information about the investment, have imaginative excuses for delaying the delivery of the product or its supposed profits, may wish to avoid mail fraud charges by using courier services to collect investors' money, and may resist giving proper details on the grounds that the underlying technology is secret—which smacks of the 1720 investment opportunity offered in the euphoria of the South Sea Bubble for "carrying on an enterprise of great advantage, but nobody to know what it is."

The Shout

This is a tactic that has been used by supposedly respectable brokers to unload questionable stock on clients whose interests they are supposed to be looking after. It consists of a client's receiving a breathless call from his or her broker saying that a "hot" stock is selling very fast and there are only 10,000 shares left. When he or she says the words "10 thousand," somebody in the background shouts "five." The client is then urged to buy some or all of the remaining 5,000 shares quickly before they sell out. Once again the ploy is to urge the client to act before he or she has had a chance to do the necessary due diligence research on the stock.

The Risk-Free Fraud

The SEC Web site makes the point that no investment is risk free and claims of high returns for no risk are usually fraudulent. They quote eel farms, prime bank securities, and wireless cable projects among questionable Internet offerings. The basic rule is that reward comes at the price of risk, and the greater the reward, the greater the risk associated with it. Some of these scams are backed by an elaborate trail of specious transactions to make them appear legitimate.

Note that with all of these schemes, if you take your time to make your decisions and check out the investment carefully, you are less likely to be conned. It is worthwhile checking out the SEC Web site for examples they give of past frauds.

A PSYCHOLOGICAL CHECKLIST FOR INVESTORS

Some of the psychological considerations affecting the individual investor can be summarized into a checklist:

- Be clear in your own mind about your motivations for investing.
- Be aware that making commitments to a group (for example, an investment club) may bring pressures for you to act in a way you do not want to.
- Beware of following the herd and form your own independent views.
- For market decisions, there is a limit to the amount of relevant information that can improve accuracy and a danger that too much information may lead to a false sense of confidence.
- There is strong evidence that investors overrate their past successes and underrate their past failures, leading to overconfidence in their ability to make investment decisions.
- High levels of emotional arousal lead to a reduced ability to make good decisions, which is something the unscrupulous exploit.
- If your investment activity is causing emotional arousal or other emotional problems, do something to stop them.
- Choose a time frame for your investment operations to give you the time you need to make good investment decisions, compatible with other commitments in your life.
- There is no guaranteed link between any individual investment decision and intelligence, and so there is no point in being ultraproud of your acumen.

- There is a link between not making the best use of data that arrive after an investment is made and losing money.
- Success in the markets encourages pride in investment acumen, which sets you up for a fall.
- Common causes of untimely exits are pride in an investment acumen, a desire to appear consistent with your actions, and a feeling that some action is needed to justify the time you spent monitoring positions.
- All other things being equal, it is better to stay with the positions you hold than to chop and change.
- Any need to change positions depends on what the markets do and have nothing to do with perceptions of consistent behavior.
- If you need to discuss your investments, note that it is best done with people who understand the markets.
- The balance between resolution in holding a position and timely action in exiting it depends on style of investment and market behavior, and it needs to be worked out individually by each investor.
- Decide what information you are going to take in to help your investing and what information you are going to exclude.
- Develop your own criteria for what you are prepared to invest in and how you are going to manage your investments.
- If anybody telephones you to try to get you to invest in something, you do not know where they are really calling from and so it is best to assume the worst, especially if they try to get a quick decision or offer a "sure thing."
- Always take the time to check out any investment opportunity carefully, realize that rewards have risk associated with them, and there is no such thing as a "sure thing"—if something seems too good to be true, the chances are that it is.
- In euphoric market conditions, boiler room and similar scams appear much more credible, and there is likely to be an upsurge in them whenever such markets occur.

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CHAPTER 4

Background to Investment Decisions: Practice and Theory

There are a number of ways in which investment decisions have been and are being made. The premise of this book is that the most successful (market) decision methods come from a fusion of inferences derived from multiple perspectives of the same situation: Look at a possible investment decision from many angles and obtain many independent results, and then combine them to come to a final decision. That premise has been the reason for the breadth of this book's content, and its foundations will be explored in this chapter. There is a sound mathematical basis to confirm the correctness of this approach, which is particularly relevant for investment decisions. Thus a collection of weakly effective but independent opinions can be shown to create a more effective "committee" opinion than any considered individually. Also in this chapter, we will look at techniques for dealing with uncertainty, evaluating news, and inferring conclusions from complex data.

Fortunes have been made in the markets by people without significant mathematical knowledge, who may have been doing things that were mathematically correct but whose decision techniques were based solely on intuition. Their observations and techniques are worthy of at least equal prominence to any that are mathematical, and so we begin this chapter with a description of decision methods based on intuitive judgments.

INTUITIVE INVESTMENT JUDGMENTS

Decisions in the markets are always likely to be a mixture of art and science, and one of the problems of predictive sciences is that they usually presuppose that an outcome will depend on predefined fixed variables. To understand the limitation of this, we pose the question of how many computer programs were written to predict that a coup would be attempted against Mikhail Gorbachev when a quarter of a million Russian troops were billeted in what was then East Germany, which caused a sharp fall in the then German currency, the Deutsche mark? Similarly, how many computer programs predicted that Iraq would invade Kuwait to cause a collapse in the Kuwait dinar? No matter how sophisticated computer investment and/or trading programs become, there will always be elements of "soft" information missing from them, or a logical train of consequences unforeseen. Humans can digest this soft information from news sources, rapidly work out its implications for markets, and make appropriate investment decisions. In "normal" times, where anomalous news is not impacting on prices, computers can probably do the job almost as well; but there remains a need for humans to monitor whether the assumptions behind any computer program are contemporaneously valid and intervene when they are not. Unless we move to a different kind of world, human judgments are likely to be needed for the foreseeable future, and so we move on to look at some of their aspects recognized as relevant to the markets.

EXPERTISE

First, as pointed out in the introduction, we are each endowed with a unique set of life experiences, which should mean that each individual has a better understanding of some market sectors than others. It therefore makes sense to identify and build on whatever strengths the individual has and to track the financial instruments to which those strengths relate with a view to finding investment opportunities the individual understands. As a further step, individuals should consider what areas they wish to invest in and what knowledge they need to acquire to do so effectively. This point is made at greater length in Jim Slater's book with the catchy title of *The Zulu Principle*: Reading a short article on Zulus made his wife an expert on them relative to most of the people around her (in Surrey, England, not Natal, South Africa), and further reading could have enhanced this relative (local) expertise at little cost. Essentially, the judgment that each individual needs to make is whether the cost of acquiring knowledge is justified by the use that can be made of it. The answer to that question will depend on the individual's strengths and life experiences and whether, in an international marketplace, purely local expertise will be adequate to make a competitive investment decision.

One way to expand an individual's expertise is to develop a network of specialists, each of whom can contribute expertise in a given area in which others may be weak. Investment clubs may provide one such mechanism, Internet forums another, but the main point is that it can be worth the individual investors' while to broaden their network base to gain the expertise they need to expand the investment opportunities they feel comfortable about making. With regard to what was said in Chapter 3 about group dynamics, a reminder is given that commitments to a group, forum, or network may accompany membership, and so the "strings" need to be understood before deciding to join.

INFERENCES FROM THE ACTIONS OF INSIDERS

In the case of investments in securities, it may be possible to make inferences from the investment decisions of those with inside knowledge, which is what we now look at. Prior to the 1933 to 1934 period, it was legal in the United States to use inside knowledge to assist with investment decisions, but the practice was outlawed in the Securities and Exchange Act, and it has subsequently been outlawed in most developed countries. This clearly presents a problem for the management and directors of those running such companies who also own shares in them. So one way that a balance has been struck between appropriate incentives and openness has been the introduction of legislation requiring insiders' share dealings to be disclosed. From the external investors' perspective, this means that such share dealings may or may have been prompted by inside knowledge. Slater gives an account of how to interpret such dealings. His account relates to legislation governing the behavior of directors of British companies, which has had a major influence on the following summary that is probably relevant to other legislations:

- Web sites and brokers provide information about insiders' share dealings.
- There is a period prior to the announcement of results when directors cannot deal in their company's shares.
- Directors selling may be less important than directors buying, since if they are buying shares, it will be in competition with other investment opportunities.
- In assessing the significance of directors' buying shares, their circumstances need to be considered. For example, on taking up an appointment, a director might feel a need to display confidence in the company by buying some shares. As another example, if somebody that already has a large shareholding buys a few more,

it may not be significant, whereas if a purchase is large relative to an existing shareholding, it can be significant.

- Directors know their dealings are being watched, so there is some potential for them to manage the perceptions of the investing community—for example, to support a share price with token purchases—providing another reason for judging any dealings in relation to existing holdings.
- If a single director is selling, it could simply be a case of the cash being raised for a necessary purchase. But if multiple directors are selling (or buying), any inferences to be drawn about the company's prospects are strengthened.
- The position within a company of a director who is selling is relevant. If a finance or sales director were to sell most of his or her shares, there could be a more significant inference than if (say) a production director were to sell his or her shares.
- As part of your due diligence, as an investor, you should examine directors' share dealings for (about) a half-year period prior to your making any investment. If you decide to invest, you will feel more comfortable with your decision if you can find confirmation from a company's directors.

This is necessarily an inexact process. Usually directors' share dealings are not used as the sole criterion for an investment decision, but either to confirm such a decision or not provide contrary indications.

PRECURSORS TO UNSTABLE SITUATIONS

There are well-established ways in which markets react to perceptions of risk, which give rise to expectations of related price changes in associated instruments. By "related" we mean that money tends to flow from one instrument into an associated one and back again. When price changes occur but are in the wrong proportions, it is a sign that pressure might be building up for a correction. Such a situation occurred in October 1987, when the S&P 500 lost 25 percent in a single day and many individual shares much more. Money flows within the markets need to be monitored and understood. During times of uncertainty, money flows into gold. If the market for securities is bearish, money flows out of securities and into bonds, and if the securities market is bullish, out of bonds and into securities. The situation leading up to the "crash" of 1987 illustrates quite well how the markets occasionally get out of balance and build up pressure for a correction. The "crash" of 1987 was accompanied by one of the largest one-day increases in the price of bonds ever seen, correcting the imbalance.

First, from Figure 4.1 we note that the price of gold had been rising for the two weeks prior to 19 October. This price movement might not have been a cause for concern normally, but in this case it was accompanied by unusual bond and securities price movements that indicated it could be due to uncertainty about a correction. At Monday's open on 19 October, the price of gold had jumped 3 percent over its close on Friday, 16 October.

Second, from Figures 4.2 and 4.3, we note that both U.S. bond and S&P 500 prices had both fallen heavily in the two weeks preceding 19 October. This was unusual, given that money usually flows out of one and into the other, with associated price changes in opposite directions. Such a situation might occur due to an excess of bonds being made available for auction, but that does not seem to have been the case here. Pressure was building up for something to happen, and many people would have exited the market the previous week, in which trading volume for the S&P 500 peaked for the year, which could well have been the smart money leaving the market and the less smart entering. Note also that while bond trading was heavy, heavier trading volumes had occurred a few weeks earlier, suggesting that there was relatively less urgency in the market for bonds than for securities. There was an issue of whether bonds or securities would give way, but little doubt that a correction was due.

Finally, Figure 4.4 shows an example of what was going on in European exchanges prior to the opening of U.S. markets on 19 October. Given the extent of the correlation between price movements on world securities markets, there was little doubt that it was going to be securities that gave way.

This is an example of how an understanding of the workings of the markets provides clues when pressure for a correction is building. What some people do is to exit their positions when large corrections appear imminent. This may be the safest tactic for small investors or, for that matter, any investor concerned about exposure to high risk. In the case of the 1987 crash, another tactic would have been to buy gold, which would have worked had it been bought in the week before the crash and sold on the day of the crash. However, buying gold could have been unprofitable if the correction had been more gradual. It is worth monitoring bond and securities prices, and their trading volumes, to check for both urgency and this kind of precursor to unstable situations.

While the bond-to-securities relationship is usually the most important, and the one that almost always needs careful monitoring, there are other relationships between different market sectors that should be sought out and monitored for investors wanting to specialize in some area of investment.

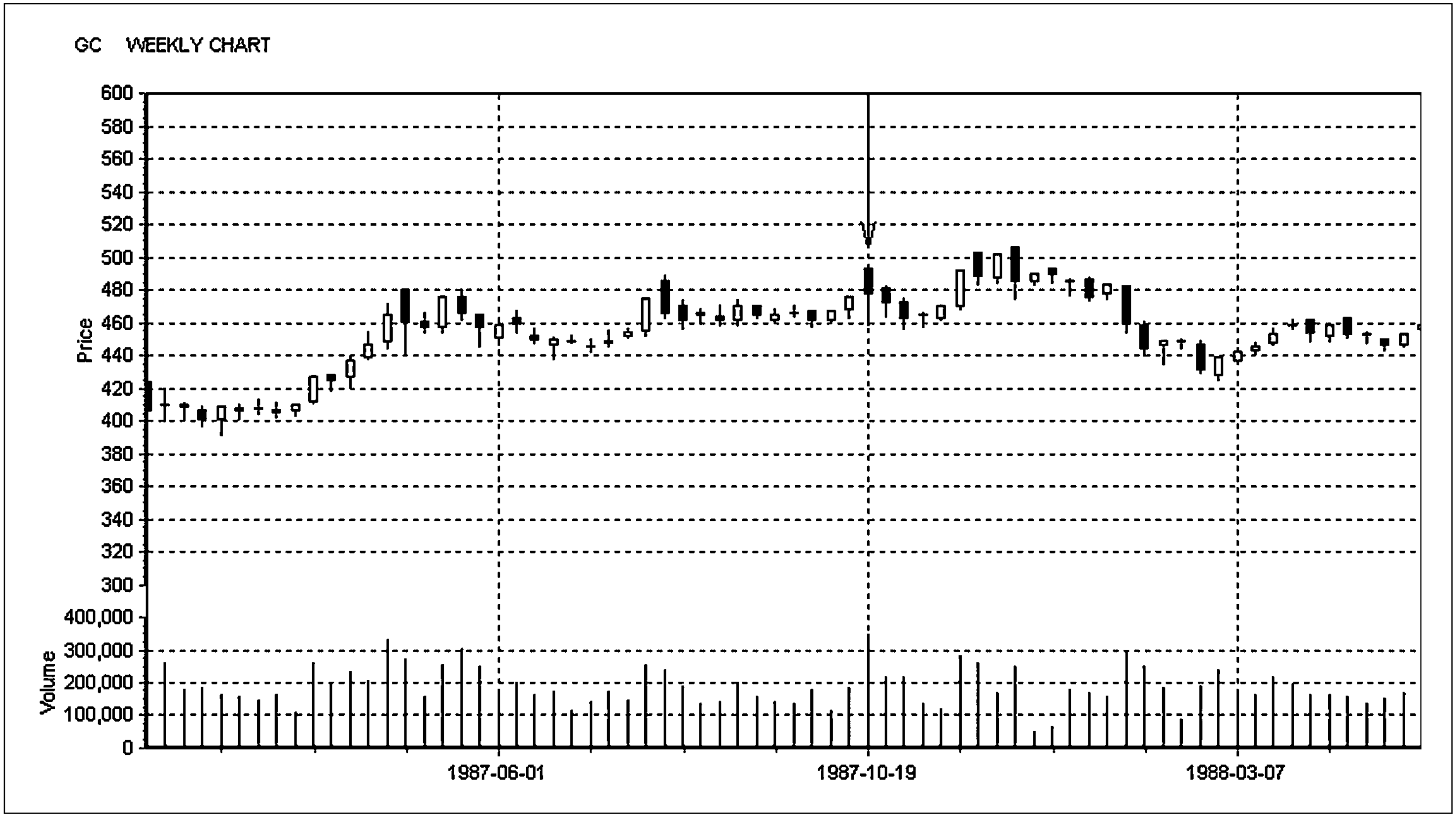
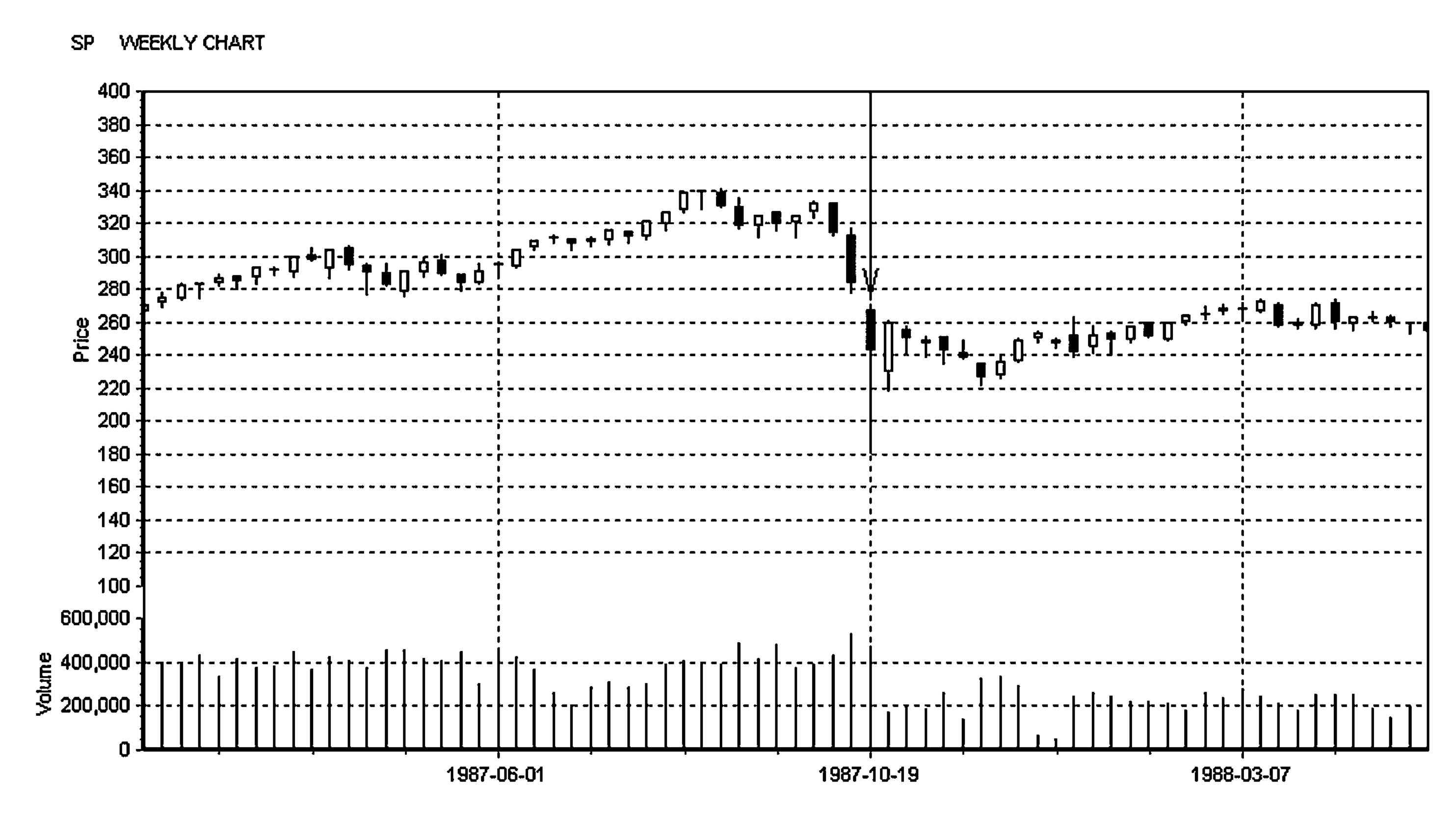


FIGURE 4.1

At the open of the trading session of 19 October 1987, there was a 3 percent increase in the price of gold, which had been rising gradually for the previous two weeks. Gold is a haven for money in times of uncertainty, which this week proved to be.

F I G U R E 4 . 2

Prior to 19 October 1987, U.S. bonds had been falling steadily. The usual flow of money is from stocks into bonds and vice versa, with price increases following an inflow of money and decreases following an outflow. The situation prior to 19 October was anomalous, in that stock prices had been falling as well as bond prices. Pressure was building up for a price correction to either stocks or bonds. Stocks went down and bonds went up. One interesting point is that the crash in stocks occurred on 19 October, whereas the rise in bonds did not begin until 20 October.



F I G U R E 4 . 3

Note that, like bonds, prices of the S&P December futures had been falling steadily for the previous two weeks, suggesting a correction was imminent. The market opened around 267 when it was still possible to get out. Observant investors might have anticipated what was coming because heavy falls had already taken place on foreign stock exchanges to which U.S. prices tend to be correlated.

FIGURE 4.4

The situation leading up to 19 October 1987 suggested a correction was imminent. On the day itself, there may have been an issue of whether bonds or stocks would give way. European markets trade five to six hours ahead of U.S. markets, are strongly correlated with the United States, and what was going on there left little doubt that stocks were going to give way. The chart shown is for London's FTSE 100 index, which had opened almost 10 percent down on its Friday close (16 October) and headed downward from there.

NEWSLETTERS

One way to keep track of market interrelationships is via appropriate newsletters. There is at least one widely read, weekly, inter-market-update newsletter that should alert investors to contemporary activity in stocks, bonds, currencies, and precious metals. Such newsletters usually have relevant charts so that price activity in these four sectors can be seen, enabling any unusual (relative) price movements to be picked up. In general, newsletters also help to form a general impression of where the markets are and where they are heading, which helps in assessing "prior probabilities" for the Bayesian concepts to be described in the next section.

MATHEMATICS-BASED INVESTMENT JUDGMENTS

Abstract mathematical concepts tend to scare people, and in their enthusiasm for their subject, mathematicians can easily lose their audiences by lapsing into incomprehensible symbols. In writing this section, I had to use some symbols, but I have tried to keep them to a minimum. In Chapter 3, the point was made that more information does not always lead to better decisions. A similar situation exists with the complexity of mathematics applied to the markets—that is, more complicated mathematical concepts do not always lead to better decisions. A great deal can be accomplished with some relatively simple mathematics, to which we now turn our attention.

PROBABILITY

It is often said that the calculus of probabilities is the language of uncertainty. There is plenty of uncertainty in the markets, and so it is worth knowing something about probabilities. One of the difficulties with statistics is that they can get very complex very quickly—which leads to the completely false idea that unless its complexity is fully understood, the subject has nothing to offer. There are five fundamental rules of statistics, all of which are relatively easy to state and understand, and when understood, offer a useful basic knowledge of the subject. For the sake of explaining the rules, we are going to imagine a situation where there are three possible hypotheses, H_A, H_B, and H_C; and we want to know the probabilities $P(H_A)$, $P(H_B)$, and $P(H_C)$ of each being true.

Rule 1 (probabilities cannot be negative): Probabilities must be greater than or equal to zero; for example, $P(H_A) \geq 0$.

Rule 2 (probabilities cannot exceed unity): Probabilities must be less than or equal to 1; for example, $P(H_A) \leq 1$.

Rule 3 (probabilities sum to unity): Probabilities must sum to 1; for example, $P(H_A) + P(H_B) + P(H_C) = 1$.

Rule 4 (sum rule): The probability of H_A or H_B being true is $P(H_A) + P(H_B)$.

Rule 5 (product rule): The probability of H_A and H_B being true is $P(H_A) \times P(H_B)$.

Note the importance of the words *or* and *and* that distinguish rules 4 and 5.

To illustrate these rules, suppose two dice are rolled together. Let H_A be the hypothesis that a 1 will appear on the first die, H_B the hypothesis that a 1 will appear on the second die, and H_C the hypothesis that a 1 will not appear on either die. Note here that H_C has been chosen carefully so that rule 3 will be valid. The general point is that at least one hypothesis needs to be chosen to be the negative of the sum of all the others. Each die has 6 sides and will rest on one of them. Consequently, the chances of a specific number appearing on any one die is 1/6 [that is, $P(H_A) = P(H_B) = 1/6$], which is greater than zero (satisfying rule 1) and less than 1 (satisfying rule 2). From rule 4 (the sum rule), the chances of a 1 appearing on at least one die are 1/6 + 1/6 = 1/3. From rule 3 (probabilities sum to unity), this means that the chances of a 1 not appearing on either die are 1 – 1/3 = 2/3 [that is, $P(H_C) = 2/3$]. Finally, from rule 5 (the product rule), the chances of a 1 appearing on both dice from a single throw of the pair are 1/6 × 1/6 = 1/36. If you like, experiment by throwing a couple of dice several times to see if your results are similar to these. These are the basic rules of probability, and there are no difficult concepts involved in understanding them.

Market situations are rarely (if ever) certain, and so a grasp of these rules should help to clarify estimates of scenarios on which decisions need to be based.

AVERAGES μ AND DISPERSION σ

Concepts of data averaging and dispersion are used a good deal in market literature, and so we need to introduce them here. Later in this book, we will be looking at averages (or means) of various items of data and also ways of distinguishing between data sets that are tightly clustered around their averages and those that are much more widely dispersed. Formally, if we want to find the average μ of a set of N data values $(x_1, x_2, x_3, \ldots, x_j, \ldots, x_N)$, then we just add them up and divide the sum by the number of values. With the symbol Σ used to imply summation, a formula for this can be written as

$$\mu = \frac{\Sigma_{j=1}^{j=N} x_j}{N} \tag{4.1}$$

[While the formula is unnecessary for a result that most people can work out very simply, it is useful to introduce formal notation for a well-understood calculation so that (hopefully) similar notation becomes less forbidding when it next appears.]

To measure the dispersion of the data around the mean μ, we can look at another average, in this case the average of the square of the differences between individual data values and their mean. This average is called the *variance* σ^2 and its square root σ, the *standard deviation*. If data values are tightly clustered around their means, then standard deviations are small, whereas if they are widely dispersed around their means, standard deviations are large. There is an issue about how many independent data values remain to calculate a variance after a mean has already been derived from the same raw data, which has the effect of reducing the number of independent data items by one. This means that variance is calculated as

$$\sigma^2 = \frac{\Sigma_{j=1}^{j=N}(x_j - \mu)^2}{N - 1} \tag{4.2}$$

with standard deviation found as its square root.

To put equation 4.2 into words: First calculate the mean μ. Then for each data value x_j, calculate the square of the difference between it and the mean, $(x_j - \mu)^2$. Sum these squares of differences, and divide the result by 1 less than the number of data values $(N - 1)$.

There are a host of similar formulas describing such things as the *skew* (asymmetry) or *kurtosis* (peakedness) of data sets, which are all known as statistical moments of differing degrees. The first such moment is the *mean*, the second the *variance*, the third the *skew*, and so the list goes on. Most of the literature on the markets is confined to the mean and standard deviation, and so we will not go deeper into statistical moments at this point.

COVARIANCE, CORRELATION, AND INDEPENDENT OPINIONS

In the previous section, we talked about the mean, variance, and standard deviations of a set of data values $(x_1, x_2, x_3, \ldots, x_j, \ldots, x_N)$. Situations arise with market decisions in which we need to consider the interrelationships between data values of different types—typically prices from different financial instruments. What this requires is a way of expressing relationships between values of different data types (say, x and y) having the general forms ($x_1, x_2, x_3, \ldots, x_j, \ldots, x_N$) and ($y_1, y_2, y_3, \ldots, y_j, \ldots, y_N$). Rather than talk in terms of x and y, it is more usual to talk in terms of separate variable types x_1 and x_2, such that the series of values previously represented by x and y become ($x_{11}, x_{12}, x_{13}, \ldots, x_{1j}, \ldots, x_{1N}$) and ($x_{21}, x_{22}, x_{23}, \ldots, x_{2j}, \ldots, x_{2N}$). In general, if there are M types of variables and N values in each type (for example, M financial instruments with N prices for the same periods in each), then the kth value of the ith variable type is written as x_{ik}. A first step in establishing interrelationships is to work out the means of each variable type ($\mu_1, \mu_2, \mu_3, \ldots, \mu_i, \ldots, \mu_M$) from (4.1). A relationship known as *covariance* (similar to variance) between variables of type x_i and x_j can be defined as

$$\sigma_{ij} = \frac{\Sigma_{k=1}^{k=N}(x_{jk} - \mu_j)(x_{ik} - \mu_i)}{N-1} \tag{4.3}$$

Since there are M variable types, it follows that an M-by-M table of covariances can be calculated. For most market calculations it is sufficient to understand (4.3), but we note that if standard deviations of all variables are calculated according to (4.2), then the correlation between variables x_i and x_j can be expressed as

$$\text{Corr}\,(i,j) = \frac{\sigma_{ij}}{\sigma_i \times \sigma_i} \tag{4.4}$$

Correlation is usually a more familiar concept than covariance, and it is limited to values within the range of –1 to +1. It provides a quantifiable measure of the extent of any linear relationship between variables, with +1 indicating that values of the two variable types go up and down in unison, and –1 that they move in exactly opposite directions.

Later in this book, we will use the concept of covariance to look at portfolio theory and the need to avoid portfolios with highly correlated instruments for which risk/return ratios can be unacceptably high.

For the moment, we stay with this chapter's theme of decision theory and envisage a typical situation in which we have M weakly effective opinions about the market, to which we assign credibility factors ($w_1, w_2, w_3, \ldots, w_j, \ldots, w_M$) and require those credibility factors to sum to 1. On N occasions, we monitor whether each of these opinions is correct or not and assign values of 0 (if correct) or 1 (if incorrect) to variables x_{ik}, where i goes from 1 to M and k from 1 to N. By calling these opinions "weakly effective," we assume that each is correct more often than it is incorrect, but not by much. We now compute an M-by-M table of covariances σ_{ij} for errors of the

M opinions, according to (4.3). The total variance of our credibility-factored opinions is given by

$$\sigma_p^2 = \sum_{i=1}^{i=M} \sum_{j=1}^{j=M} w_i \times w_j \times \sigma_{ij} \qquad (4.5)$$

Given that we expect each of the opinions to be weakly effective, the variance σ_p^2 reflects the error of the committee of opinions. The more it can be reduced, the more accurate the overall opinion of the committee becomes. In a formal mathematical sense, the next step is to find the values of w that minimize σ_p^2 subject to the constraint that values of w are non-negative and sum to unity—which then allow them to be interpreted as probabilities, or in the present parlance, credibility factors for the opinions. Techniques for doing the constrained optimization lie beyond the scope of this book but can be found in books on optimization (for example, Fletcher).

Equation 4.5 is an interesting result that bears closer examination. First, if all the opinions are fully correlated and the credibility factors equal, then there is nothing whatsoever to be gained from having multiple opinions, and the maths can be tracked backward to show that, for that case, (4.5) and (4.2) give the same result. A fundamentally different situation arises when the opinions are uncorrelated. In this instance, $\sigma_{ij} = 0$ whenever i and j are unequal, resulting in a *reduction* in the variance of the errors of the committee of opinions σ_p^2, with a consequent *increase* in committee accuracy. The really useful consequence is that σ_p^2 *can be shown to be inversely proportional to the number of fully uncorrelated opinions*—implying that good decision making derives from considering a “committee” of multiple independent results for the same question, and weighting each appropriately. This result may be mathematical, but the lessons are more philosophical in that independent perspectives (from which, it is hoped, independent results will come) should be actively sought as part of any market decision-making process. If such perspectives can be found, it becomes possible to combine results that are individually only weakly effective into a committee result that is collectively much more effective. This is the key result referred to in the introduction to this chapter and the reason why the background to a number of methods relating to investment decisions is offered in this book—the greater the number of independent market perspectives that can be brought to bear, the better the market decision. Needless to say, herd behavior and various other matters that we have yet to examine conspire to thwart this aim, but its potential should be kept in mind.

BAYES' RULE

Bayes' rule is a simple and interesting formula that serves to explain how existing expectations need to be updated when some new information appears. In market situations, news is constantly appearing, and expectations may need to be modified as a result. Evaluation of news is difficult since it inevitably involves subjective judgments, and the news itself may vary from a large number of contradictory items to a very small number of items that might be contradictory if a greater sample size were available. Given the subjectivity involved, Bayes' rule cannot offer a perfect solution, but it does offer a consistent, probabilistic, and principled way of updating expectations in line with subjective evaluations. I use the conventional notation for this simple rule, but I find it to be off-putting, so to aid understanding, I have prepared a simple computer program to implement the rule, which will be introduced properly in an example at the end of this section. In the meantime, Bayes is important to understand how markets react to news, and so readers are encouraged to persevere.

The starting point is a prior probability P(H) of some hypothesis H. The prior probability must be compatible with the basic rules of statistics discussed earlier. It reflects our expectation that hypothesis H, which we will assume in this case to be that share prices will increase, before the arrival of some data D, which might be in the form of news. Whatever the news is, an assessment needs to be made of the probability of its data D being consistent with the hypothesis H. This probability is known as the *likelihood* and denoted by P(D|H)—that is, the probability of receiving data D given hypothesis H. For the moment, we also assume that P(D|H) will also be consistent with the rules of probability stated earlier.

If the hypothesis H was that a share price would rise and new data D referred to an impending industrial dispute that could impact on a company's profitability, then its impact would be adverse. Thus, P(D|H) would be low, indicating the news (containing data D) to be inconsistent with the hypothesis H of share prices increasing. But the dispute might be settled before industrial action takes place, and so whatever the judgment is, P(D|H) needs to reflect the various alternative possibilities and not just the worst-case scenario. On the other hand, news might relate to a big new order, which would be consistent with hypothesis H of share prices going up; that is, the news is consistent with the hypothesis H, and so P(D|H) would be high. For the sake of simplicity, we now introduce hypothesis H-, which is that share prices will go down P(H-), the prior probability of share prices going down, and P(D|H-), the probability of the new data D given hypothesis H-. For the example described,

$$P(H\text{-}) = 1 - P(H) \tag{4.6}$$

and

$$P(D|H\text{-}) = 1 - P(D|H) \qquad (4.7)$$

To recap, we have prior probabilities P(H) and P(H-), reflecting the (prior) probabilities of hypotheses H (prices going up) and H- (prices going down) before data D (the news item) arrives, and P(D|H) and P(D|H-) reflecting the probabilities of the data being consistent with the two hypotheses. With these definitions in place, the probability of hypothesis H after the data have been digested, P(H|D), is

$$P(H|D) = \frac{P(H) \times P(D|H)}{P(H) \times P(D|H) + P(H\text{-}) \times P(H\text{-}|D)} \qquad (4.8)$$

Equation 4.8 is a form of Bayes' rule and offers a logical means of modifying expectations in the light of new information. For the simple question of whether prices will go up, all that is needed is a prior probability P(H) and a likelihood P(D|H). With those two pieces of information, P(H-) can be found from (4.6) and P(D|H-) from (4.7), so that the raw inputs to (4.8) are available. Alternatively, for this restricted set of assumptions, (4.6) and (4.7) can be incorporated directly into (4.8) to get the probability of hypothesis H after the data have been digested, P(H|D), as

$$P(H|D) = \frac{P(H) \times P(D|H)}{P(H) \times P(D|H) + [1 - P(H)] \times [1 - P(D|H)]} \qquad (4.9)$$

Just as P(H) was called the *prior probability* P(H|D), the probability of H after data D have been accounted for is called the *posterior probability*. A PC-based computer program called *BayesNews.exe* is included on the attached CD ROM to compute posterior probabilities for the set of circumstances described previously. One of the ways in which Bayes' rule can be used is to update expectations on a continuing basis so that the posterior probability from a previous calculation becomes the prior probability for a subsequent calculation after a new item of data has arrived. This is illustrated in the following example.

Example: In an environment in which most airlines are losing money, one particular airline, that has also been losing money has a recovery plan in place of unknown effectiveness. The probability of the share price going up P(H) is estimated as .3. The airline then reports an interim profit, which bucks the general trend and results in P(D|H) to be estimated as .8. From the formula in (4.9) and the computer program *BayesNews*, P(H|D) is now .6316. [Test the numbers for P(H) and P(D|H) in the program to see if you get the answer for P(H|D).] A terrorist hijacking dents the confidence of the traveling public, and traffic consequently decreases. This news detracts from the hypothesis that the airline will make money, and P(D|H) is estimated as .4. So P(H|D) is recalculated (using the previous posterior probability of .6316 for the new prior probability) as .5334. These estimates are obviously subjective and will require trial and error to optimize, but, as mentioned earlier, the main point is to find a consistent, probabilistic, and principled way of updating expectations in line with news.

What has been described here is a restricted form of Bayes' rule, which offers a useful framework for evaluating news and therefore an immediate market application.

DISTILLING INFERENCE FROM COMPLEX DATA

Bayes' rule is appropriate for modifying existing expectations in the light of latest news, but it relies on prior probabilities and subjective assessments, which means that there will be occasions when an inaccurate correction is made from an inaccurate datum. There is a need to consider many items of data ($D_1, D_2, D_3, \ldots, D_N$) simultaneously and form a judgment on a hypothesis (H) as $P(H|D_1, D_2, D_3, \ldots, D_N)$—that is, the conditional probability of the hypothesis H given data $D_1, D_2, D_3, \ldots, D_N$. Such judgments are often made during periods when markets are closed and account for price movements between the close of one day and open of the next. The events of 16 through 19 October 1987 (described earlier) provide an example of when this kind of offline reevaluation took place.

Providing that sufficient representative data exist, it is possible to develop models that produce results for $P(H|D_1, D_2, D_3, \ldots, D_N)$, but in market situations they are limited by the data available, uncertainty over whether the data will continue to be representative, as well as design and complexity issues needed to find the most representative models. People should not be deceived by anthropomorphic names such as *neural networks* that appear to endow a reasoning or intuitive capability to models that are simply statistical representations of data they are trained on and lack any ability to "understand" that data. A similar lack of understanding is present with machine-learning techniques—which can find rules to classify the data but cannot distinguish between the meaningful and the coincidental. Despite those negative comments, statistical models often give much better results that those emanating from people claiming to have modeled data with such understandings. This is true particularly of economists who force nonlinear data through linear formulas they are able to "understand" and "justify" but who tend to produce models that offer conflicting results, often because similarly plausible models can be devised yielding different results. At the heart of this issue is whether economists' "understandings" result in better answers. At the moment, in many fields, economists form the herd and for that reason their methods (if not their inconsistent results) tend to prevail. Stamp has made a study of forecasts, most of which came from economists, and his overall conclusions are that their results are badly flawed.

In contrast, expertly developed, nonlinear statistical models in no sense purport to "understand" the data, but they can sense and model past relationships and use them as a basis to forecast future behavior. As long as past relationships exist, are strong, and are consistent, such models can work. Where this is not the case, they may or may not work. The same broad comments may also be true of economists' models, but in their case the process of sensing and modeling any underlying relationships is much more subjective and tends to be linear, and so quality becomes more variable as a result. However, they should be able to offer a better idea of when their underlying assumptions are about to break down and their results become invalid. For the kind of complex decision models under discussion, outputs are either conditional probabilities or numbers that need to be interpreted with the aid of (often arbitrary) thresholds to distinguish between different hypotheses. A good discussion on these issues and some other items in this chapter can be found in Bishop.

KEY POINTS FROM INVESTMENT DECISION TECHNIQUES

- Predictive sciences assume the future to be dependent on predefined variables and are bad at accommodating "soft" information from news sources or working with a consequential sequence of events affecting prices. Humans are much better at this.
- When news is not influencing prices, computers can do a fair job at making investment decisions, but humans are needed to monitor that software assumptions are contemporaneously valid.
- Investment decisions tend to be part art and part science.
- It pays to identify your own expertise and to recognize those areas of the markets where it can be usefully applied.
- Consider acquiring more knowledge if the cost of that acquisition is justified by the use that can be made of it.
- Consider developing a network of specialists to expand the investment areas you feel comfortable with, but look at any strings before getting involved.
- Check the gold/stocks/bonds triangle for any unusual movements, and consider getting out of the markets if things look

unstable. There may be a cost in going to cash, and the issue is whether there is likely to be a bigger cost if the markets make a sudden move.

- Learn the five rules of probability.
- Try to look at an investment decision from any independent perspective that has a greater than 50 percent chance of delivering the right answer. Most of the time, a simple vote on a number of such perspectives will deliver a better answer than any individual one, the exception being when an individual perspective is head and shoulders above all the others.
- Bayes' rule offers a means for updating the expectation of a hypothesis from assessments of how consistent a news item is with that hypothesis.
- Periodically, markets reassess the totality of data they have received, and prices correct as a result.
- Attempts to model the probability of a hypothesis given some data depend on there being a sufficient quantity of representative data available. Such models have their limitations no matter how they are done.

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PART TWO

Fundamental Analysis

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CHAPTER 5

Introduction to Fundamental Analysis

Fundamental analysis makes use of accounts and rational economics to assess the value of a something, so that a "rational" price for it can be assessed. Its adherents accept that anomalies will occur when prices differ from value and that any such differences present a profitable buy or sell opportunity. We have seen earlier, in Figure 3.1, that there can be many influences on price, and so a mismatch between price and value may not present an immediate profit opportunity. However, the belief behind fundamental analysis is that, over the long term, prices and values will converge and so any mismatch between the two should eventually work its way through to an opportunity for profit.

Fundamental analysis can be applied in its various ways to both stocks and commodities. In the case of commodities, economists usually have plausible (though not always correct) arguments for assessing value, and in my experience they are worth listening to. In the case of securities, accountants tend to have the most useful education for assessing value because the most common form of raw data, company accounts, tends to be what they deal with on a daily basis. Almost any financial figures that are issued have a story behind them, which needs to be interpreted from both their values and any comment that accompanies them. For example, if bond prices fell at a time when a government was issuing large numbers of them to finance a budget deficit, then their decline might be attributed to excess supply. In contrast, if during a time of normal supply, they fell when stock prices were increasing, the inference might be that demand had reduced as money chased after better investment opportunities elsewhere. A classic situation arises with company accounts: Every so often skeletons are thrown out of the corporate financial cupboards and massive losses reported, to prepare the ground for announcements of "record" profits in the coming years, during which time new skeletons are probably accumulated in the same corporate financial cupboards.

In the late 1990s dot-com boom, when securities analysts collectively failed to reflect the dubious investment quality of many shares being floated, confidence in this type of analysis fell. The situation was made worse by reports of accounting scandals at Enron and a number of other companies, which contributed to the downfall of one of the world's largest accountancy firms. Securities analysts have long complained about company accounts, and accounting scandals are nothing new—but they tend to come into much sharper focus when people are looking for scapegoats to blame a bear market on.

My own view is that the idea that the financial circumstances of all companies can be adequately described in a common format is a little optimistic and that there may always be pressure on auditors to exercise their professional judgments to bury a company's bad news in the footnotes to their accounts. Similarly, for commodities, perceptions of value can be altered by rumors of frosts, attempts to corner markets, or opinions of prominent people, which they sometimes articulate after they have taken a position in the market from which they are trying to enrich themselves.

Fundamental analysis is not so much of a science as a rational attempt to analyze all available information to come to a judgment on the value of something. Securities analysis forms the major part of fundamental analysis. Despite its well-publicized problems around the beginning of the third millennium, it is worth studying because its most successful adherents have made a great deal of money from using it. Even if it is not used directly, an informed judgment on the value of investments is a useful piece of information for a number of reasons: It can provide a base level at which prices are likely to stop falling and if a security is bought at a price well away from its intrinsic value, then a monitoring and exit strategy may need to be tailored to those circumstances. You should always be clear in your own mind about any difference between price and value because value can change rapidly with relevant news—resulting in an equally rapid price movement that you may want to take (tactical) advantage of. An old maxim that often proves true calls for selling on good news because liquidity is higher and slippage lower.

It is also important to be aware of the limitations of fundamental analysis. It cannot predict when prices will move, and so its adherents may be in for the long haul. It aims to identify opportunities for good entries, but once a position is taken and the security price has (it is hoped) corrected itself and delivered a paper profit to the investor, there may be no clear exit point.

For this reason alone, it is worth studying technical analysis in later chapters, where exits are discussed at some length.

Finally, it should be appreciated that there is a great deal of fuzziness about fundamental analysis. It is based on a combination of figures and judgments, and for that reason alone it can never be directly compared with technical analysis, which delivers answers based much more on figures than on judgments.

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CHAPTER 6

Introductory Fundamental Analysis

An investment is a financial operation, which, after careful consideration, promises safety of principal and adequate returns.

Unknown

BACKGROUND AND BASIC CONCEPTS

Fundamental analysis in securities goes back a long way, but we will pick up the story with the term *value investing*, which is associated with a gentleman mentioned earlier in this book, Benjamin Graham. His books *Security Analysis* (written with David L. Dodd) and *The Intelligent Investor* are recognized classics in this field and describe numerous case studies in which the true meanings behind company financial statements are inferred to determine values. Graham also inspired the respect and loyalty of a number of disciples to his methods, who subsequently became successful and well-respected investors in their own right, the best known of whom is probably Warren Buffett.

Two keys to Graham's success were the clarity that he brought to investment thinking and the tenacity with which he sought out the information he needed to make his ideas work. The basic idea is very simple: If you buy a share, you are buying a part of a company, and so you need to assess what that company is worth to understand the value represented by the share purchase. Therefore, the investor should not only look at prospects for dividends and growth but also take a bank manager's view and ask what collateral a company is offering for the "loan" reflected in a purchase share of its stock. Graham and Dodd's *Security Analysis* first appeared in 1934, just after the trough of the great depression, at a time when many companies were trading at a discount to their (conservatively estimated) book values. In other words, if the realizable assets of the companies were sold, debts paid, and the residues distributed to shareholders, then shareholders would receive more than the price at which their shares could be bought on an exchange. The more usual situation is that shares trade at premiums to their realizable asset values, with companies' claiming the difference to be due to "goodwill," which may feature prominently in less conservative estimates of book value. Graham's message was to look for and exploit value/price differences, and there was plenty of scope in which to do that in the 1930s and 1940s, before the bull market leading up to 1966. Despite the subsequent reduction in opportunities for value investing, Graham's disciples have continued to adhere to his philosophy to the present day—not being afraid to withdraw from markets that offered poor value when they became overheated.

The idea of a value/price difference is fairly simple to grasp, but it may fail to distinguish properly between growth shares and others that are in static or declining markets. The 1930s saw the publication of many good ideas, one of which came from John Burr Williams who initially addressed the question of how much a future dividend stream would be worth today and later extended his ideas to include growth. A thorough analysis of this topic is described by C. P. Jones, but we concern ourselves with the issue of valuing a dividend stream (from a company in a stable situation) having a value of D_0 currently, D_1 at the first period after valuation, growing at a stable (fractional) rate of g during that period, from a company whose risk profile has meant that a (fractional) interest of k would be required by a lender for a loan during that period.

Williams's valuation formula is

$$\text{Present value} = \frac{D_1}{k - g} \tag{6.1}$$

To avoid doubt, if the dividend is growing at g per interval, this is the same as

$$\text{Present value} = \frac{D_0(1+g)}{k - g} \tag{6.2}$$

In both of the above formulas, there is a presumption that k is sufficiently greater than g to yield plausible answers.

As an example, if a stock were offering a quarterly dividend of 10c, growing at a fraction of 0.02 per quarter (8 percent annually), and had a risk profile requiring an interest payment of 0.03 per quarter (12 percent annually), then the value of its dividend would be 10(1 + 0.02)/(0.03 − 0.02) = 1002c.

Now it is likely that some of a company's earnings are retained for investment and others distributed as dividend. All the formula aims to do is value the dividend component of a company's earnings. Usually, some of earnings are retained to invest in future growth, which feeds back to the investor in the form of enhanced future dividends or share price, and so the formula leaves this reinvestment component of earnings unvalued.

The basic problem is to come up with a value that can be ascribed to a stock whose shares reflect the net asset value of the company, as well as properly valuing dividend and growth prospects. We note first of all that a company's net realizable assets reflect the collateral it offers to all its lenders, which ultimately includes shareholders. Clearly, a company that has substantial assets, growth, is paying a dividend, and has a share price around the value of its net realizable assets would be a better prospect for a loan and have a lower value of k in (6.2) than a company whose share price was trading at a substantial premium to any net realizable assets. While it may not be immediately obvious, the formula contains a mechanism (that is, the value of k) to accommodate the ideas of both Graham and Williams, and its use could reasonably be extended to value total earnings: by substituting them in place of the dividend in equations 6.1 and 6.2. Graham also offered a formula for the price of a share, in terms of (annual) earnings per share E, expected earnings growth rate r, and current return on AAA-rated bonds Y as

$$\text{Present value} = E \times (2r + 8.5) \times \frac{4.4}{Y} \tag{6.3}$$

As an example of (6.3), if the earnings per share E were 10c, the annual growth rate r were 20 percent, the annual yield on AAA-rated commercial bonds Y were 5 percent, then the present value would be

$$\text{Present value} = 10(2 \times 20 + 8.5) \times \frac{4.4}{5} = 426.8\text{c}$$

Equation 6.3 contains no specific mechanism for distinguishing between high- and low-risk securities, but most of Graham's literature stresses the need for safety of principal, suggesting that his formula was developed for low-risk securities.

The formulas given are useful to indicate what share values depend on, but unfortunately, the assessment of the worth of a security requires more than putting numbers into formulas and cranking a handle to get results. A wider appreciation of business and the markets a company operates in, as well as an ability to interpret financial statements, are also desirable.

THE ANNUAL REPORT

An annual report should contain an account of the company's activities and prospects for the future, a balance sheet showing a company's capital position, a profit and loss statement, a cash flow statement, and any associated notes—which may be written to obscure unpalatable information. There are whole books written on the interpretation of financial statements, which are important but beyond the scope of this introduction to fundamental analysis. It is anticipated that a first fundamental filter will be based on Internet-available accounting ratios (examples are given in Appendix 6.1) or other Web data and that annual and interim reports for individual companies will be read as part of a second-stage filter. So, for the moment, it is suggested that any account of the company's activities and prospects should always be read and an appreciation obtained of those elements of a company financial report that follow this paragraph. For those who feel that fundamental analysis should be the overwhelming influence in their investment decisions, self-study from specialist books on the interpretation of financial statements is recommended, along with the books by Graham and Slater given in the bibliography. I am not aware of any simple set of fundamental criteria that can guarantee a successful outcome, but in terms of the Bayesian principles of Chapter 4, better interpretations of financial statements should lead to better assessments of both prior and posterior probabilities for (fundamental) decisions about a particular stock.

THE NATURE OF ASSETS

It was mentioned in the previous chapter that it is difficult to describe the financial condition of all companies in the common format of a balance sheet—where unpalatable news is often hidden in cryptic footnotes. One of the hardest items to get right on a balance sheet is the value of *total assets* (TA). These are composed of *tangible assets*, such as property, plant, and office equipment, which may be relatively easy to value, and *intangible assets*, which generally are not. Dealing first with tangible assets, their realizable worth can depend on the nature of the business concerned. For example, a property company might have a well-diversified portfolio of saleable properties, for which numerous transactions of similar nearby properties exist to provide a basis for establishing their worth. If that property company were to be liquidated, the money it received should coincide quite closely with the values indicated on the balance sheet.

On the other hand, a mechanical shovel company of the 1950s, finding its market under threat from a new-fangled device called a *backhoe* (JCB in Europe), might have found itself in a distress sale situation along with other manufacturers of mechanical shovels. Under such circumstances, the orderly markets assumed for the disposal of plant might not exist, and amounts realized may fall well short of that anticipated by their books. Another example comes from a certain airline that bought a number of spare aero engines for use with its DC3 aircraft, but it never bothered to depreciate them. When their DC3s came up for replacement, they had to face the fact that they were not going to realize the book value of their engines and they would have to make some adjustment to their stated worth. The conclusion is that when a company, or part of its assets, needs to be liquidated, it is not the book value of the assets that matters but what they are and the level of demand for them at the time of their disposal.

Intangible assets consist of items like patents, trademarks, and brand names, which at first sight may not appear to have the same value as tangible assets. Ultimately the value ascribed to intangible assets should be their ability to generate revenue. Brand names provide one example of this. To illustrate their worth: If a company were set up to bottle a mixture of chemicals, carbon dioxide gas, and water and attempt to sell it under (say) a brand name of "Brand X Cola," it could not expect to sell it as easily or for as much as the brand leader for colas. Both companies might have the same tangible assets, but one has a well-established presence in the marketplace and the other does not. It is also interesting to note that some new entrants to the cola market have opted to sell under brand names first established for other products, presumably to compete with the strong brand names in the cola marketplace. The point is that brand names contribute to the appeal of a product and contribute to the goodwill element of a balance sheet. The problem for investors is to assess whether or not goodwill is worth as much as its owner claims for it.

With regard to patents, sometimes companies have licensed income streams from their patents whereas on other occasions they may be the only company interested in exploiting them. In the case in which the patents are used internally and licensed externally, valuation becomes easier than it is if there is no external market from which to assess their worth. In the case in which a company is the sole exploiter of a patent, there may be no external confirmation that it has any intrinsic merit. So it may not have any value if the company folds, making its worth more of a statistical probability than something calculable from a licensed income stream.

Companies tend to be valued more on their earning power than their book values, which exclude intangible assets. Because intangible assets have an earning power, it follows that they should also have a value. For this reason, companies usually sell at a premium to their book values. When one company acquires another company, the difference between the price paid for the company and its book value is called *goodwill* and is carried on the books of the purchasing company. Unfortunately, many acquisitions do not work out as planned, and the allowable discretionary element of goodwill can be inflated to disguise the true cost of an acquisition.

"Knowledge" companies are based much more on intangible assets than tangible, and they represent an increasing proportion of the economy—indicating that a good understanding of the value of intangible assets will be needed to evaluate many new investment opportunities. In contrast, old well-established manufacturing industries tend to be much more capital intensive and may need a substantial portion of their earnings to be reinvested just to keep their incomes intact. The investor needs to be wary that such investment differs from that likely to produce more income, such as the opening of a new factory to make additional products, rather than replacing worn-out plant or updating it just to retain current income levels.

Increasingly, investors are coming to realize that the ability to generate an income stream from intangible assets, coupled with effective defense against competition, can represent a good investment opportunity and that the perceived downside protection afforded by tangible assets may often be illusory because of uncertainties over book values and the market conditions in which a liquidation might have to take place.

One final point in this section is that research and development activity—so critical to many companies' future prospects—is treated as a current expense and not reflected in the balance sheet as an asset.

INCOME AND EARNINGS

Income can be reported in a variety of ways, often intended to portray a company in the best possible light. Where possible, the investor should try to assess whether the income reported is likely to be repeated or simply reflects unrepeatable one-off sales. Similarly, knowledge of the cyclical behavior of an industry sector as well as the incomes of immediate competitors can help in assessing income prospects.

Often, *operating income* is emphasized. This figure reflects earnings before anything is deducted. Since equity investors derive their benefits from income after deducting expenses such as interest payments and income taxes, *net income* (after these deductions) tends to be a more reliable metric for assessing future earnings prospects. There can be situations in which a company has to make corrections for exceptional charges, and when they do that, they may publish a figure for *adjusted net income*, which corrects for these charges. Where that is the case, it offers an additional perspective on dividend prospects that should be taken into account.

Of even greater interest to investors is the component of income known as *earnings*, which is often quoted as *earnings per share* (EPS). These are the after-tax profits of companies that are available or reinvestment or distribution (at the discretion of the directors) as dividends. It is usual to retain a portion of earnings for reinvestment, and the ratio of earnings to dividends paid is known as the *dividend cover*. For example, if earnings per share were 12c and the dividend (per share) were 4c, then the dividend cover would be 12/4 = 3.

Earnings are of considerable importance when assessing share price, and the *price/earnings* (P/E) *ratio* is usually a major consideration in any share purchase decision. As an example, if earnings per share were 10c, and the shares cost 100c, then the P/E ratio would be 100/10 = 10. If the shares rose to 150c, the P/E ratio would be 150/10 = 15. If the shares fell to 75c, the P/E ratio would be 75/10 = 7.5. Since earnings are reported quarterly or half yearly, it follows that P/E ratios will fluctuate considerably between earnings announcements and may jump if results differ from those of a previous reporting period. One consequence is that share prices can also jump on the announcement of unexpected figures for earnings, and some investors try to anticipate such announcements by taking positions shortly before them. There is an issue of whether dividends or earnings should be used to assess a share price. Providing that retained earnings are used for genuine investment, as opposed to necessary "investment" just to stand still, the logic is that the investing of retained earnings will eventually reward the shareholder with either future dividends or an increase in share price. For that reason, earnings, rather than dividends, tend to be used to assess share price.

The P/E ratio by itself cannot distinguish between slow- and fast-growing companies. Imagine that there are two companies, one growing at 5 percent annually and the other at 15 percent. Each announces earnings of 10c per share, and each has a share price of 100c. Expectations are that over five years the two companies' earnings will increase annually to (10.5c, 11.03c, 11.58c, 12.16c) and (11.5c, 13.23c, 15.21c, 17.49c, 20.11c), respectively; that is, the slow-growing company's earnings should increase by 22 percent, and the fast-growing by more than 100 percent over the five years. If the P/E ratios were to stay the same, then over the five years the slow-growing company's share price should increase by just over 20 percent, and the fast-growing by more than 100 percent.

The *price/earnings growth* (PEG) *ratio* provides a metric for comparing prices, earnings, and growth rates for investors wanting to buy shares in growth companies. It is simply the P/E ratio divided by the growth rate, expressed as a percentage. In the case of the slow-growing company with earnings of 10c, share price of 100c, and growth rate of 5 percent, the PEG ratio is $100/(10 \times 5) = 2$. The fast-growing company had similar figures but a 15 percent growth rate, and so its PEG ratio is $100/(10 \times 15) = 0.667$. Generally, a PEG ratio of less than 1 is sought for an investment in a growth company, but there are a number of other considerations that we also need to take into account and will look at later.

CASH FLOW

Very loosely, *cash flow* is the increase in cash over some reporting period, which will usually be a quarter, half-year, or year. There are three principal components to cash flow: (a) cash flow generated or consumed by operations, (b) cash flow associated with borrowing and repayment of loans, and (c) cash flow associated with capital spending. Clearly if a company trumpets an increase in its cash flow and that increase turns out to have come from issuing shares or taking out a loan, a very different inference might be drawn than if the same increase had come from an improved operational position. Similarly, if the cash flow worsens because of capital expenditure that should generate greater future income, then due account of those improved prospects needs to be taken before reading too much into the reduced figure. Cash flow from operational activities is what many companies refer to as "cash flow," and it can sometimes be used as a surrogate for gross income, but first, deductions must be made for the replacement of worn-out plant. It is useful to compare gross profit with cash flow from operational activities. If gross profit exceeds this component of cash flow, then sensors should be on full alert for creative accounting since profits are much easier to massage than cash flow from operational activities.

DEBT

A company's debt can be financed in a number of ways, such as by issuing bonds or preferred stock or by obtaining loans. Company debt is not unlike personal debt. Where it is used to enhance income-generating capabilities, it is justified. Where it is used to meet day-to-day expenditure to avoid necessary restructuring, the company is heading for trouble. The ratio of debt to shareholders' equity—that is, debt divided by the sum of tangible and intangible assets less total liabilities—is a useful way of assessing the extent of a company's indebtedness. The definitions are in Appendix 6.1, where it can be seen that a share price at a cyclical low will impact unfavorably on this ratio. Conversely, a share price at a cyclical high will impact favorably. A common heuristic is that a debt/equity ratio up to 50 percent is acceptable, but beyond 55 percent is unacceptable for conservative investors. However, the investor needs to look beyond these simple heuristics to the circumstances of the company, and in particular to the extent to which cyclical variations of share price are likely to impact on this ratio.

We saw in Chapter 2 that preferred stock has guaranteed dividend payments and prior claims on assets attached to it. This makes it debt rather than investment. Sometimes, companies lump it in with common stock on their balance sheets to reduce the perceived value of their debts. Where this is the case, it needs to be put back into the debt calculation, where it belongs.

GROWTH

Unlike a share backed by an undervalued asset, a share bought for future growth contains an element of uncertainty on the question of whether that growth will be achieved. The bibliography lists a number of well-written books by Jim Slater (focused on the British markets), which deal with the question of share price growth. He suggests calculating growth rate from the average of a consistent five-year earnings record. One way to do this would be to work out the growth r_t in year t from earnings E_{t-1} from the year before and E_t in the current year as

$$r_t = 100\left(\frac{E_t}{E_{t-1}} - 1\right) \tag{6.4}$$

Assuming values $E_1, E_2, \ldots, E_t, \ldots, E_n$ are available for n years, then values of r_t can be computed, examined, and averaged for $t = 2$ to n. Typically, five years of steady growth are sought—that is, $n \geq 6$. As an example, Company X reports a sequence of annual earnings per share as 10c, 15c, 18c, 20c, 25c, and 30c. Growth rates are $r_2 = 100(15/10 - 1) = 50$ percent; $r_3 = 100(18/15 - 1) = 20$ percent; $r_4 = 100(20/18 - 1) = 11.1$ percent; $r_5 = 100(25/20 - 1) = 25$ percent; and $r_6 = 100(30/25 - 1) = 20$ percent. Looking at these figures, they show annual growth in excess of 10 percent and average growth of $(50 + 20 + 11.1 + 25 + 20) = 25.2$ percent.

To assess whether or not a share qualifies as "growth," allowances need to be made for

- Seasonality
- Cyclical share price behavior
- Recovery from a deep recession or disaster

Thereafter, criteria that suggest future growth include

- A five-year record of satisfactory growth
- A low P/E ratio relative to growth—that is, a low PEG ratio
- An optimistic assessment of future prospects in the company's most recent financial report
- Strong liquidity, low borrowings, and high cash flow
- A competitive advantage
- A strong share price performance relative to the most relevant exchange index

- A satisfactory dividend yield
- A reasonable asset position
- A high proportion of shares owned by the management

These considerations may not all be met, and so, as is frequently the case with fundamental analysis, a judgment based on the circumstances of the company is needed—in this case to decide if the criteria are sufficiently satisfied for the security to qualify as growth stock.

An additional assessment of growth prospects comes from an examination of a company's situation. Companies can grow by developing new products for existing markets or by developing new markets. The cola "wars" are a sign that their market is saturated and the businesses of many companies in that marketplace are mature. Cola companies could have developed new products, but they opted for a growth strategy of developing new markets for their products, particularly in former communist countries. Once the world market for colas is saturated, they will be able to achieve growth only through persuading people to drink more cola or offering new products. Something of a mixed strategy has been possible for Microsoft, which has achieved growth through both new products and new markets. Microsoft's future growth may be limited more by legal, than by technical or market considerations.

MARKET SITUATIONS IN WHICH MONEY CAN BE MADE

There are some recognized market situations in which profits can be made, including the following:

- Classical value investing, advocated by Graham and pursued so effectively by him and his disciples. This depends on recognizing an undervalued asset, buying it, and holding on to it until the market becomes aware of its value and prices rise to reflect it.
- Cyclical stocks in a turn-around situation. Typical of these companies are steel and auto manufacturers. The technique is to wait for their stocks to turn up, then buy and hold them during their bull trend.
- Growth stocks for which the growth potential may not have been properly assessed and is not reflected in the share price.

For value investing and growth stocks, the various accounting ratios given in Appendix 6.1 can help in drawing up a short list, which should then be reviewed. Note that a cyclical stock, near the top of a cycle, may easily be mistaken for a growth stock and will be discussed further when we come to technical analysis.

PRODUCT AND COMPANY LIFE CYCLES

Fundamental analysis requires an appreciation of company prospects and markets for whatever they produce. The subject is endless, but the books by G. M. Moore and C. M. Christensen listed in the bibliography provide an introduction to some typical business situations that can arise and their impacts on companies.

Moore's work comes from a background of high-tech marketing and is particularly relevant to understanding the problems faced by new companies dependent on single products. He studies (high-tech) product life cycles, and he categorizes buyers as technology enthusiasts, visionaries, pragmatists, conservatives, or skeptics. The early market is formed from *technology enthusiasts*, who buy because of their interest in the technology, and *visionaries*, who buy because they can see a product's long-term potential but may fail to see pitfalls that might prevent that potential from being realized. The next group are the *pragmatists*, who are people that can see a product's potential, have usually done an assessment of any risks involved, and are usually able to justify the purchase in terms of the benefits it provides. In Moore's analysis, these are the key groups that determine if a product will succeed as he identifies a "chasm" between the early market and the pragmatists, into which many products fall and never emerge into mainstream business.

After the pragmatists are the *conservatives*, who buy rather than let the rest of the world pass them by, and finally come the *skeptics*, who at last accept that their reservations no longer justify not buying and do so after everybody else. In Moore's analysis of sales volumes, a trough (or chasm) can occur when the early market is exhausted (but before the pragmatists have started buying) and a peak around the time that the pragmatists have bought and conservatives are starting to buy. Profitability usually peaks during the first wave of pragmatist buying and declines as competition enters and margins are forced down. After competition enters, there is usually a battle for market leadership. This usually involves consolidation of the (usually small) competing enterprises that were set up to provide the product into just a few larger ones.

Moore introduces the concept of a *gorilla* who eventually becomes the market leader and usually achieves maximum profitability for future products sold in that marketplace. When considering a company where prospects for new products feature strongly in an investment decision, investors need to be cognizant of the fact that there will eventually be a market leader who is worth backing early and also, that before a chasm is crossed, any statements about future income streams from a product should be treated with caution. History suggests that identifying the market leader early is difficult because the eventual winner may not be the company with the best technology but the one with the best marketing and business skills.

As the market for a product matures, the product is produced ever more efficiently, and it becomes more of a commodity than an expensive novelty as the marketplace in which it sells is exposed to competitive products. Some case studies are examined by Christensen, who introduces the concept of *disruptive technology* that affects the livelihoods of companies dependent on the technology being replaced. A very early example of this was when the mechanical loom replaced the hand loom and compromised the incomes of cottage weavers. They responded by forming a group called the *Luddites* who organized the breaking of mechanical looms (between 1811 and 1816 in England). Like most change for the general economic good, mechanical looms were accepted eventually, and the cottage weavers were forced to find some other economic activity.

One of Christensen's examples was briefly referred to earlier. Until the late 1940s the excavator industry was producing products that used cables and pulleys for power transmission. The hydraulic backhoe (JCB) was produced in the late 1940s, and it began to make inroads into the traditional cable-based excavator market. Its advantages were many, and manufacturers faced the dilemma of embracing hydraulics or going out of the excavator business. A comparable situation is described in Neville Shute's autobiography *Slide Rule*, in which an aircraft company he formed cheaply in the 1920s to make wooden aircraft found that the market for such aircraft declined rapidly with the introduction of metal airplanes. Without a major investment in metal-working equipment in the 1930s, they could not remain competitive. But this change in materials also meant that starting an aircraft company in the 1930s required much more capital, which acted as a barrier to new entrants, thereby insulating existing players from new competition.

Christensen also describes how vertically integrated computer manufacturers of the 1960s became uncompetitive with later manufacturers whose operations were based on assembling externally produced chips and disk drives made by specialist manufacturers; in turn, disk drive manufacturers were superseded by newer manufacturers of smaller, lighter, and cheaper equivalents to their products. His message is to create a corporate structure that best fits whatever it is that needs to be produced and not to be afraid of fragmenting that structure into more specialist entities when valid reasons for doing so exist. Disruptive technologies and their effects may not show up in a numerical analysis of company statistics, but they are typical of the background considerations an investor needs to be aware of in case these technologies or something similar, become relevant to their investment decisions.

DECISION CRITERIA AFFECTING STOCK SELECTION

At this stage, Appendix 6.1 should be digested as it contains basic definitions as well as criteria for identifying stocks at *fire sale prices*.

Fundamental analysis is essentially a two-stage process. The first stage can be reduced to seeing if certain criteria are met that indicate the stock is of interest. The second stage involves looking at all the information, soft and hard, concerning the stock and coming to a judgment on whether or not to buy it. In Chapter 3 the point was made that more information does not always lead to a better decision, as skill in its interpretation is needed to determine both its relevance and effect. In Lowe's biography of Graham, she reports that his final partnership, Rea-Graham, formed toward the end of his long life, attempted to create a mechanistic system for value investing. There have been academic studies to "prove" that the system would have worked, but the Rea-Graham partnership continued after Graham's death and generated relatively disappointing returns of under 5 percent for the five years up to 1993. This leads me to be suspicious of the idea that fundamental analysis can be reduced to looking at figures—and to a feeling that the success of Graham's disciples comes as much from their ability to evaluate circumstances surrounding investment opportunities as from any mechanistic interpretation of accounting ratios.

Graham's *The Intelligent Investor* offers criteria for stock selection for defensive investing. Defensive investing stresses safety of principal more than returns and will probably have a good proportion of any portfolio invested in bonds. In terms of the present notation, Graham's defensive investing criteria amount to the following:

- The company must be of adequate size, with reasonable liquidity.
- The company's financial condition should be healthy, with a current ratio of at least 2.
- The company's earnings should be stable, with positive earnings reported over the previous 10 years.
- The company should have paid a dividend for at least 20 years.
- The company's earnings should have seen an increase of at least a third over the previous 10 years.
- If earnings over the previous three years are averaged, the stock price should be no more than 15 times that average.
- The price asked for the stock should be reasonable relative to the company's assets. Two tests of reasonableness are given, and it is sufficient to pass either of them: (1) The stock price should be less than or equal to one and a half times the book value, or (2) the P/E ratio times the book value should be less than $22\frac{1}{2}$.

- The stock should fit into a portfolio that has a quotient of 100 over the P/E ratio greater than or equal to the yield on AAA-rated bonds—that is, $(100/PER) \geq Y$.

To comment on these criteria: A reasonable volume of trading and low bid/ask spreads are indicators of size, as well as a stock's inclusion in a portfolio forming a representative index for an exchange. The importance of earnings is not disputed, but if a company is paying dividends to prop up its share price (possibly to avoid a hostile acquisition), then during difficult periods of trading, financial reserves needed for later restructuring and investment may be compromised.

Slater's philosophy represents a more aggressive style of investment, and the nonmechanistic judgments needed are illustrated with examples in his books. In particular, the price/earnings growth (PEG) ratio is introduced with a warning that it may not always work, that it can identify an undervalued prospective growth share but is not guaranteed to do so, and that ideal candidates are companies with P/E ratios in the range of 12 to 15 and growth rates of 25 percent. Slater's work can be fully appreciated only by reading his books, but the following list of points represents an attempt to capture the essence of his advice for selecting growth shares:

- Earnings per share should be growing at around 15 percent annually, totaling in excess of 100 percent in the previous five years.
- The latest chairperson's report, interim report, and broker's consensus forecasts should be optimistic.
- It is an advantage to invest in companies that are difficult to compete with. In this respect there needs to be a competitive advantage. Types of advantages are listed in descending order: excellent brand name, patents, copyrights, government franchise, and/or established position in niche industry or dominance of that industry.
- Return on capital employed should be greater than 20 percent.
- Choose attractive industry sectors and avoid unattractive ones. Examples of attractive sectors are health and household, food retailers and manufacturers, business services, media, leisure, and stores. Examples of unattractive sectors are shipbuilders, builders, textile, electrical and engineering companies lacking branded products, and software companies whose products are vulnerable to new technologies.
- Debts below 50 percent of net assets—that is, $AL \leq 0.5(TA - IC)$ where AL is all liabilities, TA is total assets, and IC is intangible assets.

- Net operating cash flow to be not less than net operating profits.
- A share price within 15 percent of its two-year high and strong relative to market averages.
- An element of novelty about the company or its products.
- A bias toward sound companies with smaller market capitalizations and space in their markets for growth.
- The asset position should be reasonable, particularly in the case of smaller companies carrying debts.
- A management group holding a significant proportion of the outstanding shares of stock and having an "owner's eye" on the running of their company.
- Try to buy shares in fields you are familiar with, or try to become familiar in fields in which you wish to buy shares.
- Buy shares with PEGs of 1 or less, and with P/E ratios less than their growth rates.
- If prospects look good, buy growth shares just before growth companies announce their results.
- Buy growth shares that are sustainable—P/E ratios between 12 and 15 with growth rates of 20 to 25 percent are recommended as good prospects.

His criteria were developed for British markets, with an indication that investments should begin with share purchases in the top 250 British companies. Slater's *Beyond the Zulu Principle* identifies situations in which share price growth is likely to be extraordinary—but a reminder is given of the SEC's warning of the high risks associated with high profits. The recommendations listed represent an attempt to minimize the additional risks that accompany the higher rewards likely with growth shares. Slater also recommends that the number of different types of shares should be limited to around 12, presumably so that investment monitoring does not become too diluted by having to stalk the progress of too many companies.

Ultimately, the criteria selected must relate to the risk/return profile being sought by the investor. In this regard, there is an old adage that the percentage of a person's wealth held in stocks should be 100 less his or her age and that older people, who need an investment income to live on, should be more risk averse than younger people, who have time to start again if their investments fail. The debate on the merits of this investment advice promises to run forever because it comes down to individual circumstances, opportunities available, and motivations for becoming involved in the markets.

Finally we arrive at the issue of comparing companies. Accounting ratios provide part of a basis for doing this and are normally used as a first filter.

The idea is that if two companies operate in a similar field, then with appropriate data, it should be possible to compute their intrinsic values using equations 6.1 to 6.3 to see where their share prices are relative to each other's and their respective intrinsic values. As a general principle, competitors' share prices should be looked at before taking a share purchase decision, and competitors' results can be expected to affect share prices. The usual logic is that trading conditions are generic to all comparable companies, so that if one does well, they are all likely to. Frequently the logic is flawed, but it has the effect of dragging prices up and down as expectations of value are influenced by competitors' news. This does present another opportunity for a profit since if one company's value is out of line with its competitors, then a price change can be expected to correct the situation.

APPENDIX 6.1

Accounting Formulas

The notation and following formulas are loosely based on those given by Lowe in *Value Investing Made Easy*. Any inferences from these ratios need to relate to the circumstances of the company to which they are being applied. As an example, one accounting ratio, book value, disregards intangible assets. Thus, if a company without significant tangible assets wanted to borrow to invest in advertising its brand, its book value could well become negative—even if the investment was sound and subsequently created the additional sales and intangible value intended. This is a case in which book value might not be of great interest when comparing two such similar companies. In contrast, if property companies were being compared, then most of their assets would be tangible, and their intangible assets would be low—meaning that book values should be of much more interest in their case. The general point is to work out which of these ratios is relevant to the operation of a company before using them to assist in a related investment decision.

NOTATION

TA = total assets
IC = intangible assets
AL = all liabilities
SI = value of preferred stock issues
S = number of common shares outstanding
SE = total shareholders' equity
CA = current assets (working capital)

CL = current liabilities (short-term debts)
I = inventory
LTD = long-term debt
SP = share price
E = earnings per share (annualized)
GP = gross profit
TS = total shares
r = percent annual growth rate of earnings
g = fractional growth rate for a defined time period
k = interest required on a loan to a company (of a known risk profile) for a defined period
Y = yield on AAA-rated bonds
D_i = dividend payable at period i
P/E = price/earnings ratio
PEG = price/earnings growth ratio

FORMULAS

Shareholders' equity (SE) = TA – AL – SI
Book value = (TA – IC – AL – SI)/S
Debt/equity = LTD/SE
Net current asset value = CA – CL
Current ratio = CA/CL
Net quick asset value = CA – I – CL
Quick ratio = (CA – I)/CL
Net net current asset value = CA – CL – LTD
Net net current assets per share = (CA – CL – LTD)/S
Profit margin = GP/TS
Price/earnings (P/E) ratio = SP/E
Price/earnings growth (PEG) ratio = $P/(100 \times E \times r)$

EXPLANATIONS

Shareholders' Equity (SE) (= TA – AL – SI)

This formula yields a measure of the net equity left for shareholders, and it consists of both tangible and intangible assets, less liabilities. It is used in the calculation of the debt/equity ratio.

Book Value [= (TA – IC – AL – SI)/S]

This formula attempts to express the net tangible assets per share available to the common stockholder. It consists of tangible assets less all debts and items having a prior claim on assets, divided by the number of common shares. The exclusion of intangible assets from this calculation makes it a questionable measure of value for companies that derive their income from such assets. For example, a company whose income was derived from the exploitation of copyrights or patents could not have its worth properly reflected by conventionally calculated book values. Book value needs to be used with care and any unaccounted but realizable assets from intangibles kept in mind. In a situation in which a stock is trading below its book value and liquidating would produce a potential capital gain, any book value will be less than 1. Generally, shares trade at a premium to their book values, resulting in a figure that is greater than 1 and reflecting the benefits of intangible assets.

Debt to Equity Ratio (= LTD/SE)

This is the ratio of debt to shareholders' equity, in which equity is calculated as tangible and intangible assets, less all form of debt, including preferred stock. The problem of valuing intangibles accurately is probably the greatest source of distortion in this figure. Where a company is very highly indebted, its survival becomes questionable. In such situations, there may be restructuring of the company's capital base that involves shareholders losing most or all of the proportion of the company they previously owned. Healthy debt-to-equity ratios are 50 percent or less.

Net Current Asset Value (= CA – CL)

This statistic is current assets less current liabilities. If it is less than zero, the company needs to raise cash. When stocks are selling at two-thirds or less of net current asset values, they are worth investigating to see why they are so cheap. They may be worth buying as "value" investments, but be warned, such stocks may not be easy to find.

Current Ratio (= CA/CL)

This statistic is the ratio of current assets to current liabilities and indicates that the company needs to raise cash if the ratio is less than 1. Sound companies have current ratios of 2 or more, indicating that only 50 percent of working capital is needed to cover current liabilities.

Net Quick Asset Value (= CA – I – CL)

This is a more stringent test of a company's ability to meet its short-term obligations. If assets need to be disposed of quickly, then inventories may need to be subtracted out of whatever money can be realized. Net quick asset value is therefore similar to net current asset value, but it disregards inventory, which it implicitly assumes will take a while to dispose of. Where inventories can be liquidated quickly, then the current asset value may be a more relevant statistic.

Quick Ratio [= (CA – I)/CL]

This is a more stringent version of current ratio, and it excludes any benefit from inventories. It is the ratio of current assets, excluding inventory, to liabilities. A healthy figure would be 1 or more, but its significance depends on the nature of the inventory, how large it is, and how easy it is to liquidate.

Net Net Current Asset Value (= CA – CL – LTD)

The calculation of net current asset value excluded long-term debt. In contrast, if the net net current asset value calculation reveals that working capital is enough to pay for both current liabilities and long-term debt, the stock is usually of significant interest and worth investigating.

Net Net Current Asset Value Per Share [= (CA – CL – LTD)/S]

This formula is just net net current asset value divided by the number of shares. Any stock with a price below $1\frac{1}{3}$ times this figure should be examined to see why it is so low and whether it is worth buying. Such stocks are hard to find as this figure represents a fire sale price. If the reason for the low price is an overreaction to bad news or that a stock is out of fashion, then impediments to purchase may disappear.

Profit Margin (= GP/TS)

This formula is the gross profit divided by the number of shares. The result should be positive or have good prospects of becoming so, but it does not usually feature strongly in a share purchase decision.

Price/Earnings (PE) Ratio (= SP/E)

This ratio features strongly in most share purchase decisions. Stocks with very high P/E ratios are probably in a bubble situation and are best avoided. Look at the P/E ratios of competitor stocks to seek out the best value to buy.

Price/Earnings Growth (PEG) Ratio [= P/(100 x E x r)]

This is a statistic used to evaluate growth rather than to identify bargain stocks. Bear in mind that future growth is always an estimate, often confused with cyclical stocks in a recovery phase and best applied to low market capital companies having some unique advantage and operating in unsaturated markets that have plenty of growing space.

CHAPTER 7

Fundamental Analysis in Practice

It may come as no surprise that putting the ideas of Chapter 6 into practice is a little harder than it may seem at first sight. There are a number of problems, the easier of which center on data and differences in accounting practices, and the more difficult on what the various accounting ratios mean for different industries. There is a clear contrast between a stable manufacturing industry, such as automobiles, and a mining operation. In the case of an auto plant, valuation of tangible assets is relatively straightforward. In the case of a mine, there may be uncertainty about the extent of any mineral reserves and the future costs of their extraction, and whether the world price for the mineral will fall below the extraction cost to render the "asset" a liability. Such concerns are beyond the scope of this book but are mentioned to alert investors to the fact that accounting ratios mean different things in different industries and may need to be reassessed for that reason.

Typically, a securities analyst wanting to apply fundamental principles will work in a top-down fashion, beginning with macroeconomic considerations, moving on to specific markets and then to the health of specific companies as indicated by accounting ratios and local knowledge. The work of modern securities analysts is described in Jeffrey Hooke's book, details of which are given in the bibliography. It is impossible for an analyst to cover all markets, and so they tend to specialize in specific areas and develop expertise within those areas. They will usually produce a plausible report—but it should be appreciated that plausible reports do not always contain profitable recommendations. The experimental psychologist Robert Cialdini has observed that explanations enhance credibility. Unfortunately, it does not always follow that explanations enhance the value of the conclusions of an analyst's report. The point that is frequently overlooked is that a plurality of similarly plausible explanations leading to very different conclusions can usually be devised, indicating that any comfort drawn from a single explanation is likely to prove illusory. The implications for online investors using fundamental analysis are to try to find investments where local expertise is of lesser value, try to invest in areas where they have such expertise, and try to develop expertise in areas where they want to invest and not to expect to get it right all the time.

DATA

In the previous chapter we introduced the idea that a stock's intrinsic value might be determined from a combination of risk, earnings, assets, and growth potential. To put those ideas into practice, a good data source is needed. Historically, this has come from companies' annual reports, and they remain a definitive source of data for evaluating a stock. SEC filings are another source, but most investors will be tempted to use one of the many Web sites with precalculated ratios that are available for this purpose.

Free sites will quote earnings per share (EPS) and price/earnings (P/E) ratios. My first warning on data is that such sites often quote totally different statistics for the same stock. In the case of Toyota (ticker symbol TM) in September 2003, three popular Web sites quoted price/earnings (P/E) ratios of 13.16, 16.99, and 25.98—at a time when the share price was fairly static. It is not difficult to demonstrate the low reliability of such sites when quoting fundamental data. For a random sample of four stocks looked at on two sites, figures for earnings per share (EPS) came close to agreement on just a single stock. Clearly the EPS and the P/E ratio give no indication of the asset position, volatility of earnings, or growth rate. For those statistics, more informative Web sites are needed. The next type of Web site might be available through a broker or by subscription, and it typically offers details of contemporaneous accounting ratios, which if correct, should help to determine the asset position.

For longer-term assessment of cyclical behavior or growth, some kind of database is needed. Standard & Poor's kindly made their Compustat fundamental database available for the purpose of this book. This is one of a number of such databases that are available on a subscription basis, and it is supplied with spreadsheet templates to enable the data to be imported as a balance sheet, income statement, stock comparer, and so on. At present, access to such databases may be expensive for the individual investor, but there is a general trend toward reducing prices for data access that is likely to reduce their cost in future.

Full-service brokers may supply their clients with analysts' reports for individual stocks. Such reports are useful, but they have been subject to criticisms that analysts are too eager to follow the herd and too timid to put their heads above the parapets with definitive nonherd recommendations. Chapter 3 mentioned the various pressures giving rise to this behavior as well as the fact that consideration of more data does not always lead to a better decision. The truth is that nobody is absolutely sure about the extent to which consideration of additional data yields additional benefits, and this question is related to an area of statistics known as the *bias/variance dilemma*, which we will look at later in this book. At present, investors have to find the degree of fundamental data for decision making that they feel comfortable with and appreciate that at times of financial euphoria or despair, fundamentals may count for very little.

ACCOUNTING PRACTICES

The next problem is how to analyze the data in a sensible way. At this point the investor or analyst discovers that within a given industry, accounting practices differ among companies. For illustrative purposes, the Standard & Poor's (S&P) database was used to examine the accounts of four car companies: General Motors (GM), Ford, Nissan, and Toyota. GM and Ford took credit for intangible assets in their accounts, and, while there may be some variance of opinion as to their exact extent, it seems perfectly reasonable that some allowance for intangibles should be made. Nissan and Toyota took no account of intangibles, despite having strong brands and presumably other intangible assets that might have made their balance sheets look better had they wanted to take intangibles into account. Such differences in accounting practice make comparisons between companies less easy and are very likely to be overlooked in the calculation of prepackaged Web-delivered results. Another difficulty of making comparisons is that companies' annual reporting dates may not be coincident; meaning that like periods may not be being compared by annually reported figures.

A COMPARISON OF FOUR AUTOMOBILE COMPANIES

Figure 7.1 shows a table of earnings for four car companies: GM, Ford, Nissan, and Toyota. The data are not complete, with missing items indicated by Standard &, Poor's notation of "@NA." For the most part, missing items are diluted (that is, after allowance for extraordinary items) earnings per share (EPS), but a few EPS figures are also missing for Nissan and Toyota in the early 1990s. Earnings figures for GM and Ford are in line with prior expectations that the car industry is cyclical—with lows in the early 1990s,

	GM			FORD			NISSAN			TOYOTA	
	EPS from Ops.	EPS diluted		EPS from Ops.	EPS diluted		EPS from Ops.	EPS diluted		EPS from Ops.	EPS diluted
Dec01	3.370	3.330	Dec01	(0.440)	(0.440)	Mar01	1.400	1.330	Mar01	2.920	2.920
Dec00	8.700	8.580	Dec00	4.510	4.420	Mar00	(3.396)	(3.396)	Mar00	2.420	2.420
Dec99	8.870	8.710	Dec99	3.576	3.501	Mar99	(0.180)	(0.180)	Mar99	1.980	1.980
Dec98	8.640	7.100	Dec98	3.135	3.072	Mar98	(0.080)	@NA	Mar98	1.800	@NA
Dec97	8.070	@NA	Dec97	3.238	3.164	Mar97	0.500	@NA	Mar97	1.620	@NA
Dec96	5.470	@NA	Dec96	2.094	@NA	Mar96	(0.660)	@NA	Mar96	1.260	@NA
Dec95	8.890	@NA	Dec95	2.048	@NA	Mar95	(1.490)	@NA	Mar95	0.770	@NA
Dec94	6.200	@NA	Dec94	3.095	@NA	Mar94	(0.670)	@NA	Jun93	0.860	@NA
Dec93	3.430	@NA	Dec93	1.359	@NA	Mar93	@NA	@NA	Jun92	@NA	@NA
Dec92	(2.990)	@NA	Dec92	(0.418)	@NA	Mar92	@NA	@NA	Jun91	@NA	@NA
Dec91	(5.820)	@NA	Dec91	(1.370)	@NA	Mar91	@NA	@NA	Jun90	@NA	@NA

NOTE: @NA = Not Available

	Growth (Fraction)
Mar01	0.206612
Mar00	0.222222
Mar99	0.1
Mar98	0.111111
Mar97	0.285714
5 Yr. Av. Growth:	0.185132
01 Price	70
01 PER	23.9726
01 PEG	1.294893

FIGURE 7.1

Earnings per share from operations. (*Source*: Standard & Poor's Compustat.)

highs in the late 1990s, and a worsening situation at the beginning of the third millennium. Earnings figures for Nissan are a surprise in that they do not seem to correlate with those of other manufacturers, and the company is posting losses when others are recording profits. Nissan's worst loss is reported in March 2000, when the other three manufacturers are recording good earnings. Nissan is a potential turnaround situation that deserves close attention, and by 2001 the company is reporting positive earnings again.

The most remarkable earnings results are posted by Toyota. For the five years up to 2001, earnings are growing at an average rate of 18.5 percent and are never less than 10 percent. At the end of March 2001, Toyota's price/earnings (P/E) ratio works out at 24, and the price/earnings growth (PEG) ratio, 1.3. There are reservations about treating an established car company as a growth stock as well as questions about the applicability of the PEG concept, but it is applied, and Toyota's PEG of 1.3 suggests it is not undervalued, particularly when operating in a marketplace in which cyclical earnings behavior is an expectation. After 2001, Toyota's earnings growth falters. This may have more to do with market conditions than with the operation of a company that is widely respected for its pioneering of quality systems.

Balance sheets show a company's asset position and what share of those assets is (in theory) reflected in the purchase of a share. Quantities required for accounting ratios are the current and total assets and liabilities, intangible assets, long-term debt, and shares outstanding. These are shown in Figure 7.2 together with calculations of five asset-related accounting ratios defined in Appendix 6.1.

To examine these figures in detail: The shareholders' equity is the net assets of the company after all prior claims have been taken into account—which in the case of GM and Ford is less than the values claimed for their intangible assets. Thus while Ford and Nissan appear to have comparable shareholder value, the value represented by the purchase of a Ford share is effectively intangible whereas that represented by the purchase of a Nissan share is tangible. When book values (which exclude intangible assets) are considered, this effect becomes much more apparent, with a GM share having a book value of around minus $3.5, Ford around zero, Nissan around plus $2, and Toyota around plus $15.5.

Debt/equity ratios reflect the ratio of long-term debt to shareholders' equity, but they are sensitive to the valuation of intangible assets. For this reason, the figures for the four car companies are not strictly comparable as Nissan and Toyota would undoubtedly fare better if such assets were included. The ratio should alert the investor to situations in which long-term debt may be a problem. This appears to be the case with Ford, and also GM in 2001, whose ratios are 15.6 and 5.3, respectively. "Healthy" values of

SIC: 3711	GM	FORD	NISSAN	TOYOTA
	Dec01	Dec01	Mar01	Mar01
ASSETS				
Total Current Assets	168257	196597	24515.67	55409
Intangibles	21767	7800	0	0
TOTAL Assets	323969	276543	52038.35	137407
LIABILITIES				
Total Current Liabilities	115260	93918	25087.15	44821
Long Term Debt	104638	121430	11310.86	24886
TOTAL LIABILITIES	304262	268757	44300.84	80245
NET ASSETS:	19707	7786	7737.506	57162
COMMON SHARES OUT	559.044	1809	3973.708	3684.998
Shareholders Equity	19707	7786	7737.506	57162
Book Value	–3.684862	–0.007739	1.947175	15.51208
Debt/ Equity	5.309687	15.59594	1.461823	0.435359
Net Current Asset Value	52997	102679	–571.4766	10588
Current Ratio	1.607991	2.093284	0.97722	1.236229

FIGURE 7.2

Extracts from balance sheets and related accounting ratios. (*Source*: Standard & Poor's Compustat.)

debt-to-equity ratios are less than a half, which are easily achieved by Toyota and might have been approached by Nissan had credit been claimed for intangible assets. Current operating problems are indicated by both the net current asset value and current ratio. These are the difference between current assets and current liabilities and the ratio of current assets to current liabilities, respectively. In Figure 7.2, Nissan's current ratio is less than unity, indicating that it needs a small cash injection to meet its near-term obligations. For readers wanting more details of these calculations, two spreadsheets are in the accompanying CD ROM. *AutobalanceSheets.xls* provides examples of S&P's balance sheet template, and *AutoVal.xls* provides the subsequent calculations needed to arrive at the answers in Figure 7.2.

A quick, but less accurate, way of assessing a company's overall creditworthiness is to look at its bond ratings, which are issued by companies such as Moody's and Standard & Poor's and are included in the Standard & Poor's database product as well as on its Web site. (A brief description of bond ratings was given in Chapter 2.) In the case of the four car companies whose 2001 accounting details are shown in Figure 7.2, corresponding ratings for long-term debt are BBB+ for both GM and Ford, BBB- for Nissan, and AAA for Toyota. Given the book values and debt/equity ratios shown in Figure 7.2, rating Nissan below GM and Ford is a little surprising, but it is not surprising that Toyota is top of that particular class. There are differences between the assessment of a company's probability of defaulting on its debt obligations and the effective share in its equity it offers to the holder of its common stock. These differences need to be born in mind before using the shortcut of equating a bond rating to the estimated receipts to a common stockholder after liquidation.

Weekly charts for the four car companies spanning both the reporting year and the one following are shown in Figures 7.3 to 7.6, with specific comments. A general comment is that it is not uncommon for the four share prices to halve or double within a year, which indicates that, apart from long-term fundamentals, other mechanisms are heavily influencing prices.

STOCK SCREENING

The aim of stock screening is to draw up a short list of companies that appear to be currently mispriced or that offer potential for future price change. There are many ways of screening stocks, but the simplest is probably value investing. A value screener can be devised to look for companies with book values that are high relative to their share prices. Results are likely to be dominated by companies with difficulties that are not apparent to the screener and that need to be identified through further research.

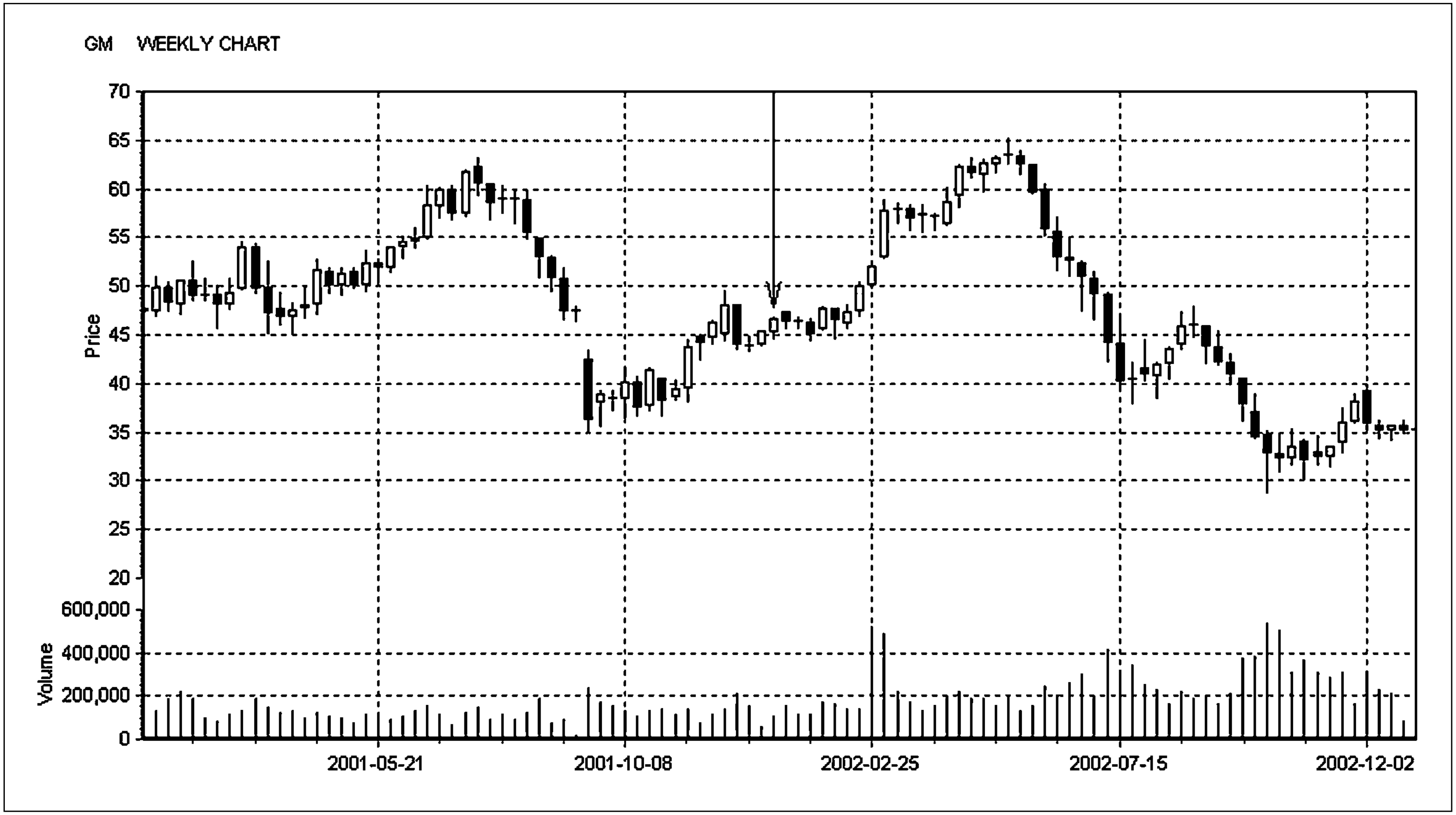

FIGURE 7.3

GM's EPS for December 2001 are 3.37, down from 8.7 a year previously. The arrow indicates that at the end of December 2001. GM's share price rises in the following few months, suggesting that the market has already discounted GM's worsening results before they are announced. Quarterly announcements provide cues for a company's ongoing performance.

FIGURE 7.4

Ford's results for December 2001 are a loss of $0.44 per share, down from an earning of $4.51 per share a year previously. Once again the arrow indicates the end of the accounting period. The cyclical nature of Ford's share price suggests that it will recover as the company's relative position improves.

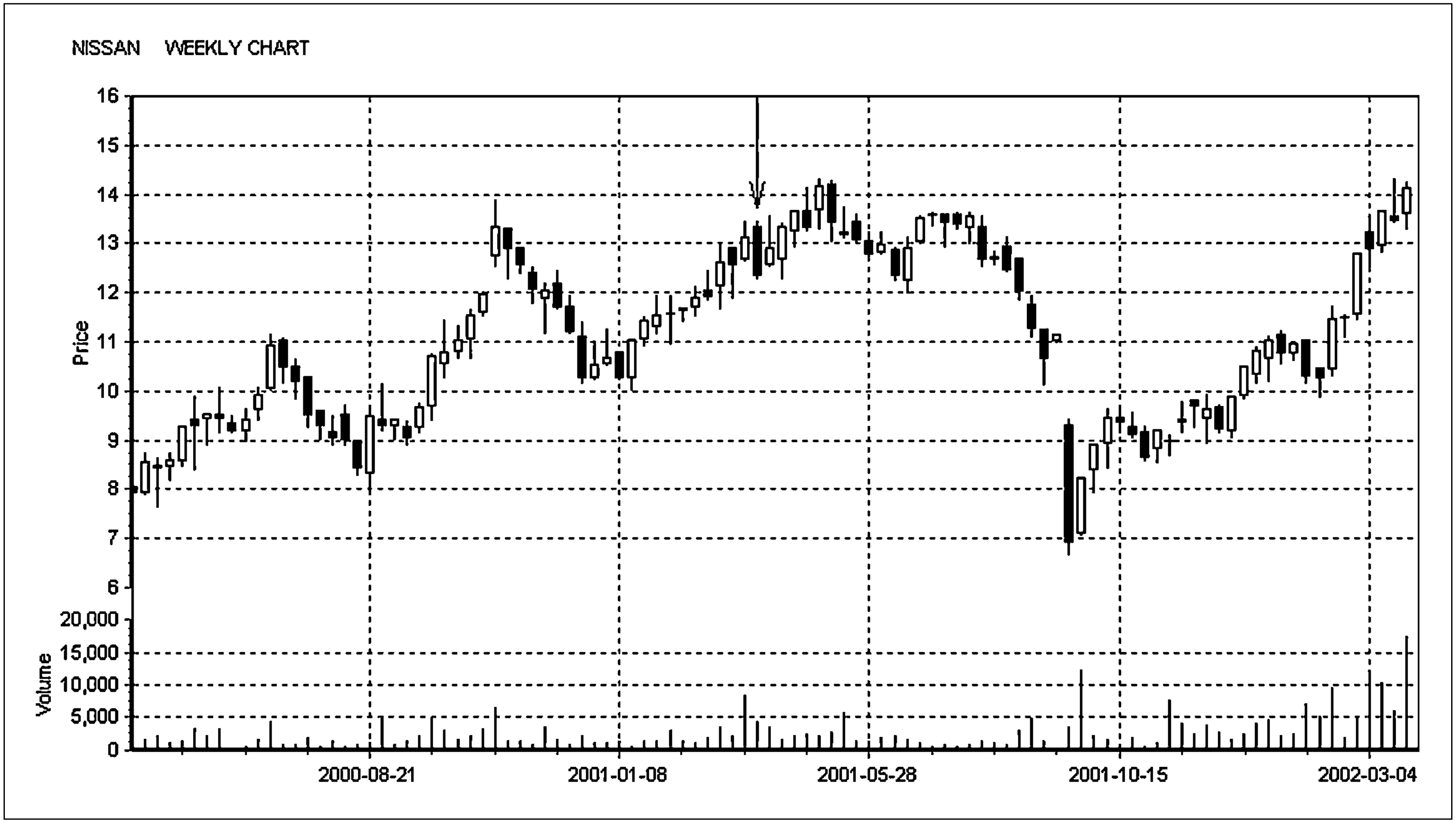

FIGURE 7.5

The arrow on the chart shows the end of Nissan's accounting year in March 2001. Nissan had posted a series of increasingly negative EPS reports, culminating in an earnings of $3.396 in March 2000. By March 2001, its EPS is $1.4. This looks to be a potential turnaround situation, although the price remains volatile for a long time afterward. By September 2003, the stock is trading at $23.

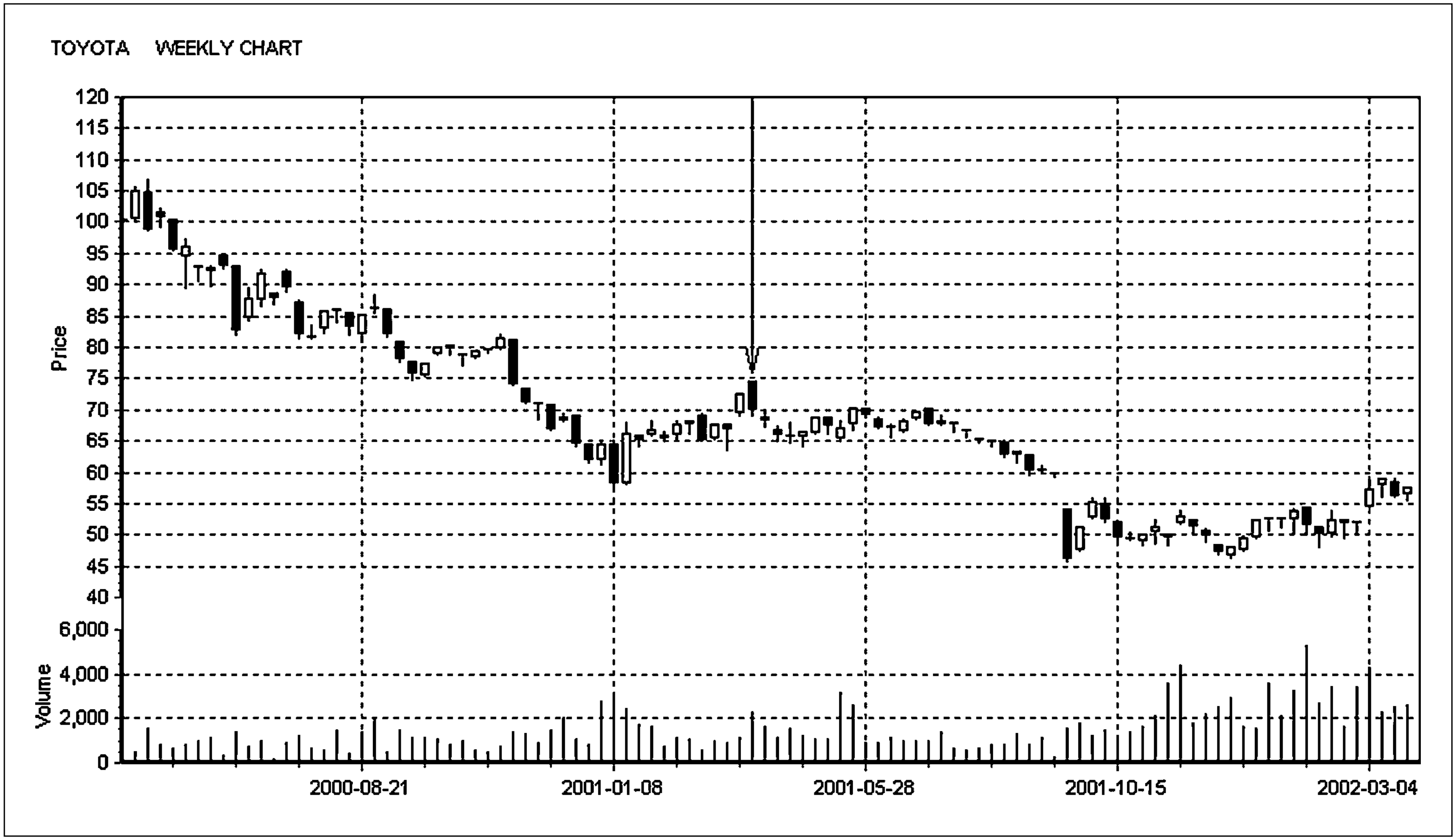

FIGURE 7.6

Toyota's annual earnings per share has shown a consistent growth for at least the previous five years, and as a result its P/E ratio is significantly higher than that of other auto manufacturers. Its EPS in March 2001 (the bar on the chart is indicated by the arrow) is $2.92, up from $2.420 a year previously, but the market has probably sensed that it cannot last, and the EPS for 2002 falls slightly. The chart is interesting because it begins in 2000 with a P/E ratio of 43, which reduces to 25 by March 2001 and is around 22 by March 2002. It suggests a market perception of a company maturing from a phase of steady growth into one of earnings consolidation.

Typically, these difficulties might be pending legal actions, operations in diminishing markets, financial problems, or contingent liabilities that the market felt were underprovided for in their accounts. With luck, there may be a few bargains, but the technique of value investing is so well known that most are likely to have been snapped up.

As an example of a less usual stock screener, the PEG concept was applied to stocks in the S&P 500, with (steady) earnings growth estimated from a five-year average up to 2001. Companies with PEGs between 0.3 and 1 with a record of continuous earnings growth were sought. Some 16 companies passed through the screen. Results are shown in Figure 7.7. Of the 16 companies that passed through the screen, with the exception of Safeway, most of their EPS figures either grew or held up reasonably when examined in September 2003, but their share prices tended to be more erratic. Fuller results, showing companies that failed the screen, are given in an *Excel* file (Figure 7.7 *Companion.xls*) on the accompanying CD ROM. Such a screen applied to S&P 500 companies reflects a crude way of trying to find sizable, well-run companies offering products to expanding markets and (for example) may exclude well-run companies operating in cyclical markets as well as turn-around situations.

Unfortunately this type of screen will also capture cyclical stocks near the tops of their cycles and fail to differentiate between companies whose finances are prudently managed and those that are encumbered by large debts. To make that distinction, an analysis of the type shown in Figure 7.2 will be needed. In theory, with enough fundamental data, there is nothing to prevent a more sophisticated screen from being developed to detect growth companies with well-managed finances, at least as far as they can be deduced from fundamental data. There is also an argument for relaxing the condition of continuous growth and making a case-by-case examination of companies that have good overall growth but fail to pass through this screen. Candidate companies can be seen in the companion spreadsheet to Figure 7.7 on the accompanying CD ROM. By now, it will be apparent that there is an infinite number of stock screeners that could be devised, but the following general points apply to working with any screen:

- Develop screens to identify companies whose share prices are likely to rise.
- Apply the screens to a subset of acceptable companies.
- Do further research on companies passing through the screens to see if the outcomes anticipated by the screens' designs are likely to be realized.

Company Name	Symbol	EPS ’96	EPS ’97	EPS ’98	EPS ’99	EPS ’00	EPS ’01	%Growth	P/E Ratio	PEG
BEST BUY CO INC	BBY	0.05	0.148	0.602	0.96	1.207	1.313	119.35	37.81	0.317
MGIC INVESTMENT CORP/WI	MTG	2.165	2.78	3.44	4.35	5.1	5.98	22.62	10.32	0.456
FOREST LABORATORIES -CL A	FRX	0.097	0.108	0.24	0.74	1.005	1.75	90.37	46.83	0.518
CAPITAL ONE FINL CORP	COF	0.773	0.957	1.4	1.84	2.39	3.06	31.89	17.63	0.553
COORS (ADOLPH) -CL B	RKY	1.14	2.21	1.87	2.51	2.98	3.33	28.63	16.04	0.560
EQUITY OFFICE PROPERTIES TR	EOP	0.5	0.92	1.28	1.53	1.54	1.6	29.44	18.80	0.639
MBNA CORP	KRB	0.395	0.533	0.673	0.84	1.053	1.313	27.21	17.87	0.657
FANNIE MAE	FNM	2.5	2.87	3.28	3.75	4.28	5.92	19.17	13.43	0.700
TJX COMPANIES INC	TJX	0.295	0.457	0.675	0.835	0.935	0.98	28.62	21.32	0.745
CITIGROUP INC	C	1.15	1.345	1.245	2.25	2.69	2.82	22.93	17.90	0.781
SAFEWAY INC	SWY	0.97	1.35	1.67	1.95	2.19	2.49	21.13	16.77	0.794
BLOCK H & R INC	HRB	0.54	0.665	0.925	1.075	1.21	1.88	29.28	25.62	0.875
QLOGIC CORP	QLGC	0.093	0.2	0.305	0.55	0.61	0.83	58.97	53.63	0.909
CARDINAL HEALTH INC	CAH	0.575	0.916	1.127	1.293	1.867	2.183	31.68	29.62	0.935
GENERAL DYNAMICS CORP	GD	2.135	2.515	2.95	4.4	4.51	4.69	18.15	16.98	0.936
KROGER CO	KR	0.67	0.875	0.88	0.77	1.07	1.3	15.82	15.93	1.007

FIGURE 7.7

Results of PEG stock screener applied to S & P 500 companies. (*Source*: Standard & Poor’s Compustat.)

The screens' short list of interesting companies that (in some sense) appear to have an intrinsic value that differs from either their current or anticipated share price is only a starting point. There will often be very good reasons for such differences that are not apparent to the screens, which is why the additional research is needed. In this regard, it needs to be mentioned that the Standard & Poor's database (and presumably others as well) contains helpful information such as the turnover of inventory, who the institutional shareholders are, and bond ratings, as well as many other gems to assist investors in their decisions.

FINDING THE COMPETITION

One of the problems facing the investor is to find out who the competition is for a company of interest. This is a harder problem than it appears at first sight since companies are both entering and leaving exchanges, and those listed on exchanges are often altering their activities. A company such as General Electric has a diverse product range that probably merits multiple entries in any business activity list, but in many such lists it receives only one. Such lists are not only limited by their inability to describe companies' activities properly but they also become dated very quickly, so they are usually out-of-date as soon as they appear.

Companies' activities are defined by a numeric code of up to four digits, the first two of which are usually sufficiently generic to have a useful shelf life. These codes are known as *standard industrial classification codes*, usually referred to as "SIC codes." Two versions of such a list, *SICALPHA.xls* and *SICNUMS.xls*, are on the accompanying CD ROM. To use them, open *SICALPHA.xls* (which is alphabetically sorted) and scan down to find a company of interest. Note its SIC code, and then open *SICNUMS.xls* (which is sorted by SIC code), and scan down to find the SIC code. Surrounding companies with the same SIC code should include the main competitors to the company of interest. One point to note is that companies with ticker symbols of more than three letters are usually listed as trading on the Nasdaq when many of them actually trade over the counter (OTC). The reason for this is that the distinction did not matter for the original purpose for which the list was prepared, and so to save time, that simplifying assumption was made. If the OTC or Nasdaq distinction is important, then users of the list are advised to double-check the exchange on which the stock trades. On the recommendation of the lady who compiled this list, it is limited to the first two numbers of SIC codes. If access is obtainable to more up-to-date lists, then more numbers of SIC codes could be used to narrow this type of search for competition. My thanks go to the lady who prepared this list, who wishes to remain anonymous, but who I hope will one day read this sentence expressing appreciation for her efforts and obtaining permission for the publication of the list.

A more comprehensive classification system is offered by Standard & Poor's, which contains numerous subcategories and is known as the Global Industrial Classification Standard (GICS). This offers a much more global coverage, and Standard & Poor's kindly made a spreadsheet of it available. The spreadsheet is reproduced on the accompanying CD-ROM in two versions, one listed in alphabetical order and the other in order of GICS code. Fuller details of the classification system used are given on each spreadsheet's second worksheet, and country codes on the third worksheet. As with the first list, activity areas are constantly changing and should be kept under constant review. GICS and similar lists are sometimes available on brokers or other financial Web sites. My thanks are due to Standard & Poor's for making this information available to this book's readers.

EVALUATION OF NEW ENTERPRISES

One of the harder problems in fundamental analysis is to evaluate the share price of a proposed new venture. This inevitably involves projections based on uncertain assumptions as well as a risk of total failure. Venture capitalists work on an 80/20 rule; that is, 80 percent of companies they invest in fail to meet their expectations, but the other 20 percent keep them in business. One way to evaluate a new venture is to look at the earnings per share (EPS) from the business plan (and possibly correct it to what you think is reasonable), identify comparable companies, assess a likely price/earnings (P/E) ratio, the probability of the venture's succeeding (P_s), and the loss of risk-free interest (I) represented by the purchase of a share until the earnings are achieved. This yields a formula:

$$\text{Price} = P_s \times \frac{P/E}{EPS} - I \tag{7.1}$$

Bear in mind that the value of P_s used by venture capitalists is 0.2 and that capital invested in such ventures is at extreme risk. There are difficulties when a venture is entirely new and its market not established, since the assumptions in the business plan are more speculative and comparable companies impossible to find. In this case, and when the trading conditions of the company appear to be stable, an alternative approach based on Williams's formula (equation 6.1) might be tried. Assuming the company goes through an initially volatile period but eventually emerges to a position of growing dividends with stable risk and growth, then in the present notation, and that of Chapter 6, equation 6.1 can be developed to yield a formula:

$$\text{Dividend value} = P_s \times \frac{D_1}{k - g} - I \tag{7.2}$$

Having evaluated the worth of the dividend, there is then an issue of assessing the contribution to share price of retained earnings, which tends to depend on the extent to which retained earnings can be reinvested for the benefit of the enterprise.

LIMITATIONS OF FUNDAMENTAL ANALYSIS

Fundamental analysis should be seen as a valuable strategic tool. Properly applied, it can warn the investor not to purchase overpriced stocks and identify opportunities arising from mismatches between a stock's price and its intrinsic value. Its basic assumption is that of the *efficient market*—that is, that market forces will act to correct any differences between the values and prices of stocks.

Lest anybody be tempted to think that there is some kind of accurate relationship between fundamental variables and price, a glance at Figures 7.3 to 7.6 shows prices can halve even on improving fundamentals (Toyota 2000 to 2001) and in the case of GM, (almost) halve, double, and halve again all within the space of 18 months and much the same fundamentals. There is little reason to think there is an accurate functional relationship between price and fundamentals (that is, to think that a mathematical formula can be devised to express share price in terms of fundamental variables), but there is evidence of a statistical relationship. That is why stocks with very high P/E ratios are prone to crash disastrously.

In terms of the conceptual price model shown in Figure 3.1, fundamentals encompass a combination of longer-term experience and the effects of new information. Their figures are published on a quarterly, half-yearly, or annual basis, and in many cases their effects on price have already been second-guessed by the markets. The classical way of investing with fundamentals is to buy an underpriced security, hold on to it until prices have corrected, and then sell it. If no account is taken of the direction of price movement at the time of purchase, then it is implicitly a *contrarian strategy*—that is, it is a position taken against the sense of price movement in anticipation of a reversal. This raises the issue of whether to wait for prices to bottom out before making a purchase or to top out before making a sale. Generally, investors use fundamental analysis to assess what is likely to happen in the longer term, but they use a tactical tool to time optimal entries and exits in the shorter term. To achieve such optimal timing requires tactical tools. Charts shown in Figures 7.3 to 7.6 present many opportunities for such tools to be use profitably.

Fundamentals can also assist in formulating a prior probability of a price move. (Prior probabilities were discussed in Chapter 4 in Bayesian inference.) If, for example, a stock appears undervalued relative to its intrinsic value, then the prior expectation is that its price will move upward toward that value. If, subsequently, there were a news item or some other event that increased the probability of an increase, the consequences of those events could be interpreted within the context of a prior probability assessed from the fundamentals. More dangerously, a stock that appears to be undervalued relative to its peers may move toward their value, but it is also possible that the entire peer group may be overvalued, in which case they can all be expected to fall to their intrinsic values.

INVESTING AND TRADING

A financial decision that is made after careful consideration of fundamentals and other data and that offers safety of principal and promises adequate returns is deemed to be an *investment*. This definition glosses over the point that all investments have to be made on the basis of past or current data, which has been likened to having to drive a truck while being able to look only in the rearview mirror. A financial decision made on the basis of looking at a price chart is sometimes called "trading." Unfortunately, there are only loose definitions of both, and a degree of rivalry between proponents of the fundamental and chartist camps. I declare myself to be a neutral in this dispute, as in my view, investors and traders need all the help they can get from whatever methods are available. The aim of Chapter 4 was to stress the value of both the Bayesian approach and use of multiple independent perspectives for the same decision. The upshot is that, in theory, if both fundamental and chartist approaches yield the same conclusion, then the chances of success improve. Put simply, a dogmatic rejection of any useful method lessens the chances of profitable investments or trades, whereas if they can be used in conjunction, then the chances of profits improve. We now move on to look at chartist techniques.

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PART THREE

Technical Analysis

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CHAPTER 8

Introduction to Technical Analysis

Technical analysis is sometimes called *chartism*. It is based on the idea that market participants digest and discount all relevant information to create price histories that incorporate the information needed for price prediction. There is some theoretical justification for this view, but it is based on price histories, which are unrealistically long. In practice, the best interpretation has to be sought from whatever information is available.

Technical analysis is also sometimes called "Wall Street's voodoo economics." The subject lacks clear definitions and recognized standards, and there is just a whiff of its being in the eye of the beholder. Often, with the benefit of hindsight, "technical" rationalizations are offered to explain useful price moves. Unfortunately, these explanations may involve an element of self-delusion, in that the rationalizations behind trades that "work" are offered as definitive (rather than statistical) rules that fail when tested objectively. Technical analysis means different things to different people, so there is a lack of consensus as to exactly what it is and what its rules are. The state of technical analysis is not unlike that of economics in which contradictory opinions held by economists are unresolved, which creates a zone of uncertainty within which those claiming lesser expertise are uninformed but have the choice of following one guru or another. The underlying causes—of underappreciating the statistical nature of the problems and assuming that specific results can be generalized—seem to be much the same.

Technical analysts insist that their techniques work but that they lack the plausible explanations, so beloved by economists, as to why. Within this introductory chapter to the subject, I hope to offer an explanation that partially bridges this gulf between economists and technical analysts, but the underlying philosophies are very different in that technical analysis generally avoids the idea of an intrinsic value to which prices are likely to converge. When technical analysts consider the question of value, they usually do so from the fundamentalist perspectives described in Part 2 and adjust their strategies accordingly.

There is much to be said for combining fundamental and technical strategies, which is a recurring theme in this book. Much of the time technical analysts may be dealing in financial instruments for which prices are diverging from perceived intrinsic values, or for which such intrinsic values are hard to define. In these circumstances their tools are more useful, and can be applied more widely, than those of fundamental analysis. However, technical analysts dealing in stocks will usually have one eye on statistics such as price/earnings (P/E) ratios and exit for fundamental reasons if these become too extended. Technical analysts dealing in commodities will usually be aware of their current prices relative to both their historical highs and lows and other commodities to which they might be related. Such situational awareness is implicitly fundamental in nature and helpful for assessing when commodity prices appear overbought or oversold.

Boundaries between technical and fundamental approaches can become blurred as people try to get the best out of both methods in support of their investment decisions. “Trading” usually refers to decisions made in circumstances in which fundamental analysis is disregarded completely, buying and selling activity short term, and, if based on any methodical approach, technical analysis. Trading is a perfectly honorable way of exploiting the market, and it also serves the useful purpose of preserving liquidity. But the people engaged in it work in a very noisy price environment. They tend to do so on a full-time basis so that they can monitor prices very closely and may enjoy lower commission costs than those available to most investors. For people who cannot spend their days monitoring prices, their best option is to try to identify situations in which substantial price moves will occur so that the inevitable costs of taking a position are justified by the size of the price move expected.

The working premise of this book is that the methods described will be used in conjunction for a longer-term acquisitions and disposals process, closer to investing than trading. To that end, most of the techniques will be described using examples of weekly charts. In principle, a subset of the techniques described, particularly those of technical analysis, could also be used with daily, half-hourly, or even more frequent price bars for trading rather than investing, but the focus of this book is investing, to the exclusion of describing some techniques used for short-term trading.

A RETURN TO COBWEB THEORY

In Chapter 2, we briefly examined cobweb theory and saw that price patterns were created as a consequence of expectations and the respective slopes of the supply and demand curves. To recap, high prices attracted more supply, which then reduced prices, which then lessened supply, which then increased prices—with the nature of the resulting price oscillations dependent on the slopes of demand and supply curves. These phenomena are well known and accepted by conventional economics. However, when conventionally applied, cobweb theory needs to know the quantity of whatever is being bought or sold, and in that respect, it appears at odds with the ideas of technical analysis, which does not require such knowledge. The situation is this: If it can be shown that prices consistent with the predictions of cobweb theory can be predicted from prices alone, without any knowledge of quantity, then a bridge between technical analysis and this aspect of economic theory will have been created. To recap on the main observations: In Figure 2.5 we saw that when supply and demand slopes were of identical magnitudes, the result was a stable oscillation in price; in Figure 2.6 we saw that when the magnitude of the supply curve slope was greater than that of the demand, the result was a damped oscillation in price; in Figure 2.7, we observed that when the magnitude of the supply curve slope was less than that of the demand, the result was an expanding oscillation. Appendix 8.1 examines the simple linear mathematics of cobweb theory and shows that the next price turning point P_t can be predicted from a knowledge of the previous three P_{t-1}, P_{t-2} and P_{t-3} through the expression

$$P_t = P_{t-1} + \frac{(P_{t-1} - P_{t-2})^2}{P_{t-2} - P_{t-3}} \qquad \text{(A8.9)}$$

Assumptions behind this expression are consistent with simple cobweb theory; that is, supply and demand curves are linear, and expectations for the next price turning point are created from the previous one. This is the *bridge* needed to relate some price-predicting tenets of technical analysis to cobweb theory, and it should overcome at least some of the objections of some economists. It is also worth pointing out that the “quantity” aspect of cobweb theory represents information that is not available to market decision makers, meaning that a price-based formula such as (A8.9) offers the only realistic way in which a turning point could be predicted from cobweb theory.

Also important is the insight that price oscillations have a distinct meaning. Thus an expanding price oscillation indicates a demand slope magnitude exceeding that of the supply, and a damped price oscillation indicates a supply slope magnitude exceeding that of the demand. In practice, slopes of demand and supply curves can alter fairly quickly with time, such that an expanding price oscillation can be followed by a damped one, as buyers and sellers change their perceptions of the worth of a financial instrument. The result can be characteristic price patterns that technical analysts have found to have a predictive value under some circumstances. Thus the "voodoo" aspect of at least part of technical analysis can be related back to mainstream economic theory.

Price formations in Figures 2.5 through 2.7 represent idealized situations that are unlikely to exist in practice. The normal expectation is that a major price movement will occur via a series of oscillations of smaller sizes, consistent with the results of smaller (cobweb) price oscillations reflecting the varying demand and supply curves at different times.

A general point, which is entirely consistent with equation A8.9, is that technical analysts believe that price turning points are important and represent price levels that are likely to be revisited, and so we move on to examine them in greater detail.

TURNING *(OR PIVOT)* POINTS

Price turning points, also sometimes called *pivot points*, can be classified temporally or spatially. For the present purposes we will concentrate on the temporal. Consider a situation in which the high of a price bar is the highest for many bars on either side. In the case of a daily price chart, if a high were the highest for three days on either side, we would refer to it as a *three-day high pivot*. Similarly, if a low of a bar were the lowest for three days on either side, we would refer to it as a *three-day low pivot*. More generally, if highs or lows represent extreme values for n days on either side, they can be referred to as either an *n-day high pivot* or an *n-day low pivot*. Where a different time period is involved in the price bar, such as half-hourly, weekly, or monthly, then that would replace the "day" in the definition; for example, we could refer to a "three-week high pivot."

THE NATURE OF ECONOMIC RELATIONSHIPS

Most people have learned about a relationship such as Newton's law of gravitation without its being pointed out to them that Newton did not claim to have found the mechanism that caused gravitational attraction but rather, a relationship to describe the gravitational force between two objects of known mass a specified distance apart. Knowing the masses and their distance apart, Newton's relationship gives a definitive answer for the gravitational attraction between them. This level of certainty is just not present in economic relationships, and expectations have to be lowered.

To address the question of level of certainty, in two different cases in which the inputs are identical, a comparison of the outputs with the actual answers is likely to show that errors exist and are different in the two cases. This is not just to say that economic relationships are less accurate but also that errors are more randomly distributed, implying that their answers are fundamentally less reliable. Unlike Newton on gravitation, economists will generally claim to have "explanations" for their relationships, but they accept that they are dealing with a problem domain that is much more uncertain and with consequent problems of accuracy and reliability. A point that is often ignored is the lack of uniqueness in economic explanations. There may be a number of similarly plausible arguments for believing in different relationships to describe the same economic phenomena, whose answers may be so different as to be contradictory. This is where a reliance on plausible arguments to yield the most accurate economic relationships begins to fall apart and where the intrinsic uncertainties behind economics become exposed. The net result is the advice not to give too much credence to any economic explanation lacking in uniqueness, not to expect a high level of accuracy, nor to expect economic relationships to work in the future just because they may have done so in the past.

Economic relationships have another property that cannot be compared with Newton's law of gravitation. They can break down completely and cease to exist. A classic example of this arises when one country attempts to peg its currency to another's. Strictly, a *peg* means that one country's currency can always be exchanged for a fixed amount of another's, but the norm is for a looser peg in the form of economic management to keep currency exchange rates stable with major trading partners. Such pegs might be loosely controlled by varying interest rates in the weaker economy so that its currency maintains approximately the same exchange rate relative to that of the country with the stronger economy.

Eventually, the two countries' rates of economic growth, inflation, balance-of-payments positions, unemployment, and social problems may diverge to make any such peg unsustainable. Typically, a computer program will identify the existence of a relationship between the two countries' exchange rates but fail to have an economist's appreciation of when such a relationship is becoming unsustainable. This is an example of when an economist's qualitative appreciation of a potentially dangerous situation could alert an investor to the danger of a collapse to allow prudent action to be taken, even though the timing of such a collapse might not be predictable. Examples are the decline of sterling in 1992, following a policy of tracking the Deutsche mark, and the collapse of various Latin American currencies that attempted to maintain currency stability with the U.S. dollar. On a micro-scale, relationships that could form the basis of a useful investment decision might be detected, but such relationships might also collapse for analogous reason to those given for the collapse of currency pegs.

These general points about economic relationships are therefore important to consider:

1. They may not be accurate.
2. They may not be reliable.
3. They may collapse completely.
4. If based on plausible argument, when different but similarly plausible arguments can be identified, they are not unique and therefore cannot be relied upon.

This is the background that technical analysis shares with economics, and it provides an initial base from which expectations need to be formulated. As an example of such limitations, results of equation A8.9 are as useful as the assumptions of cobweb theory are applicable to a given situation and the extent to which correct price turning points can be identified to provide it with inputs.

GENERAL PHILOSOPHY OF TECHNICAL ANALYSIS

Technical analysis is based on the discovery of heuristics that work in certain situations and the application of those heuristics in those situations in an attempt to profit. Unlike economics, there may be little or no attempt to explain why such relationships work—simply an acceptance that for the time being they do. In respect of explanations, it is therefore one rung lower on the ladder of certainty than economics. Contrary to my own expectations, many of its adherents are economists, disillusioned with the numerical results of their own discipline, who use it in preference to (or sometimes in conjunction with) their discipline.

Technical analysis is broadly divided into four categories: the identification of price-predictive patterns, the production of reactive indicators, the identification of levels of (price) support and resistance, and the identification of significant trendlines, which, when broken, signify a price move. The word *reactive* is meant to imply that some extreme value in price has been detected, the market has turned, and an indicator is advising that to be the case. Reactive indicators are not "predictive" in the sense of attempting to predict turning points, but an assumption is usually made that a trend detected after a previous turning point will continue. Their use almost always results in a situation in which price moves will have started before an entry, and they will have reversed before an exit. In other words, both entries and exits are later than the optimum, which would be a turning point.

Use of such technical indicators requires a price move to be sufficiently large to overcome the overhead associated with late entries and exits. A particularly difficult situation arises when a move starts, a technical entry signal is given, an entry is taken, the move reverses immediately after the entry, there is a delay before a technical exit signal is generated, during which time the position becomes loss-making, and the trade is eventually exited for a loss. This is known as a *whipsaw trade*. It can happen repeatedly in sideways markets. It is a situation in which there are repeated price moves that are too small to overcome the overhead of having to wait for significant price reversals before reactive technical signals are given.

APPENDIX 8.1

Predicting Turning Points from Cobweb Theory

This appendix will show that cobweb theory provides a basis for predicting turning points from price alone, without knowledge of quantities. We use P to represent price, Q quantity, m gradient, c the intercept with the price axis when Q = 0, subscript 1 for conditions on the demand curve and 2 for conditions on the supply curve.

The demand curve is represented by the equation

$$P = m \times Q + c_1 \qquad \text{(A8.1)}$$

and the supply curve by

$$P = m_2 \times Q + c_2 \qquad \text{(A8.2)}$$

which we note can be rewritten as

$$Q = \frac{P - c_2}{m_2} \qquad \text{(A8.2a)}$$

The term P_t denotes the price at a turning point, and P_{t-1}, P_{t-2}, and P_{t-3} the prices at the three preceding turning points.

From (A8.1), (A8.2), and (A8.2a) and working through horizontal and vertical arrows of the cobweb, it follows that

$$P_{t-2} = m_1 \times \frac{(P_{t-3} - c_2)}{m_2} + c_1 \qquad \text{(A8.3)}$$

and

$$P_{t-1} = m_1 \times \frac{(P_{t-2} - c_2)}{m_2} + c_1 \qquad \text{(A8.4)}$$

Subtracting (A8.3) from (A8.4) gives

$$P_{t-1} - P_{t-2} = \frac{(P_{t-2} - P_{t-3})}{m_2} \times m_1 \qquad \text{(A8.5)}$$

Hence,

$$\frac{m_1}{m_2} = \frac{(P_{t-1} - P_{t-2})}{(P_{t-2} - P_{t-3})} \qquad \text{(A8.6)}$$

and, from substitution of (A8.6) into (A8.4),

$$-\frac{m_1 \times c_2}{m_2} + c_1 = P_{t-1} - P_{t-2} \times \frac{(P_{t-1} - P_{t-2})}{(P_{t-2} - P_{t-3})} \qquad \text{(A8.7)}$$

By analogy with (A8.4), it follows that

$$P_t = \frac{m_1}{m_2} \times (P_{t-1} - c_2) + c_1 \qquad \text{(A8.8)}$$

Introducing (A8.6) and (A8.7) into (A8.8), we find that

$$P_t = P_{t-1} + \frac{(P_{t-1} - P_{t-2})^2}{P_{t-2} - P_{t-3}} \qquad \text{(A8.9)}$$

Equation A8.9 demonstrates that if the gradients of supply and demand curves (m_1 and m_2) are fixed and the usual assumptions of cobweb theory applied, then the next (price) turning point can be predicted from prices at the three previous turning points, without any knowledge of quantity needed to complete that prediction.

CHAPTER 9

Technical Analysis without Formulas

In Chapter 8 it was said that effective heuristics would be sought and used for as long as they seem to work and that the necessity for plausible explanations would be relaxed. Some authors offer plausible explanations, and I would not argue with them for doing so, but I would point out that such explanations often lack uniqueness, may be tied to uncertain qualifications, and, when these reservations apply, are of limited value. Technical analysis implicitly acknowledges this and is generally uninhibited about any lack of explanation as long as a heuristic works. This is akin to a well-established practice in statistics of fitting a curve through a data set; that is, the same thing that Newton did to arrive at a universal law of gravitation that he knew worked but could not explain why. Regrettably with the markets, their behaviors change frequently and cannot be represented by a single, simple, universal formula—as Newton also discovered in 1720 when he lost £20,000 ($36,000 at $1.80 to the pound) in the South Sea Bubble.

The particular problem in technical analysis is that of knowing what type of relationship is currently working and when it will break down. The essential points are to find a relationship that seems to be describing price action, a criterion (often, the penetration of a line) that determines when it no longer applies, and an inference for where prices are likely to move to when a relationship breaks down. In this chapter we will look at simple, but effective, methods of technical analysis. Formulas will be avoided. This is an important chapter designed to offer a basic understanding of various categorizations of market behavior and well-tried simple methods for finding helpful heuristics to describe price action within those different categories. One point that is often overlooked is that the human eye is very good at recognition tasks, and experienced human judgment is very good at fusing information from diverse sources to make good decisions. This chapter offers an insight into the simple techniques that form a major part of many successful investors' decisions.

SUPPORT AND RESISTANCE

One of the tenets of cobweb theory is that decisions are made on the expectation that future prices will remain the same as the present. This is a powerful idea that can be extended to say that historical highs and lows create expectations of levels to which prices may return. Sometimes, prices may exceed those levels to create new extremes, but the point is that past extreme price levels act as psychological hurdles that price movements may not overcome, irrespective of whether those hurdles were previously encountered when prices were moving up or down. There are issues about how to define the rules for levels that constitute these price hurdles, and the general advice is the following:

- Previous pivots define such levels.
- The more significant the pivot, the more relevant it is.
- The more recent the pivot, the more relevant it is.
- The more pivots a level has touched, the more relevant it is.
- Pivots at either tops or bottoms can act as either support or resistance levels.

In itself, this advice is insufficient to define an algorithm to find support and resistance levels. Issues such as the weighting to be given to past pivots or numbers of pivot points touched are matters of opinion. An algorithm to find support and resistance levels has been prepared whose results are shown in Figures 9.1 to 9.4. The algorithm is based on the ideas that the most recent, largest pivots are the most relevant to the present situation and earlier, smaller pivots can be initially discounted but may become relevant when trying to decide how many pivots a level has previously touched. The details are the following:

- Categorize all pivots using the temporal method described in Chapter 8.
- Working backward from the current datum, note high and low pivots spanning progressively larger periods.
- Pivots defined in the previous step are the levels to be used for support and resistance.
- All levels below the present price are support, and those above, resistance.

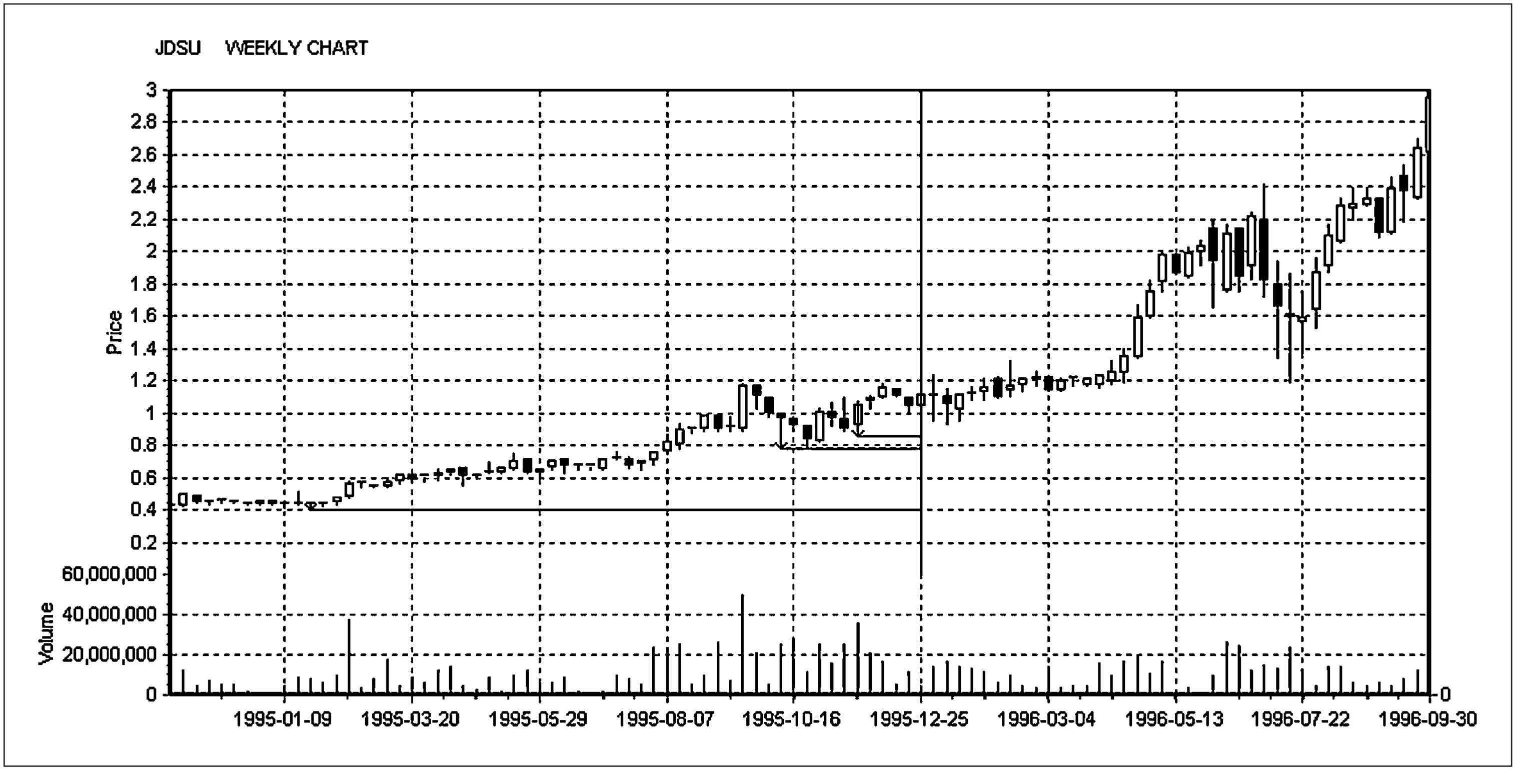


FIGURE 9.1

A cursor is shown on Christmas Day 1995, and support lines are drawn from prior pivot points that span progressively larger intervals. Support lines show price values where previous price moves have turned, and where buying pressure for a turn is likely to be found. The closer it is to the present bar, and the greater the number of previous price pivots touched by a support line, the greater the justification for believing in its relevance.

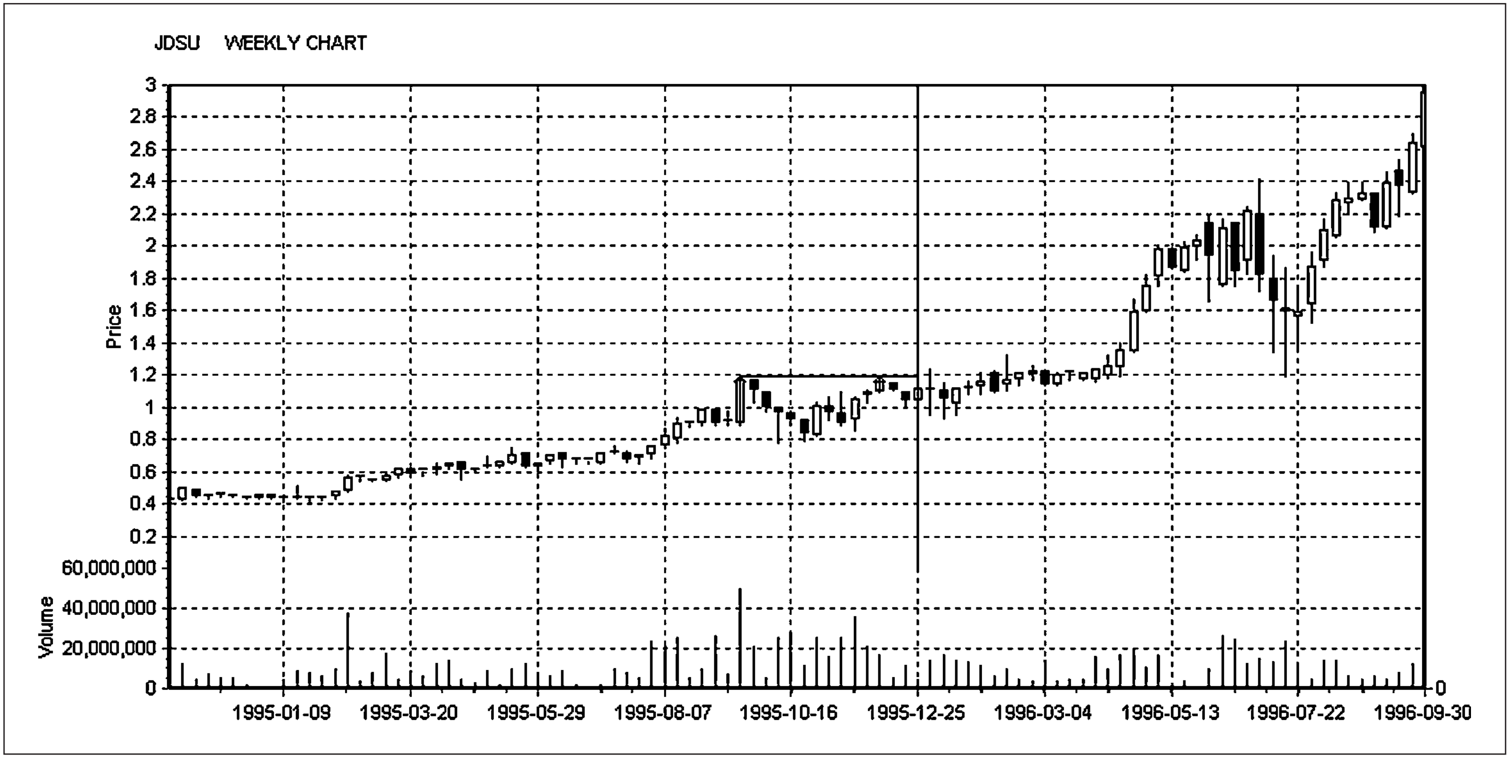


FIGURE 9.2

As in Figure 9.1, the cursor is still positioned on Christmas Day 1995, and resistance lines are drawn from prior pivot points that span progressively larger intervals. In this case the two resistance lines are effectively coincident in price and appear to be one. Resistance lines show areas where selling pressure is likely to be found to reverse upward price movements. Resistance lines are drawn from bars on 18 September 1995 and 4 December 1995 (at prices of almost 1.2), and, once again, the greater the number of pivot points they have touched, the greater their relevance.

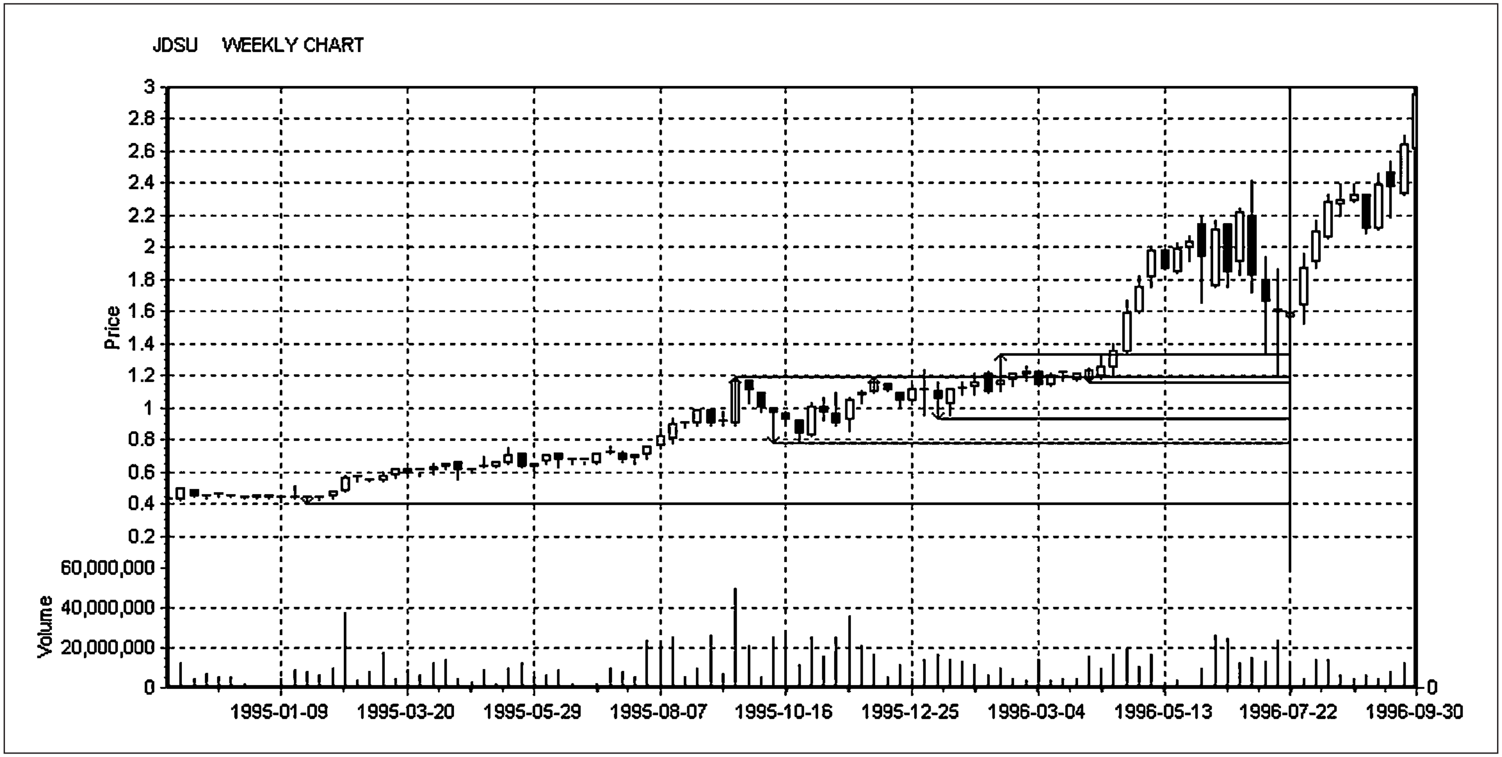


FIGURE 9.3

A cursor is positioned at 22 July 1996 and support lines drawn. Note that the number of support lines is quite large, giving many candidates to choose from. The resistance line of Figure 9.2 (starting on 18 September 1995) defines the value at a congestion period in March 1996 and also the value at the turning point of 15 July 1996. This illustrates how a resistance level can change to become a support level and vice versa.

FIGURE 9.4

Support and resistance lines may not withstand strong buying or selling pressures. In July 2000 this stock failed to reach a resistance level established the previous April. By October 2000 there was a growing realization that the dot-com bubble was over, and investors were seeking "quality." Many were bailing out of stocks and buying bonds. There was a strong downtrend at that time, which meant that the support line established on 18 April 2000 at around $75 was almost ignored, and the downtrend continued to take the stock to about a quarter of this support price by March 2001. This highlights questions that each investor needs to ask: (1) Is the concept of support and resistance relevant in a particular market situation? And (2), if lines are broken, where does price head next?

The logic of the second step of this algorithm needs some clarification, which will be given by example: If, say, a nine-day pivot high predates a five-day pivot high, the nine-day is deemed relevant as long as it is the closest pivot high of (at least) that magnitude to the present datum. Conversely, if a five-day pivot high predates the nine-day pivot high, the significance of the five-day would be superseded by that of the nine-day and can be ignored. Following the advice that the larger and more recent pivots are the more relevant means that when looking backward from the present datum, only those pivots spanning progressively larger periods need be sought. The same argument applies for pivot lows. The algorithm is not claimed to be perfect, and it represents only a subset of advice generally offered for finding support and resistance levels, but it does pick out most of the likely candidates. These can then be ranked manually according to whatever (subjective) interpretation is given to the significance of touching other pivot points, and what constitutes a touch.

Figure 9.1 shows an example of support lines drawn up to a cursor positioned at Christmas Day 1995. In this instance prices are moving upward fairly strongly, and the support lines are untested. Figure 9.2 shows two (merged) resistance lines in the same uptrend at a price just below 1.2. These lines are definitively broken in April 1996, but they provide a guide to a level at which selling pressure constrained an upward price movement for a number of months. Figure 9.3 is particularly interesting as our old friend, the resistance line of Figure 9.2, reappears as a support line to define the pivot low of the 15 July 1996 price bar. This provides an example of how a resistance line can become a support line and adds credence to the idea that in certain periods there are certain prices for each financial instrument that are much more important than others. Visual inspection of Figure 9.3 shows the useful support line just below 1.2 to have touched more pivots than any other, which tends to confirm the received wisdom about the value of such touches. Finally, Figure 9.4 is included to demonstrate that support lines do not always work and that they are particularly prone to fail when buying or selling pressures cause prices to power through them rather than hesitate or reverse at their levels.

Figure 9.4 raises two important issues, that of when support and resistance lines are likely to fail and what inferences can be drawn from such failures. To address the first of these: Stocks are seldom viewed in isolation but usually relative to their competitors. This means that if prices in competitive stocks begin to ignore either their support or resistance levels in a consistent fashion (for example, support levels of most competitive stocks begin to be penetrated), an expectation is created that prices for stocks in that industry sector are on the move. The investor can build up an expectation of such movements by looking at prices and support and/or resistance levels in competitive stocks. By doing this, they can get a feel for the overall investor sentiment toward an industry sector and help in their assessments of prior probabilities of price movements for a stock in which they are interested. Finally, on support and resistance, if prices move consistently away from previous support or resistance levels (as they do in Figure 9.4 after 23 October 2000), then a price trend is indicated.

PRICE TRENDS AND TRENDLINES

An *uptrend* is indicated by a sequence of higher pivot highs and higher pivot lows. A *downtrend* is indicated by a sequence of lower pivot lows and lower pivot highs. To remove ambiguity associated with an expanding price oscillation known as a *broadening formation*, which will be examined in a later chapter, these definitions are slightly more formal than some. A downtrend is evident in Figure 9.4 in the autumn of 2000.

Returning to the original premise of seeking heuristics to represent local price behavior, one of the most popular is that of the *trendline*. On an uptrend, this is a straight line joining as many pivot lows as possible (with a minimum of two), and on a downtrend, a straight line joining as many pivot highs as possible, again with a minimum of two. When prices penetrate these lines by a subjectively determined amount, the trend is said to be over. The ability of trendlines to represent price behavior and the significance attached to their penetration are both questionable when only two pivots are touched. Each additional pivot touch provides supporting evidence that a straight line is representing the levels of pivot lows within the trend—confirming that the local heuristic of a trendline is representing the behavior of pivot lows. Often, there are a number of possible trendlines that could be drawn, with many in close proximity that could be merged into a single trendline if conditions for a touch were relaxed. The general advice for trendlines can be summarized as follows:

- The more pivot touches, the better.
- Touches should be spaced out as much as possible along the trendline.
- Trendlines tend to work best when price excursions away from them are small.
- Long trendlines, with small price excursions, are better than short trendlines with large price excursions.

One point needs to be clarified: A two-touch trendline with wide price excursions away from it is unlikely to be of much use. Some authors insist on three touches to define a trendline, but the situation is complex, and, as mentioned earlier, a number of two-touch trendlines in close proximity can provide a signal as effectively as a trendline with more touches. Such a situation is shown in Figure 9.5, in which the first trendline that is penetrated touches three pivots but is very close to two other two-touch trendlines. An example of two-touch trendlines in close proximity occurred in the Dow at the start of the 1920s bull market. The weekly chart shown in Figure 9.6 illustrates the situation. The great crash of 1929 involved penetrations of the two trendlines shown in Figure 9.7, one of which went back to the summer of 1928 when it touched two pivots and then touched a third in May 1929. The bottom of the early 1930s bear market was followed by the penetration of a number of long-term trendlines as shown in Figure 9.8. This did not develop into a bull market until some months later, but it did signify a change from bearish to sideways market conditions. A particularly good example of how trendlines are supposed to work occurred in the Dow in 1942. A five-touch trendline was penetrated near the start of a bull market, to give the near-perfect buy signal shown in Figure 9.9.

MOVING AVERAGES

Moving averages come in a number of flavors, but for now we just consider the *simple moving average*. An n bar moving average is just the average of closing prices of a group of the last n price bars, and it is conventionally plotted on the most recent bar of the group. Since the value of a moving average is always influenced by previous values, when plotted, it will appear to show what has been happening to price rather than what is currently happening. This means that turning points on moving averages will lag behind those of prices. The general term given for this tardy behavior is *lag*. Sometimes lag is useful, but much of the time it is not.

There are many ways to use moving averages, and Figures 9.10 through 9.13 have been chosen to offer a representative selection. We digress for a short while to examine the question of the number of bars chosen to form the moving averages. In these figures they conform to a number in a series discovered some centuries ago by an Italian best known by his nickname of "Fibonacci." Literature on technical analysis is peppered with references to his ratios and series, so this is as good a point as any to introduce them. The Fibonacci series starts with the numbers 1, 1, which are then added to get 2. The series proceeds by adding the last value to the previous; thus, 2 and 1 becomes 3, 3 and 2 becomes 5, 5 and 3 becomes 8, and so on. The sequence of numbers is therefore 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144 , . . . , with each number being the sum of the previous two. As the numbers get large, the ratio of the previous number to the latest in the sequence approaches 0.618, and the latest to the previous, 1.618. These are known as *Fibonacci ratios*. As

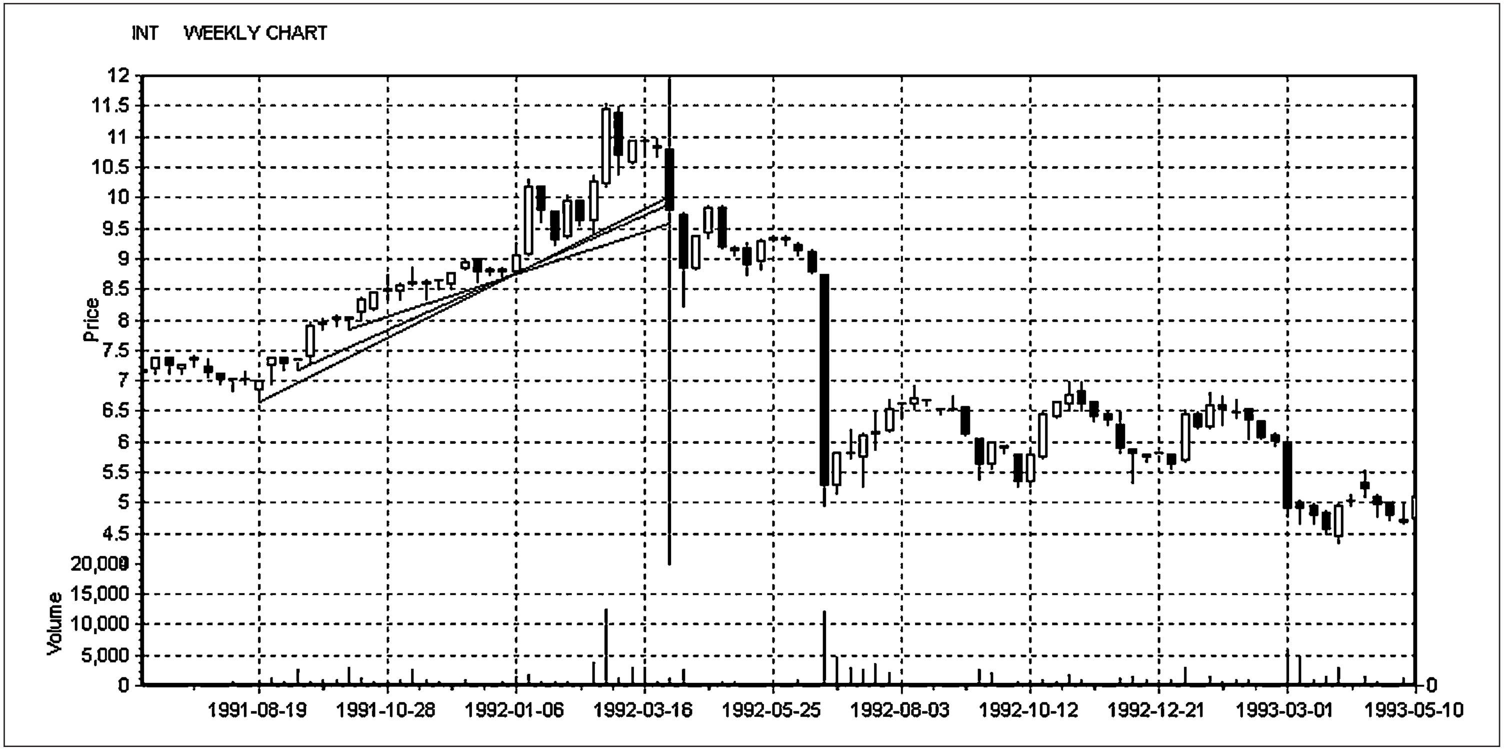


FIGURE 9.5

There are a number of similar plausible trendlines that can be drawn to describe this trend, and at least one of them involves three touches. They are broken on the price bar of 30 March 1992, and within the space of a few weeks, the stock price halves.

FIGURE 9.6

In addition to a trendline with a number of touches, the existence of a number of two-touch trendlines in close proximity, with similar gradients, can also signify the end of one trend and the start of another. This was the situation with the trendlines in the Dow Jones Industrial Average at the start of the 1920s bull market.

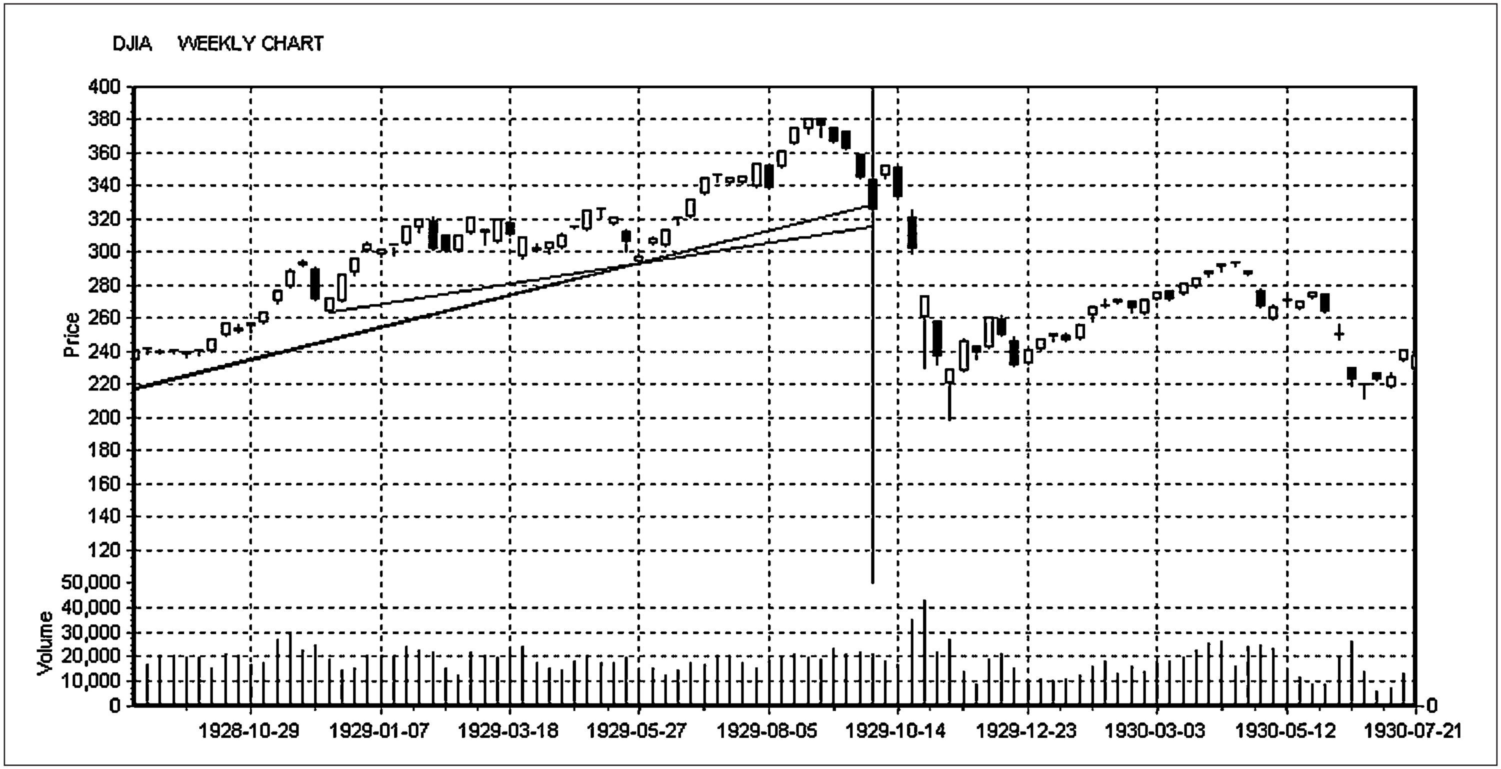


FIGURE 9.7

Some two weeks before the great crash of 1929, a trendline that started in July 1928 was broken. It had two touches in the summer of 1928 and another in May 1929, but price gains were reasonably steady, to correlate fairly well with the trendline. Its penetration should have been a cause for concern, particularly by the week beginning on 17 October 1929.

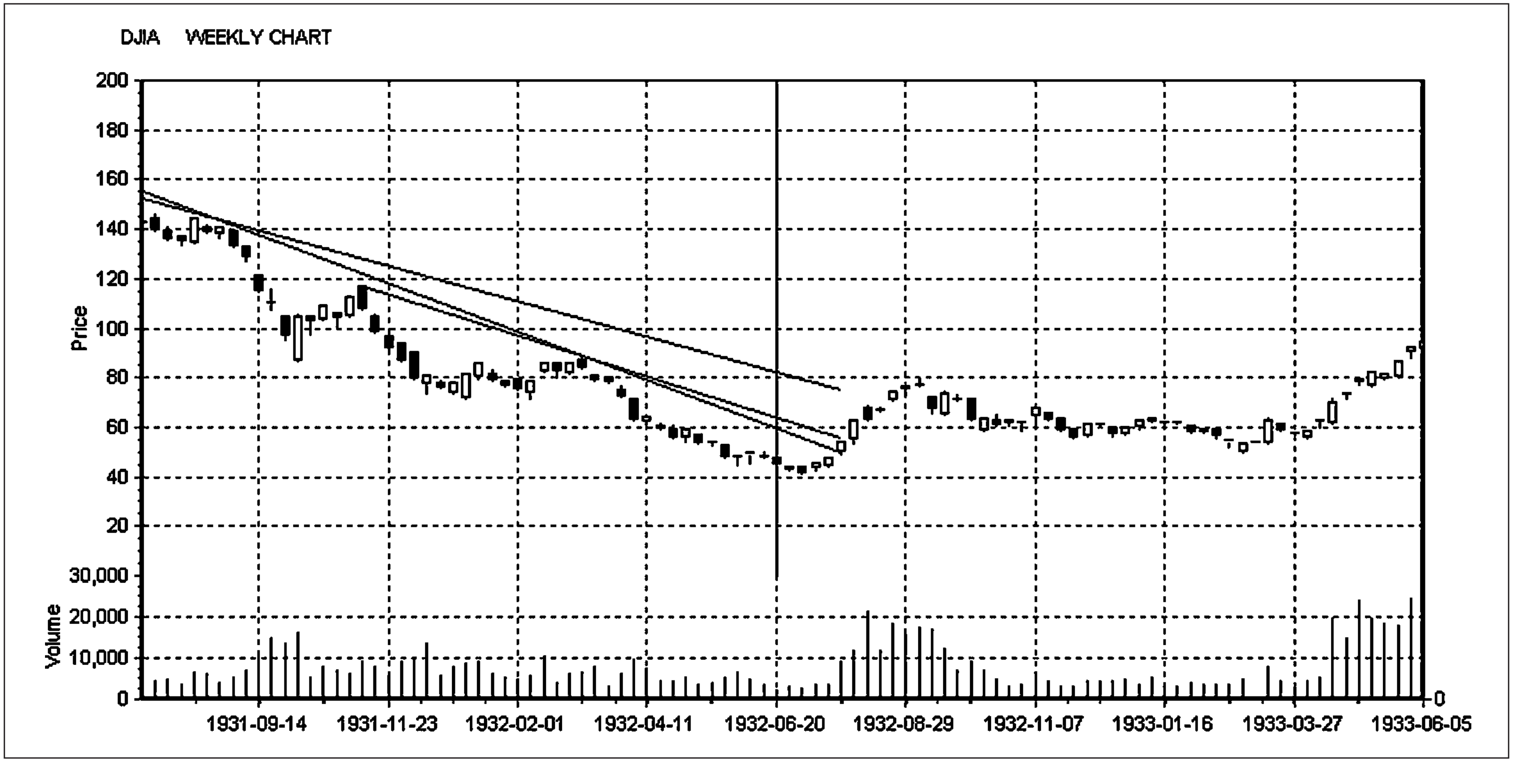


FIGURE 9.8

At the end of the 1930s bear market, there were a number of near-parallel trendlines, at least one of which was long term, with three touches, correlating well with prices that had been falling steadily. It was around nine months before prices started to move up again. In this case the trendline breaks signified the end of the downtrend and a bottom region, rather than the immediate start of a significant uptrend.

FIGURE 9.9

The start of the wartime bull market was indicated in the Dow by the breaking of the (longer) five-touch trendline shown on the chart. It is rare that such good examples of trendlines can be found, but when they are, their penetrations are all the more significant.

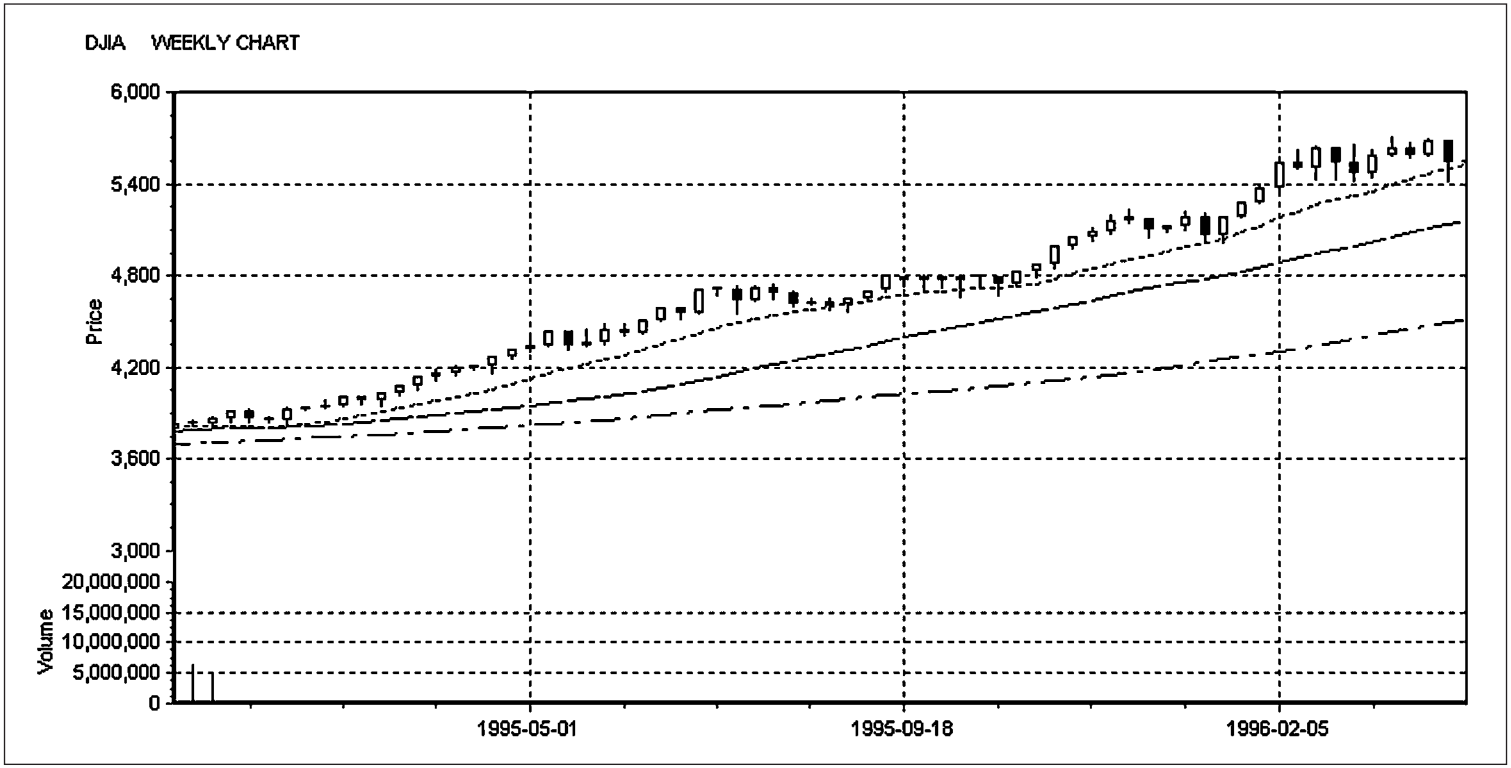


FIGURE 9.10

Three moving averages are shown for periods of 13, 34, and 89 weeks. In this strong bull trend, the 13-week moving average offers an effective support line for weekly lows, and the 34-week moving average below it offers a second line of support. When a moving average no longer offers support, it is an indication that the character of the market is changing.

an example, the ratio of the two sequential Fibonacci numbers 89/144 is 0.61806 and 144/89 is 1.61798. A well-established search technique in mathematics is to increase or decrease numbers by Fibonacci ratios. This technique has been adapted to see which moving averages are most helpful in describing price behavior through the visual examination of chart displays containing multiple moving averages whose lengths correspond to numbers in the Fibonacci series.

In the earlier discussion on support and resistance, levels were defined where hurdles to price moves were likely to be found. When prices are moving steadily upward or downward, there will be a gradual drift away from any recent support or resistance levels, and it may be the case that prices are moving into new territory where no previous levels exist. This was the case in the Dow in 1995. There was a steady bull market with occasional dips. Its chart is shown in Figure 9.10. In this case a good support line is offered by a 13-week moving average, with a secondary support line offered by a longer-term 34-week moving average. The trend continued (Figure 9.11), and the support lines were both temporarily breached in the summer of 1996, but then they were reestablished, and the 34-week moving average continued to offer good support until at least August 1998. When using moving averages as (trend) support or resistance lines, the trend first needs to establish itself so that moving averages can settle down; at which stage those offering the best support or resistance can be identified. As mentioned previously, one way of doing this is to cover a chart with many moving averages to see which ones offer the best support or resistance. Usually a shorter-term moving average offers the best support or resistance in the early part of a trend, but as it continues, it is tested ever more rigorously, and a switch will usually need to be made to longer-term moving averages.

Figure 9.12 shows the conditions toward the end of a bear trend. The 13-week moving average could be used as a resistance line, which is penetrated weakly in November and December 1977 and decisively in April 1978. This brings us to another way of using moving averages. When there is a decisive price penetration of a relevant moving average, it can be a sign that a trend is over, and in this instance some would take a long position in the expectation that a bull trend would immediately follow a bear trend. That is a dangerous assumption that we will examine later. Two further issues need to be clarified. The first is that a "relevant" moving average depends on investment style, with shorter ones being used by shorter-term investment styles and longer ones by longer-term investment styles. From Figure 9.12, we see that an investor taking buy and/or sell signals from price penetrations of the 13-week moving average would have been in and out of the Dow for a loss around November and December 1977, but the investor could have exited near the end of its bear trend. On the other hand, an investor

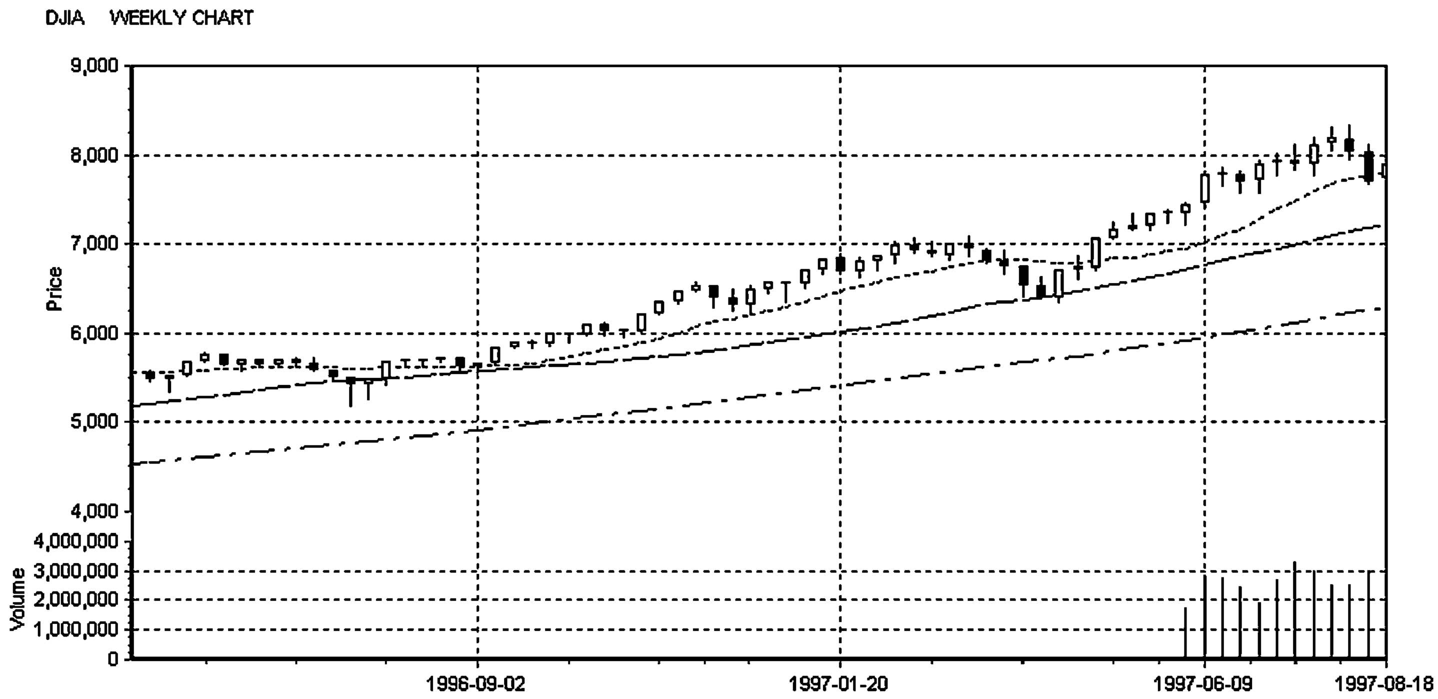


FIGURE 9.11

As the trend of Figure 9.10 continues, prices probe below both the 13- and 34-week moving average support lines, but the moves are transient, and the 34-week line begins to offer more reliable support for the larger price dips than the original 13-week line.

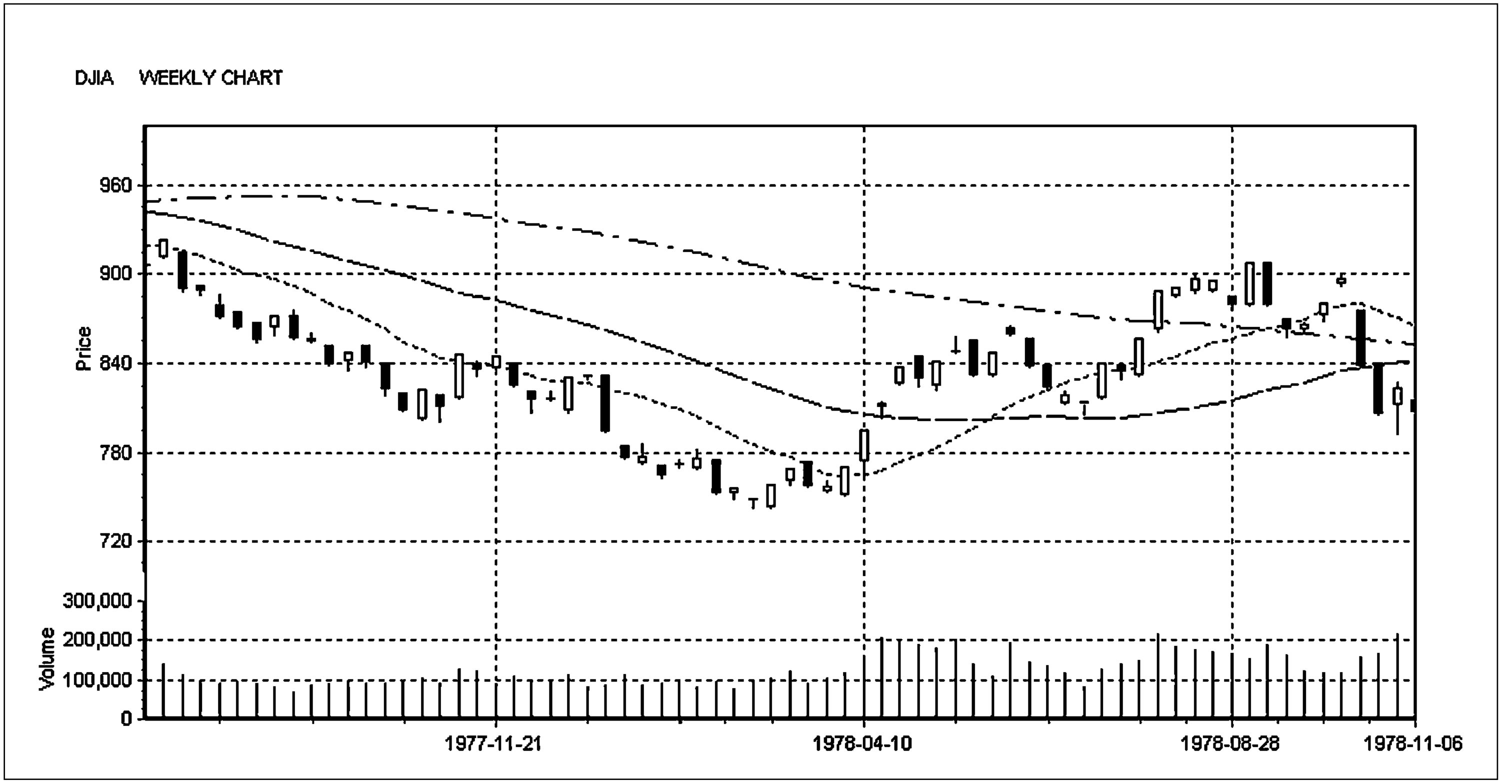


FIGURE 9.12

In this case the 13-week moving average offers reasonable resistance to price increases during the downtrend, but when prices move decisively above both it and the 34-week line (around 4 October 1978), the bear trend is clearly over. Note that at the end of the trend, the 13-week moving average moves above the 34, which would be used by some investors as a buy signal.

taking signals from price penetrations of the 34-week moving average would have avoided the November and December 1977 losses, but the investor would have exited a week or so later at the end of the trend. The second issue is that of a *decisive penetration* of a line. There are three commonly used criteria: a simple penetration of any amount, a penetration by a closing price; or a penetration by 3 percent of a line's value. Which of these (or some other) criteria is most appropriate depends on whatever works best. This is usually assessed by examining theoretical profits generated by strategies employing different penetration criteria applied to financial instruments of interest.

Yet another observation from Figure 9.12 is that at the end of a trend, short-term moving averages converge toward, and may cross over, long-term ones. These crossovers are sometimes used as buy or sell signals. In the comparatively rare case of a market such as the Dow in the early months of 1942 (shown in Figure 9.9), the bear and subsequent bull markets roughly form a V bottom. For V bottoms, and inverted-V tops, moving average crossovers can give good buy and sell signals, but unfortunately at the time the signals are given and need to be acted upon, nobody knows if such tops or bottoms will be of the V type. A common situation at the end of a trend is for a market to be unsettled, moving sideways as if searching for another direction in which to head. In Figure 9.12, the Dow rallied back to 900 toward the end of the summer of 1978. The rally was choppy, and after signaling the end of the bear trend, the moving averages shown were of little subsequent help in providing support, resistance, or signals. Figure 9.13 shows the subsequent development of a sideways market, in which moving averages shown were of no use in providing support, resistance, or signals, but the concept of support and resistance levels, described earlier in this chapter, would have become useful once again. There is a warning from Figure 9.13—which is that to follow moving average crossover buy and sell signals in sideways markets will usually produce whipsaw trades that lose the investor a great deal of money.

PRICES IN A GEOMETRIC PROGRESSION

So far we have dwelt with conventional, arithmetic charts, which for the most part are satisfactory for companies whose share prices are following an *arithmetic progression*—that is, a series of numbers that tend to increase or decrease by roughly constant amounts on each bar. For these stocks, the curvature near a top in prices can be highlighted by the use of a logarithmic scale, which has the effect of displaying price changes relative to surrounding prices. One result of this is to decrease the visual

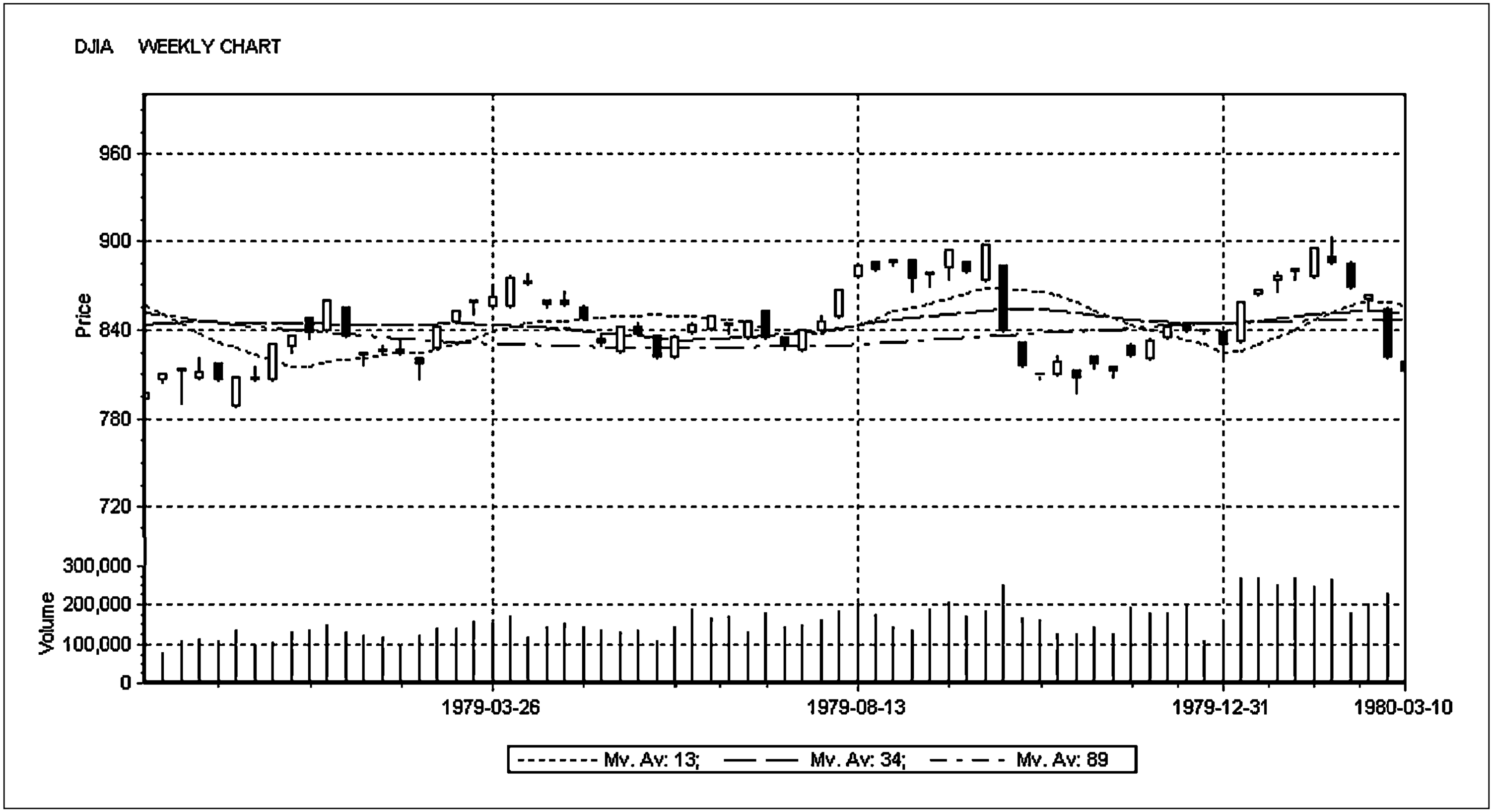


FIGURE 9.13

The brief price rally of Figure 9.11 developed into this sideways market. In these conditions, moving averages no longer offer support or resistance, and using crossover points as trading signals results in entries that are too late for the small price movements, leading to a large number of loss-making whipsaw trades. In contrast, conventional support and resistance lines tend to work well in these situations.

impact of price oscillations often associated with tops, which can make their detection easier. More importantly, logarithmic charts offer a way of visualizing stocks whose prices are following a *geometric progression*—that is, a series of prices that tend to increase or decrease by a (roughly) constant fraction of the previous price. A logarithmic plot has the effect of converting a geometric progression into a straight line, which is much easier to make sense of on a chart.

For stocks whose prices are varying as a series of geometric progressions, trendlines drawn on logarithmic charts can identify price breaks. Figure 9.14 shows a logarithmic plot of a top with a trendline break on 4 September 2000. The trendline disappears off to the left of the chart, but it is of the three-touch variety, which gives some confidence that the local heuristic it represents is applicable. In the case of trendlines drawn on logarithmic charts, the underlying assumption is that a loose geometric progression in prices has been in force until the trendline break. The mathematical equivalent of this is known as a *power law*. Figure 9.14 has an overall rounded appearance, unlike its arithmetic equivalent, Figure 9.15, which is distinctly more "peaky." The distinct upturn in prices to the left of the arithmetic chart (Figure 9.15) delays the long-term trendline break for almost two months. The point here is that if prices are behaving as a geometric progression, they need to be plotted on a logarithmic chart before trendlines can be used to make sense of them. Another situation of prices behaving as a geometric progression is shown in Figure 9.16. This was a stock that rose to dizzy heights in the dot-com boom of the late twentieth century but suffered in its aftermath. Prices probably fell below the stock's intrinsic value, and the logarithmic plot shows that a three-touch trendline could be drawn with touches at 6 November 2000, 12 January 2001, and 25 June 2001, broken by price in October 2001 to catch a price rally that tripled the share price. In contrast, the arithmetic plot of the same stock, Figure 9.17, offers no useful trendline analysis that could catch the rally, by virtue of the simple fact that prices are behaving as a geometric, and not arithmetic, progression.

Another application of logarithmic charts is that of examining very long-term price behavior. The chart of the Dow from 1897 to 2001 shown in Figure 2.2 would be incomprehensible if plotted on an arithmetic scale because all of the early price action when the Dow was around 100 would be a series of ripples close to the time axis and later, as the Dow approached 12,000, price bars would soar up the right-hand side of the chart. Plotting prices on a logarithmic scale, as was done in Figure 2.2, displays the detail of long-term price action that varies in a logarithmic fashion.

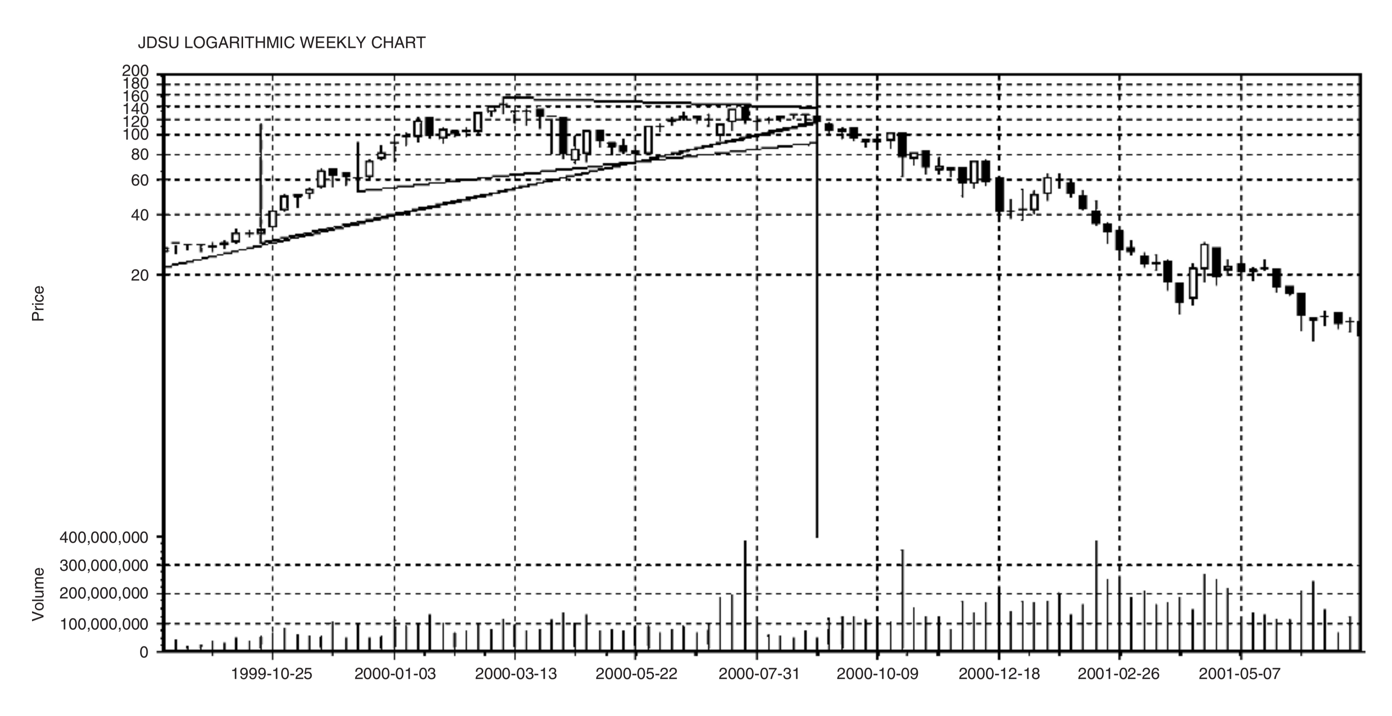


FIGURE 9.14

When prices are changing by a multiple of their previous values, logarithmic charts are valuable for trendlines. They also have the effect of highlighting the rounding of a top and reducing the visual distraction of oscillations in price often found at tops. Long-term trendlines on logarithmic charts are powerful tools. In this instance, a long-term three-touch trendline is broken on 4 September 2000, signaling a break to the downside. Compare this with the tardy break signaled by trendlines on an arithmetic chart of the same stock shown in Figure 9.15.

FIGURE 9.15

On a conventional display, these logarithmically varying prices break a long-term trendline in late November 2000, compared with the early September break shown on the logarithmic chart of Figure 9.14. Note also that candlesticks at high prices appear exaggerated and at low prices shrunk, making it difficult to assess prices over the full width of the chart.

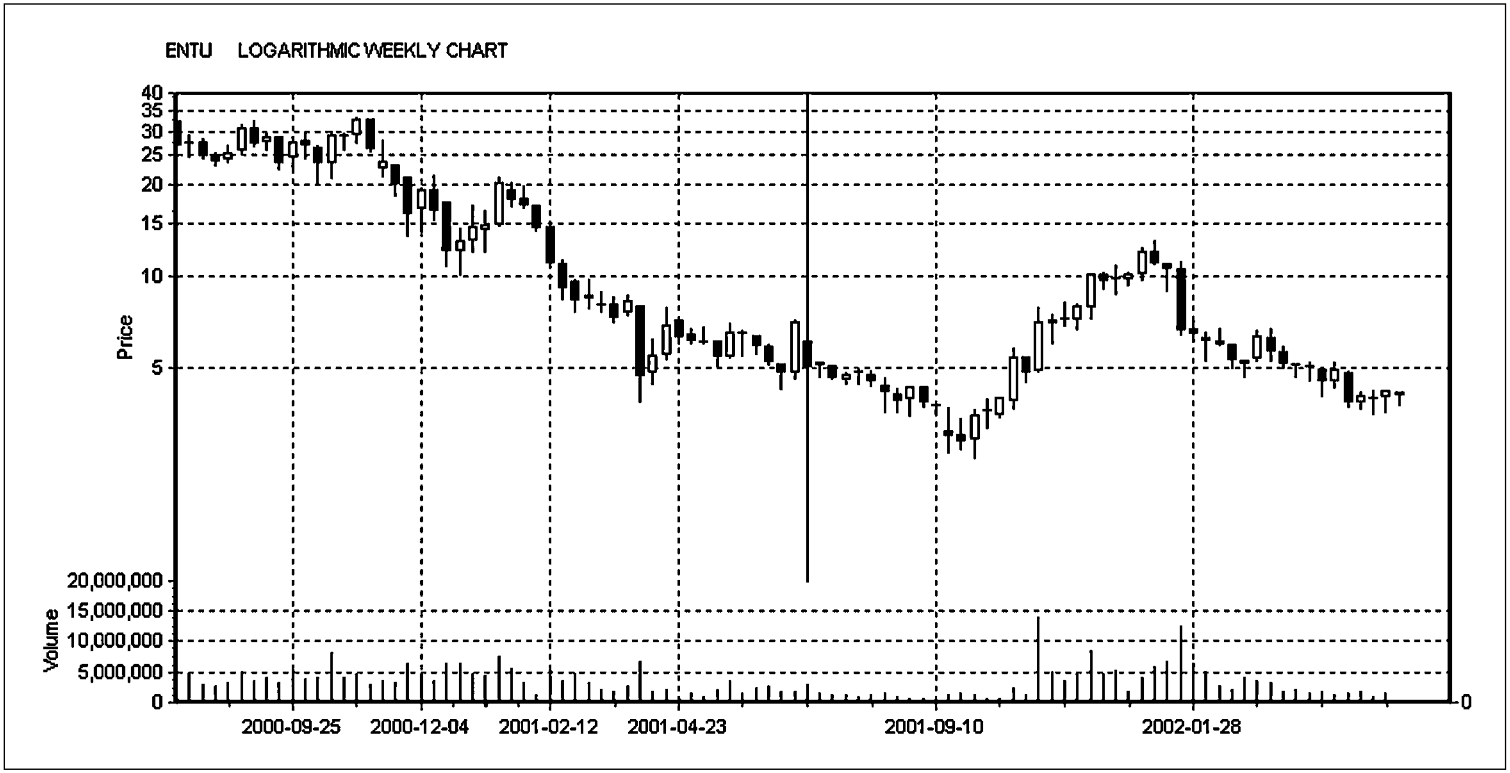


FIGURE 9.16

Stocks can suffer catastrophic price declines for a number of reasons, which may be unconnected with their long-term potential. In the case of this stock, the decay in price appears linear on a logarithmic chart, offering a potential for useful trendlines to be drawn on the chart to pick up the price rally in October 2001. Note that with this display, candlesticks are roughly the same size on both left- and right-hand sides of the chart. See Figure 9.17 for a comparative arithmetic chart.

FIGURE 9.17

An arithmetic plot of the logarithmically decaying prices shown in Figure 9.16 offers less scope for useful trendlines to be drawn. Candlesticks on the left are large, and those on the right small—making it difficult to interpret prices across the full width of the chart.

MARKET CLASSIFICATION

It has been stressed in this chapter that different techniques need to be used at different times. Where prices are oscillating around a mean, concepts of support and resistance levels are useful, and when prices are in a trend, a trendline or moving average support or resistance lines can help with decisions. If prices look as if they are forming a geometric progression, then a logarithmic chart needs to be viewed. It is important to know what kind of behavior prices are exhibiting so that the right techniques can be applied to analyze them. Common market categories have a tendency to behave in certain ways that create expectations of future behavior to assist with their exploitation. Consequently it is important to develop an ability to identify these categories, both to exploit them while they exist and to have an idea of what the next market category is likely to be—so that any exploitation strategy can be ended when one market category ends and another begun once a new market category is identified.

The main categories of markets that need to be discriminated are arithmetic or geometric bull or bear trends, or sideways. It is also important to be aware, when prices are in transition from one market category to another, what the possible categories are, and to try to build up experience of transition conditions so that opportunities can be identified early and mistakes avoided. Figures in this chapter have been selected to assist in that process by providing examples of the principal market categories. The general advice is to see which of the tools mentioned so far appears to be working the best and assume the market category is that in which that particular tool performs best. Over time, and having looked at many charts, market categorization will become second nature. Situations in which markets are in transition between one category and another, or where behaviors fail to conform to a common category, can mean that the tools do not work or that different tools appear to perform with similar (but perhaps poor) efficacies. In these cases the safest conclusion is that the market category cannot be identified either because prices are not fitting into a common category or because the common tools are not working sufficiently well to be sure what it is. An example of a category that may be difficult to identify with present tools would be a very choppy trend. In the event of categorization problems with charts of stocks, one way to discriminate is to look at charts of competing stocks to see if they can be definitively categorized. If charts for such stocks do have a common category, it creates a prior expectation that can help resolve the categorization of a stock of interest.

MOVING AVERAGE PATTERNS AND TRADING METHODS

Examination of Figure 9.10 shows that in an uptrend, short-term moving averages are above long term; in a downtrend (Figure 9.12), short-term moving averages are below long term; and in a sideways market (Figure 9.13), they can be just about anywhere relative to each other. One popular trading method involves taking signals from the point at which two moving averages cross over. If a short-term moving average rises above a long term, a long position is taken—and a short position if the short-term moving average falls below the long term. In the cases of markets having long, steady uptrends with inverted-V tops, followed by long, steady downtrends with V bottoms, such a rule should be profitable. (If anybody knows of such a market, please advise the author.)

While the rule is appealing in its simplicity, it ignores the reality that much of the time, markets transition from bull to bear (or vice versa) by going through an uncertain sideways period in which moving average crossover signals are damaging to wealth. Often, sideways periods can be found in the middle of trends, when markets are uncertain about whether to continue with their trends or reverse. In most sideways markets and choppy trends, moving average crossover signals come too late to be useful and produce sequences of loss-making whipsaw trades. Such a situation is illustrated in Figure 9.18. During a sideways period in the autumn of 1978, the 8-week moving average produces a buy signal, which results in a loss-making trade of around 40 points. In a choppy bull rally of the spring and summer of 1978, the 8-week moving average moves below the 13-week moving average on the bar of 10 July 1978, a short trade is taken on the bar of 17 July 1978 at around 830, on 31 July 1978 a signal is given to exit the trade, which is executed at 895 on 7 August 1978, taking a loss of 65 points. The worst possible situation to get into with moving average crossover signals is the long-term sideways market shown in Figure 9.13, in which almost all positions taken would lose.

Against these observations, the importance of market classification can now be better appreciated. Moving averages can provide a basis for decision making in relatively smooth trends, but in most other cases they tend to suck the investor into loss-making trades. If markets can be classified, then situations such as sideways markets or choppy trends can be identified and moving average crossover signals rejected whenever they arise in those markets on the basis of their being likely to produce whipsaw trades. The limitation of moving averages to produce useful signals in sideways markets is symptomatic of a much more general problem of poor performance with many technical signals in similar circumstances—which emphasizes the

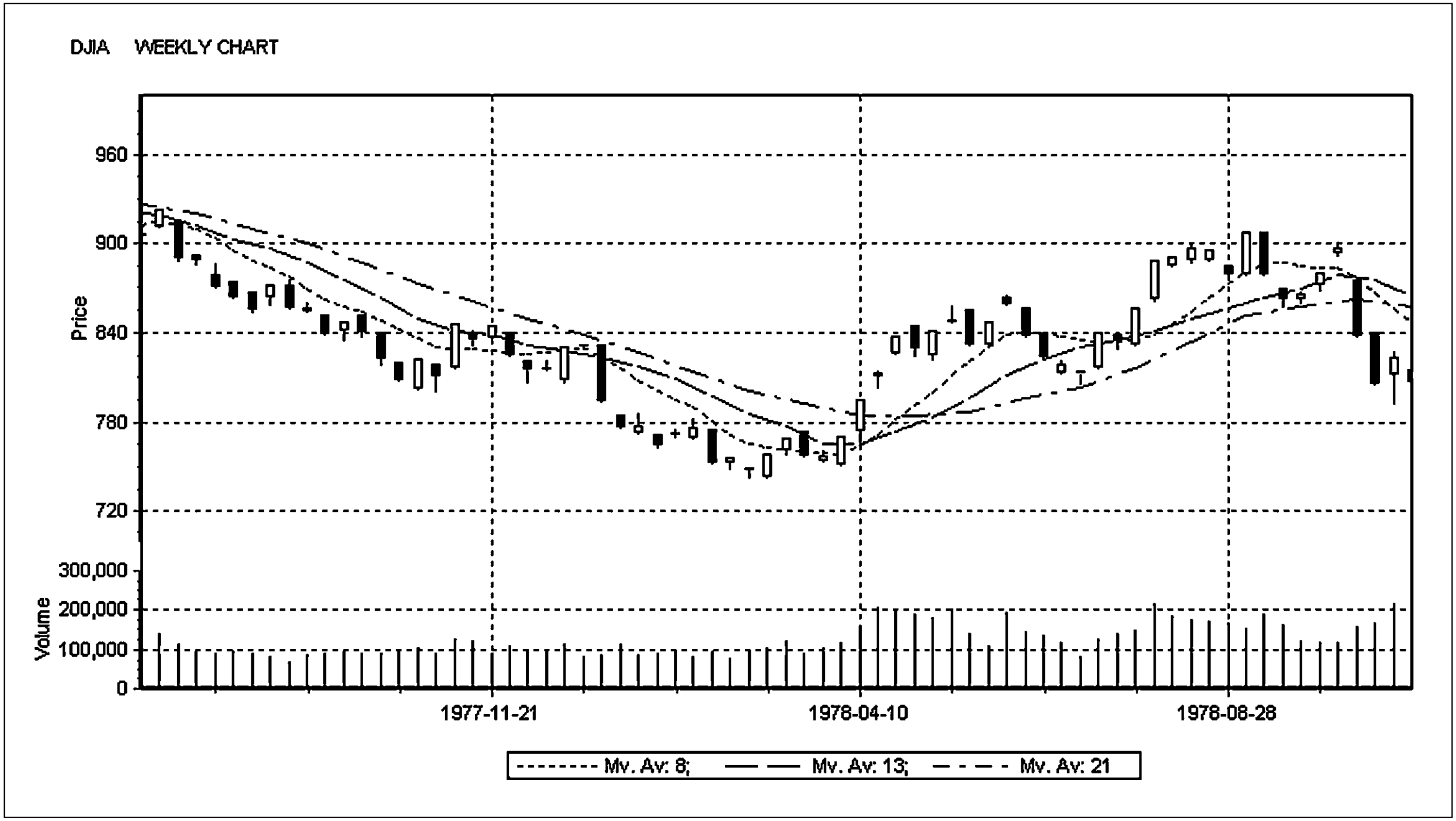


FIGURE 9.18

The dangers of blindly relying on moving average crossovers for entries and exits can be seen here. An 8/13 moving average crossover occurs on the bar beginning 12 December 1977, and a long position is taken on 17 December 1977 at around 825. On the bar beginning on 31 December 1977, another 8/13 crossover occurs, and the long position is exited on 7 January 1978 for a price of around 785—resulting in a 40-point loss. In contrast, a rule based on price penetration of the 21-day moving average would have worked well here.

need for market classification to filter out the bad signals. Finally, on the subject of sideways markets, although avoidance is a common strategy of dealing with them, another one is to revert to price bars of a shorter time period. Charts such as Figure 9.13 might present exploitable bull or bear markets when viewed with daily or half-hourly price bars, but the infrastructure associated with their exploitation would need to be changed if this route were to be followed.

SUMMARY

- There are some common categories of markets, and, over time, heuristics have evolved to assist in their analysis.
- Heuristics describing market behavior are local in character and break down when behavior changes.
- Support and resistance levels represent hurdles to price movements, but they are crossed when prices are entering a trend.
- The more times a support or resistance line is touched, the more confirmation there is of its strength as an obstacle to price movement.
- In sideways markets, support and resistance levels offer a useful way of defining the boundaries of likely price movements.
- Once crossed, a support level can become a resistance level, and a resistance level, a support level.
- A trendline defines a boundary of attempts to break a trend.
- The more times a trendline is touched, the greater the significance to be attached to its eventual breach.
- A breach of a trendline signifies the end of a trend but not necessarily the start of an opposite trend.
- When prices tend to increase by roughly constant amounts, trendlines are best drawn on arithmetic charts.
- When prices tend to increase by roughly constant fractions of their previous price, trendlines are best drawn on geometric charts.
- In an established uptrend, short-term moving averages are above long term.
- In an established downtrend, short-term moving averages are below long term.
- In sideways markets, or markets in transition from one category to another, short- and long-term moving averages may be anywhere relative to each other.

- If a chart is covered with multiple moving averages of different lengths, then in a trend, it is often possible to identify one that offers a useful support or resistance line.
- Fibonacci numbers offer a range of useful initial lengths for moving averages that can be refined later in the light of observations.
- Markets need to be classified into categories to know how best to generate and interpret signals for their exploitation.
- One way of classifying markets is to look at them with the various tools described in this chapter, to see which one of them works best, and then use the tool's characteristic best market as the basis for a classification.
- Over time, market classification will become second nature just by looking at a chart.
- Moving average crossover signals work well with long straight trends with V bottoms and inverted-V tops, but they are damaging to wealth in sideways markets.
- In general, technical signals are problematic in sideways markets, which is one reason why markets need to be preclassified before a signal is accepted.
- Many successful investments can be made with no more than knowledge of the techniques of this chapter.

CHAPTER 10

Indicators: Technical Analysis with Formulas

The last chapter gave an introduction to methods that many technical analysts use to make their judgments. There is a belief, often wrong, that throwing more mathematics and formulas at a problem will produce a better solution. If that were the case, markets could be expected to be full of millionaire mathematicians. I originally thought that with the notable exception of John Pierpoint Morgan (whose exceptional mathematical abilities led his German professors to exhort him to take up math as a career—see E. T. Bell), few famous investors would lay claim to having great mathematical abilities. I have since been enlightened by my knowledgeable friend Joaquin Castillo, who pointed out that other mathematicians have done exceedingly well, including John Von Neumann as well as Ph.D. "rocket scientists galore"—many of whom are wealthy hedge fund managers. Mathematics may not be guaranteed to deliver a profit, but it does seem to help, and with the advent of software and the Internet, results are becoming ever more accessible to an investment community that may not be mathematically inclined. In this regard, many of the indicators described in this chapter are available for contemporaneous data on financial Web sites, and all are available via the software on the CD ROM that accompanies this book.

Indicators and oscillators are useful mathematical results that help with trading decisions. The distinction between them is fuzzy, but for the purposes of this book: Any useful results that naturally belong on the price scale will be called *indicators*, and the subset of indicators that do not naturally belong on the price scale, and whose fluctuations are the key to the signals they provide, will be called *oscillators*. Generically, therefore the two of them together will be called *indicators*—in an analogous sense to *mankind* and *womankind* being referred to as *man*.

For reference, useful and readable accounts of most indicators and their backgrounds can be found in both Perry Kaufman's and John Murphy's books listed in the bibliography.

Common indicators were developed for hand calculation methods for traders with limited mathematical abilities. Through software, it is possible for traders to apply indicators (whose details they may not understand) to their own data, and through the Internet, it is possible to obtain a service that filters useful results from complex indicators applied to every financial instrument for which data are available, on just about any time scale. In brief, at present, people may wish to retain indicators that are within their own skill sets, but in the future, it is likely to be in many people's interests to accept their limitations and acquire results that are better than they could produce themselves. Some of the original indicators will survive by virtue of their intrinsic merit, but others will be replaced as better alternatives appear. At the time of this writing, the transitional process that indicators are involved in is not widely appreciated. It is inhibited by a conflict that magazine editors face between explaining useful but complex ideas that will pass over the heads of most of their readership, and retaining the interest of that readership to sustain circulation. The net result is that through present media, simple and useful indicators are capable of being popularized, but complex and useful indicators are not.

Capabilities of indicators are sometimes overstated by enthusiastic inventors wanting to promote their creations. The unfortunate truth is that almost all indicators have a number of limitations that are often not appreciated. Among these are the following:

- Implicitly or explicitly, indicators are usually associated with a fixed-length scale, which means that events taking place over different-length scales may be missed. One way of addressing this difficulty is to see if a common inference can be drawn from multiple indicators with different-length scales.
- Apart from exchange-specific indicators such as a ratio of advances to declines, they are limited to information about a single financial instrument and ignore additional information from other financial instruments that could have specific predictive value.
- Indicators often try to do too much (an example was given in Chapter 9 of the limitations of moving average crossover signals).
- Indicators tend to treat prices as a noise-polluted signal that they are trying to detect, and in the course of doing so, they disregard important concepts such as historic prices or support and resistance levels.

- Indicators often receive more credibility than they deserve because they offer quantitative, rather than qualitative, results.
- Conventional indicators are reactive (not predictive) and typically rely on a price move to start before giving a suboptimal entry signal, and a price move to reverse before giving a suboptimal exit signal.
- The extent of any profit or loss associated with suboptimal entries and exits results from a dilemma between a need to enter quickly, to take advantage of a price movement, and a need to wait to confirm that a substantial price movement has started so that losses from whipsaw trades are avoided. For want of a better description, this will be called the *whipsaw dilemma*.
- The nature of the whipsaw dilemma varies in different financial instruments, making it difficult for a universal indicator to be devised to trade all of them.
- Conventional indicators all suffer from the whipsaw dilemma to some degree, which makes it impossible to devise a trading system based on them to buy at bottoms and sell at tops.
- The caution expressed in Chapter 9 of expecting heuristics to break down is applicable to indicators. Sometimes they work well, and at other times they need to be ignored.
- There is an unresolved problem of knowing when to believe in which indicators and when to ignore them.

It is all too easy to overlook the simple techniques of Chapter 9 in favor of the seemingly more advanced techniques that follow, but the techniques of Chapter 9 offer a useful reality check on other results—that should be viewed with caution when they are inconsistent.

ON THE AVERAGE

There are two main types of average used in technical analysis. The *straight average* simply involves adding up a group of numbers and dividing their sum by the number in the group. Price moving averages are an example of this, where the group of closing prices on which they are based is called a *window of values*, which is progressively moved through the time series, with, at each step, its values being summed and divided by the number in the window. Formally, if the window size is denoted by w and the ith closing price in the window by p_i, then

$$\text{Moving average} = \frac{\sum_{i=1}^{w} p_i}{w} \tag{10.1}$$

When a major price blip enters the window of moving average values, the moving average responds, and this is known as *drop-in noise*. In general, it helps moving average–based systems and does not cause problems. Later on, when that same price blip leaves the window of moving average values, the moving average will respond to the same extent. This is called *drop-off noise*, which tends to be a problem because conditions at the front of the window of values will probably have stabilized when the price blip's exit suddenly causes the moving average's value to move. That said, moving averages are often preferred to an alternative that has only drop-in noise, known as an *exponential moving average*.

Before explaining exponential moving averages, we begin with an empirical formula for something called a *smoothing constant* α, which is

$$\alpha = \frac{2}{w + 1} \tag{10.2}$$

Exponential moving averages can begin with any number, but in the interests of getting them to stabilize quickly, they are (typically) started with a conventional moving average. At some time t, the exponential moving average μ_t from closing price p_t relates to its previous value through the formula

$$\mu_t = (1 - \alpha)\, \mu_{t-1} + \alpha\, p_t \tag{10.3}$$

To explain this, the formula in (10.2) has been devised to make an exponential price moving average μ_t look similar to a conventional moving average of length w. Equation 10.3 has the major advantage of requiring knowledge of only present closing price p_t, smoothing constant α, and previous exponential moving average value μ_{t-1} to make it work.

LEAST-SQUARES REGRESSIONS

At some point in a high school science lesson, most people will have acquired some experimental data, plotted it on a graph, and been asked to draw the best straight line they could through it. It is possible to do the same with a window of closing prices from a price chart, and it is also possible to define such a straight line automatically by minimizing the sum of the square of the distances between it and those closing prices. Finding such a "best" line through the data points goes by the forbidding name of a *least-squares regression*. How the inappropriate name of "regression" came to describe this process is a story in itself and can be found in Peter Bernstein's book listed in the bibliography. For the mathematically inclined, Appendix 10.3 describes a form of least-squares regression that will be best appreciated after reading the section in this chapter on regularization.

PARABOLIC TIME/PRICE SYSTEM

In the literature on indicators, the name of J. Welles Wilder, Jr., features prominently, and a book of his containing many useful indicators is listed in the bibliography. One of the topics it mentions is a *stop-and-reverse* (SAR) *trading system* based on an indicator that is now known as the *parabolic*.

This indicator is a magnificent exception to many of the reservations expressed in the introduction. Among its distinguishing features are the following: (1) It is heavily influenced by historical highs and lows, (2) it is not based on a fixed length, and (3) although introduced for the purposes of stop-and-reverse trading, it has found other applications, so in this sense, far from trying to do too much, its original introduction understated its potential.

The idea of the parabolic SAR is to try to find lines below uptrends and above downtrends that, when cut by price, signify a change of market direction. On such a cut, the trading position is reversed, and a new parabolic indicator is started from the bar after the one that was cut but based on the extreme high or low price (as appropriate) encountered during the span of the previous parabolic. As with most technical indicators, in sideways markets the strategy usually results in sequential whipsaw trades, and the trading account suffers death by a thousand cuts. If sideways markets can be separately identified, the investor or trader can withdraw and wait for them to end before reentering the market with this system.

My implementation of the parabolic begins with a search for a five-bar pivot at the start of a file, which can be high or low, with the type found determining the initial direction of the parabolic. Once found, the parabolic is progressively updated with a formula that has some similarities with an exponential moving average. The idea is to start with a *smoothing constant* that is small, to give the trade a chance to "breathe" and then increase the smoothing constant as the trend develops so as to track it and be close to it when it reverses. In the case of the parabolic, the smoothing constant is called an *acceleration factor* (AF), which is increased by a *factor* (DAF) on each bar, up to a predetermined maximum. Usually, the AF starts with a value of 0.02 and increases with each new price bar by a DAF of 0.02 up to a maximum value of 0.2. Figures in this book are based on these values.

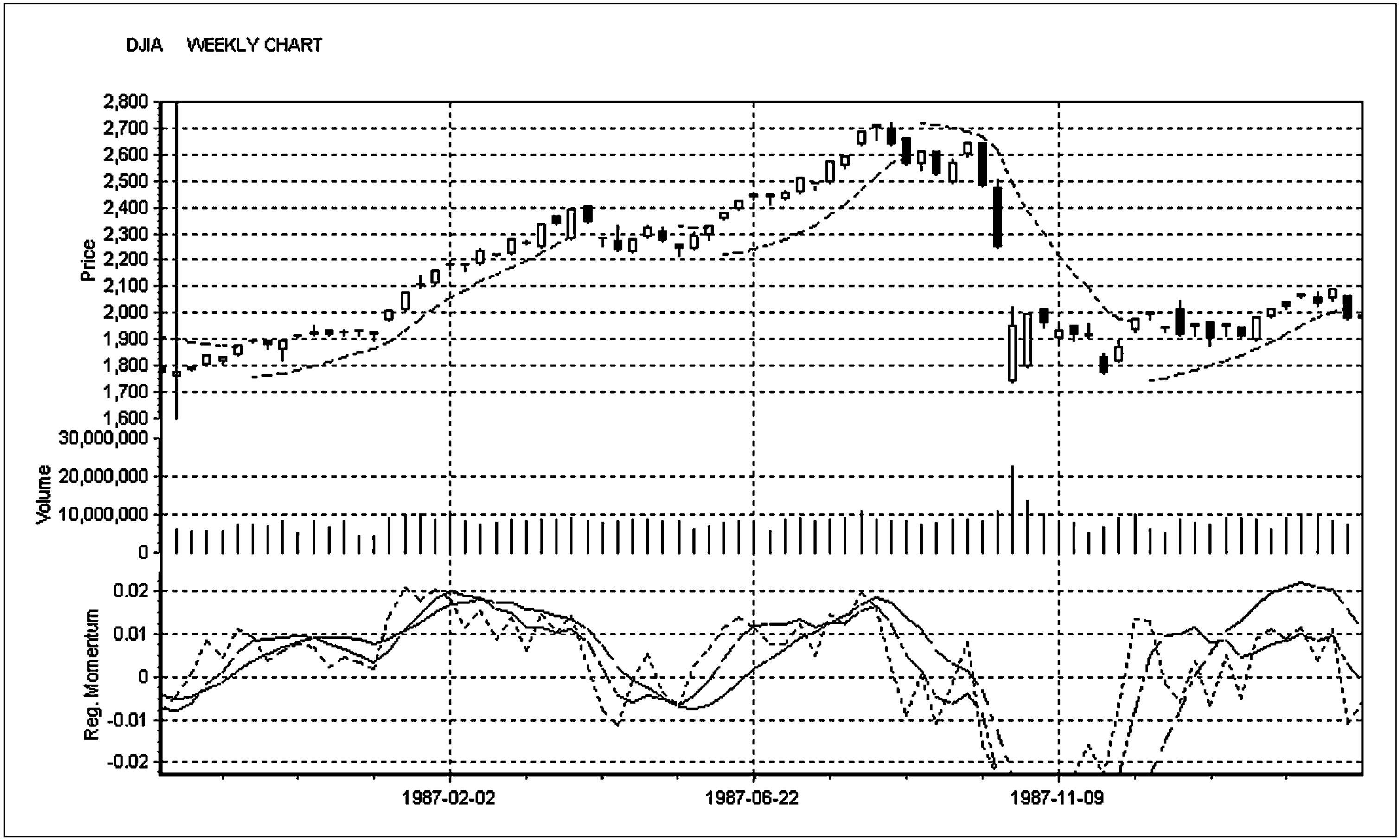
If P is used to denote a parabolic indicator, then for an uptrend at bar t,

$$P_t = P_{t-1} + AF \times (High_t - P_{t-1}) \quad (10.4)$$

and for a downtrend

$$P_t = P_{t-1} + AF \times (Low_t - P_{t-1}) \quad (10.5)$$

Parabolic indicators are shown by dashed lines plotted against the price scale in Figure 10.1. This is a weekly chart of the Dow through the crash



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Parabolic and regularized momentum indicators for the Dow through the crash of 1987. Momentum is based on a 5-week exponential moving average, and regularizations of 0, 2, and 5 can be distinguished by the smoothness of the lines.

of 1987. As indicated previously, outside of sideways markets, this can be an effective trading system—and it is also an indicator we will meet in other contexts in later chapters. The parabolic is an indicator I believe to be right and one that I am not tempted to "fix." That is not necessarily the same for others, and a generic fix will be described.

REGULARIZATION

The parabolic trading system is based on the idea that price penetration signifies a reversal. In Chapter 9 moving average trading systems based on price penetrations were also mentioned. Similarly, moving average support or resistance lines in trends were mentioned. Such systems depend on the *position* of an indicator relative to price for their effectiveness, and, in general, most indicators are used in a *positional* sense either relative to price or relative to each other. As a newcomer to the markets, I wondered why this was, because it seemed to me that the fundamental question was whether prices were going up, going down, or staying much the same. My mentors quickly (and at the time rightly) advised me that the slope of price relative to time was not easy to determine from indicators as they "wiggled" too much. *Wiggle* can be reduced with longer averages; but that results in the turning points of indicators lagging behind those of price, causing delayed entries—a phenomenon known as *lag*. This dilemma of having to accept either wiggle-corrupted or lag-affected slopes remains—and it is a generic problem with all indicators based on previous values. To change the terminology slightly, the rate of change of something with respect to something else is called a *gradient*, and in this case, the *price gradient* is the rate of change of price with respect to time. Consequently, if the central question of price direction was to be addressed by the use of indicator *gradients*, rather than *positions*, then something needed to happen to reduce the impact of the wiggle-lag dilemma. The "something" in question is a term to penalize curvature. This reduces wiggle without generating the lag that increasing the length of an average would produce for an equivalent reduction in wiggle. This process is known as *regularization*. The subject has its own literature, which is primarily in the field of data modeling, and seems little known in technical analysis. Appendices 10.1, 10.2, and 10.3 describe my efforts to redress this situation and show how regularization can be used with exponential and conventional moving averages, and least-squares regressions applied to time series.

Regularization involves a constant term λ, which determines how much curvature is to be penalized by. Typically, values of λ are found experimentally, starting with values of less than unity and not usually going above 10. If values of λ become too large, then the regularized indicators become unstable. Experience to date indicates that, starting with small values of λ, looking at the resulting indicator and increasing λ until an appropriate balance is found between wiggle and lag, seems to work. I wrote an article on this subject that was published in *Technical Analysis of Stocks and Commodities* (July 2003), and after doing so, was (rightly) picked up on this point by a well-known contributor, John Ehlers. For regularized exponential moving averages, John determined that if $\lambda = \exp(0.16/\alpha)$, behavior would be similar to that of a conventional low-band pass filter, known as a two-pole Butterworth filter. As λ is increased beyond this value, initially there is some low-frequency amplification (which may help trading) but instability will eventually appear.

MOMENTUM

There are two broad categories of momentum indicators: one expresses the behavior of a group of stocks (such as the proportion whose prices are above their 50-day moving averages) and another, which we concern ourselves with here, based on the price of an individual stock. If position logic is to be used in a generic sense, then somehow oscillators have to be made independent of the price scales of individual stocks. With oscillators, a generic solution comes through a process of nondimensionalization, where numerators and denominators of their formulas are arranged to have the same dimension(s), so that the result of the quotient is dimensionless. Price momentum is an example of this, and there are numerous indicators based on the analysis of price bars to determine the direction of price movement. The term *momentum* is therefore generic and not specific to the particular variety about to be described. The variety offered here is based on closing prices and at time step t uses as its raw input a variable dP_t defined as

$$dP_t = \frac{\text{Close price}|_t - \text{Close price}|_{t-1}}{\text{Close price}|_t}$$

$$= 1 - \frac{\text{Close price}|_{t-1}}{\text{Close price}|_t} \qquad (10.6)$$

The quantity described by (10.6) is a fractional change in price, from the last bar to the present, expressed relative to the present price. The problem with this raw input dP_t is that it wiggles too much, and so an average of a group of such values is needed to make useful inferences. The previous discussion on wiggle and lag is relevant to this issue, and a regularized exponential moving average of these values is created using (A10.2.4) as

$$f_t = \frac{f_{t-1}(1+2\lambda) + \alpha(dP_t - f_{t-1}) - \lambda f_{t-2}}{1+\lambda} \quad (10.7)$$

where α is found from (10.2) and the regularized exponential moving average started using conventional moving averages—that is, f_1 and f_2 are found as conventional moving averages.

In Figure 10.1, values of f_t given by (10.7) are plotted on the lower scale, for a value of α consistent with a five-bar average and regularizations λ's of zero, 2, and 5. Without regularization $\lambda = 0$, the wiggle is too large to get much sense of long-term price direction. Ease of inferring long-term price direction improves as regularization is applied, but signals come later. Turning points of the most regularized momentum oscillator are fairly consistent with signals given by the parabolic indicator, also plotted on Figure 10.1. One particular point of interest occurs around April 1987, where the parabolic becomes confused in a sideways market, but its signals are not confirmed by corresponding turning points in regularized momentum. This provides an example of the message of this book, which is to look at market situations from multiple perspectives and to seek as many confirmations as possible before making decisions.

There are different ways of using momentum. Strictly speaking, when a momentum oscillator is above zero, average prices are going up, and when below zero, down. This means that at least one (short-period and unregularized) oscillator should be above zero before a long position is taken and below zero before a short position is taken. It is intrinsically dangerous (but often done) to use momentum turning points alone as entry or exit signals. The reason why this is dangerous is that momentum indicates the rate of price change, meaning that if prices move quickly, and then continue to move in the same direction but at a slower rate, there will be a momentum turning point. Using such a turning point as an entry signal would simply enter a position against the direction of current price movement. Such a strategy is sometimes advocated on the grounds that momentum extremes flag conditions that are either "overbought" or "oversold"—but it is risky to take a position unless prices have reversed.

Momentum Summary

- Find some combination of length and regularization that makes sense of price direction.

- Make sure that a (short period and unregularized) momentum indicator has a positive value prior to entering a long trade, or negative value prior to entering a short trade.
- Correlate regularized momentum with other systems, such as the parabolic, and develop heuristics for using systems in combination in different market conditions.
- Be aware that if momentum oscillator turning points are used as overbought or oversold indicators, a position may be taken that is against the trend in price.
- There are whole books written on momentum and numerous variants of the momentum oscillator, but the basics are here, and at the time of this writing, other literature does not cover regularization, which is useful for momentum.

MOVING AVERAGE CONVERGENCE DIVERGENCE (MACD)

An indirect momentum system, known as the *moving average convergence divergence* (MACD), was devised by Gerald Appel and is widely used. Precise details of the original system have been much modified to suit different markets, but a general theme is retained. This is to define two exponential moving averages of different lengths and then develop an oscillator based on the difference between them. This difference is plotted, along with an exponential moving average with a length (typically) of 9. The result is two lines, one slow and the other fast. A standard signal is generated when the fast line crosses the slow. In the 1987 crash (shown in Figure 10.2), 8- and 13-period exponential moving averages of prices for the Dow are used to generate a *nondimensional difference line* (equal to their difference divided by the longer exponential moving average), which produces a good sell signal a few bars before the crash. Nondimensional lines are useful in sideways markets as crossovers occur at relatively smaller (nondimensional) values than in genuinely trending markets. This allows scope for rules based on minimum absolute values at crossovers, thus avoiding trading in troublesome markets. A readily available description of the conventional MACD system, together with some additional rules, can be found in John Murphy's book that is listed in the bibliography.

The system appeals to many because of its simplicity and intelligibility, but the differences between the exponential price moving averages on which it is based sometimes get it into trouble. When there is a long straight trend, the long exponential moving average tends to catch up with the short, resulting in minimal difference between the two. If the steady trend subsequently fluctuates slightly, a countertrend signal is generated because

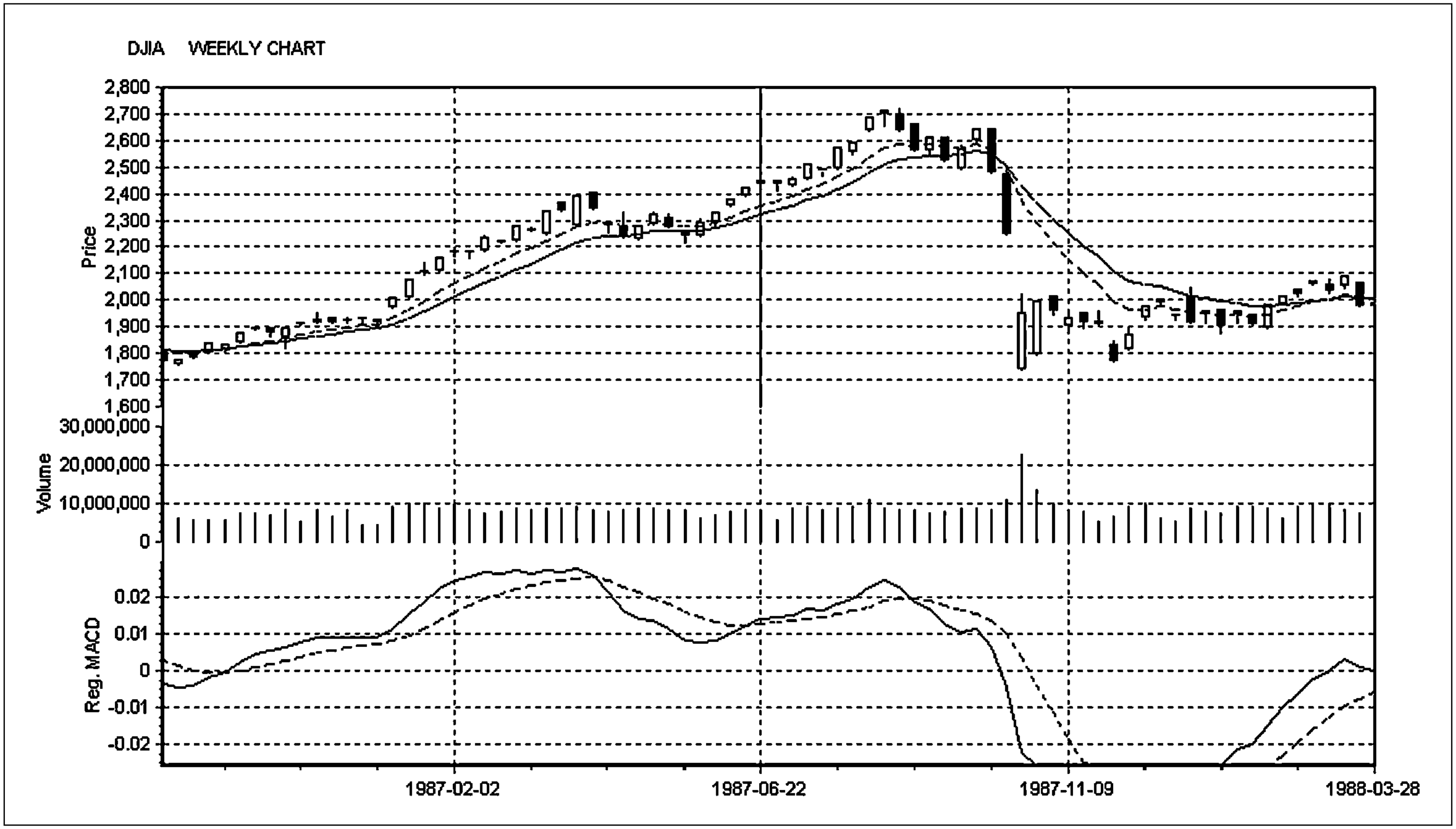


FIGURE 10.2

On the lower axis, normalized differences between unregularized 8- and 13-week moving averages are shown as a solid line, and their nine-bar exponential moving average as a dotted line. Signals are given when the solid line crosses the dotted. In strong trends like this one, the system works well, and the crash of 1987 is flagged well in advance.

the difference prior to the fluctuation was small. The general point is that the system is more susceptible than most to the influence of historical price events because of their lingering impacts on its exponential moving averages, which feed through to affect their differences and resulting MACD signals. The system can generate false signals in a number of situations, particularly in wavy trends. My advice therefore is to ensure that confirmation for a MACD signal is sought from techniques such as a prior parabolic SAR signal (in the same sense as the MACD signal) or the substantial penetration of a moving average that has recently provided good support or resistance.

MACD Summary

- MACD relies on the difference between two exponential moving averages of price to generate a fast line and an exponential moving average of that fast line to produce a slow one. To preserve positional integrity for calculation of their difference, the two exponential moving averages of price should *not* be regularized.
- Buy and sell signals are produced by crossovers between fast and slow lines.
- Calculating lines in a nondimensional way produces crossovers at relatively smaller values in sideways' markets and offers scope for additional rules to avoid trading in those markets.
- Crossovers of the two exponential moving averages can also be used to generate buy or sell signals.
- Experiment to see what lengths (and possibly minimum absolute values for crossover thresholds) make most sense, paying particular attention to behavior in sideways markets.
- Seek confirmation of price direction from a technique based directly on price—such as the parabolic SAR, particularly in wavy trends.

STOCHASTICS

In mainstream math, *stochastic* means something associated with a random variable whose properties are described by a probability distribution. In technical analysis, *stochastic* is the name given to an indicator that is based on its value relative to a range of values defined by some prescribed number of previous price bars. These indicators are used primarily when prices are in a trading range, rather than a trend. There are two names generally associated with the variants of this idea, George Lane and Larry Williams, with an obvious difference being a reversal of scale and a less obvious difference being the modifications used to introduce momentum into the stochastic.

To proceed with the basic idea: At some price bar t, we seek the maximum price H_{nt} and minimum price L_{nt} associated with the n price bars that precede and include the price bar at time t with a closing price of C_t.

At time t we define

$$\%K_t = \frac{100(C_t - L_{nt})}{H_{nt} - L_{nt}} \tag{10.8}$$

and

$$\%D_t \text{ as } \frac{\Sigma_{j=1}^{m} \%K_{t-m+j}}{m} \tag{10.9}$$

Finally, $\%D_t$-slow is a moving average (usually of length 3) of $\%D_t$.

To put some figures to this, usually n is 5 and m is 3. This means that we look back four bars, include bar t, establish a price range ($H_{nt} - L_{nt}$) from these five bars, and compute $\%K_t$ according to (10.8) and $\%D_t$ according to (10.9). We repeat this process for two further price bars to find the average, which is $\%D_t$-slow. Contemporaneous values of $\%D_t$ and $\%D_t$-slow are then used to detect overbought and oversold conditions, as well as crossovers. Different authors advocate different thresholds to define overbought and oversold conditions, but these are generally below 25 percent for oversold and above 75 percent for overbought. Perry Kaufman lists a number of ways George Lane suggested stochastics could be used to trade, with divergences (prices moving one way and the stochastic another) emphasized (see bibliography). A point that needs to be appreciated is that in developing $\%D_t$-slow as a simple average of $\%D_t$, any substantial turning point in $\%D_t$ will always produce a crossover. If there are wiggles in $\%D_t$, then there may be more complex crossovers from which alternative trading rules may be devised—the value of which depend on how much inference can reasonably be extracted from those wiggles. A common way of using stochastics is to take a position as prices are emerging from overbought or oversold regions, $\%D_t$ having crossed over $\%D_t$-slow and both stochastics heading in the same direction. Figure 10.3 shows how well the stochastic works around the crash of 1987.

Stochastics Summary

- Overbought and oversold conditions are indicated when the stochastic is in the upper or lower 25 percent of its range.
- When prices are emerging from these regions, and $\%D_t$ has crossed over $\%D_t$-slow, and both stochastics are heading in the same direction, a buy or sell signal is given.

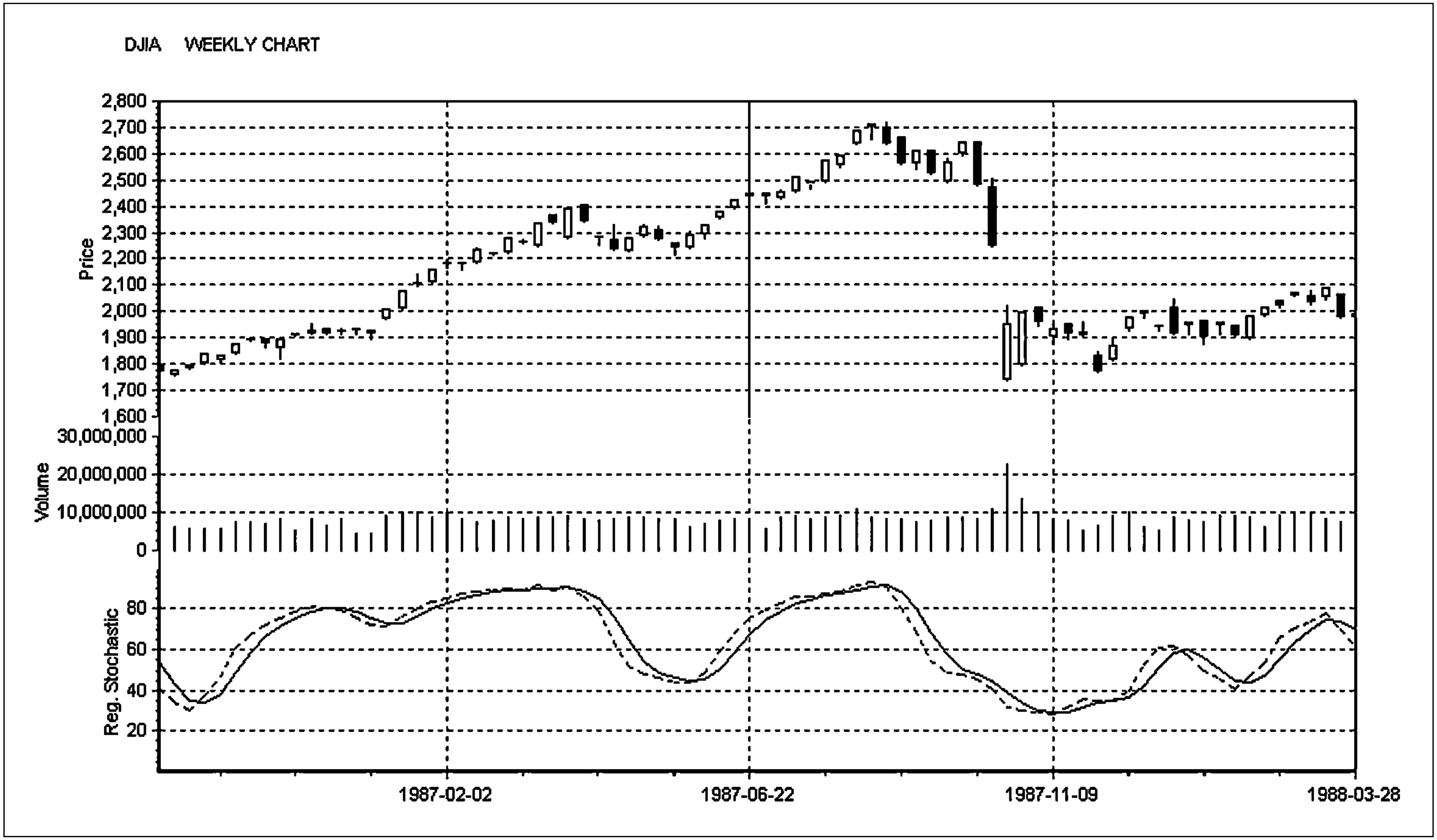


FIGURE 10.3

This is a standard 5-3-3 stochastic consisting of a %D line (dotted) and its three-bar average %D-slow (solid line). Signals are a little complex, but basically, oversold and overbought conditions occur when lines are in the lower and upper 25 percent of their range. When prices emerge from theses regions, with the lines appropriately positioned, a buy or sell signal is generated. The stochastic flags the 1987 crash very well. Note that in the sideways markets of April 1987 and January 1988, the lines were in the middle of their range. In December 1986, a questionable sell signal is generated.

- More complex buy and sell signals can be found in Kaufman's book.
- In sideways markets, stochastics can often be found oscillating in the 40 to 60 percent region.
- Try to use the stochastic with other indicators.

TREND2NOISE

At this point, it is useful to try to recap some of the themes developed so far, as they are going to come together in the Trend2Noise indicator. Points made in this chapter include:

- Momentum quantifies current trend in price.
- A stochastic expresses where the current price is relative to the recent past.
- A "best-fit" line can be drawn through closing prices through a process of least-squares regression.
- Indicators can be used either in a positional or gradient sense. If used in a positional sense, regularization should be small or avoided; if used in a gradient sense, regularization smooths indicators and reduces the number of false signals.

In the Trend2Noise indicator, what I am trying to achieve is the idea of momentum expressed relative to price fluctuations around a trend (which I call *noise*). My reason for wanting to do this is to produce an indicator to express trend relative to related price fluctuations, rather than as an absolute measure of price movement. In most tradable trends, such fluctuations will be small, and so the absolute ratio of trend to noise will be large. There are situations in choppy trends, and, in particular, sideways markets, in which decisions based on absolute measures of trend tend to produce whipsaw trades. In contrast, if trend is expressed relative to local price fluctuations, it should become easier to discriminate between tradable trends and sideways market situations.

In Chapter 17, we will look at how Trend2Noise can be incorporated in a trading system, but for now, we content ourselves with the observation that there is a strategic need for an indicator that helps to discriminate between momentum in a steady trend we may wish to exploit and momentum in a choppy trend (or sideways market) we may wish to avoid.

To produce this indicator, a window of the w most recent price bars is used. Closing prices form the basis of a momentum calculation, which in this instance is obtained using the regression method of Appendix 10.3, without regularization, to obtain a straight (regression) line that approximates closing price C_{t-j} at some point $t - j$ as

$$C_{t-j} = m(t - j) + c \tag{10.10}$$

where m is the gradient and c the intercept with a price axis.

For each time step j through the window, the quantity

$$\Theta_j^2 = \max[\{m(t - j) + c - \text{High}|_j\}^2, \{m(t - j) + c - \text{Low}|_j\}^2] \tag{10.11}$$

is computed. Equation 10.11 is saying that if at some price bar j, the high is farther from the regression line than the low, the distance between the high and the line is calculated, squared, and becomes Θ_j^2. On the other hand, if the low is farther from the regression line than the high, then that distance is squared to become Θ_j^2.

These provide local measures of fluctuations from trend, which are then summed and processed to get a *root mean square (RMS) measure* as

$$\text{RMS} = \left(\frac{\Sigma_{j=1}^{w}\Theta_j^2}{w}\right)^{0.5} \tag{10.12}$$

We now have the ingredients in place. The definition of the raw indicator is

$$\text{Trend2Noise} = \frac{m}{\text{RMS}} \tag{10.13}$$

If required, this can be regularized to assist with gradient trading logic. Currently, this is done using equation A10.2.4 with a smoothing constant α of unity and regularization constant λ to suit the required trading logic. Figures 10.4 and 10.5 show the same results for the Trend2Noise indicator for both the 1987 crash and a 2000 to 2001 sideways market, with Figure 10.6 showing equivalent performance of momentum indicators in the 2000 to 2001 sideways market.

Trend2Noise Summary

- The Trend2Noise indicator represents an attempt to measure momentum relative to price fluctuations around a trend it is based on.
- The Trend2Noise calculation of momentum is based on a best-fit regression line through a predefined window of closing prices, not through averaging of price differences.

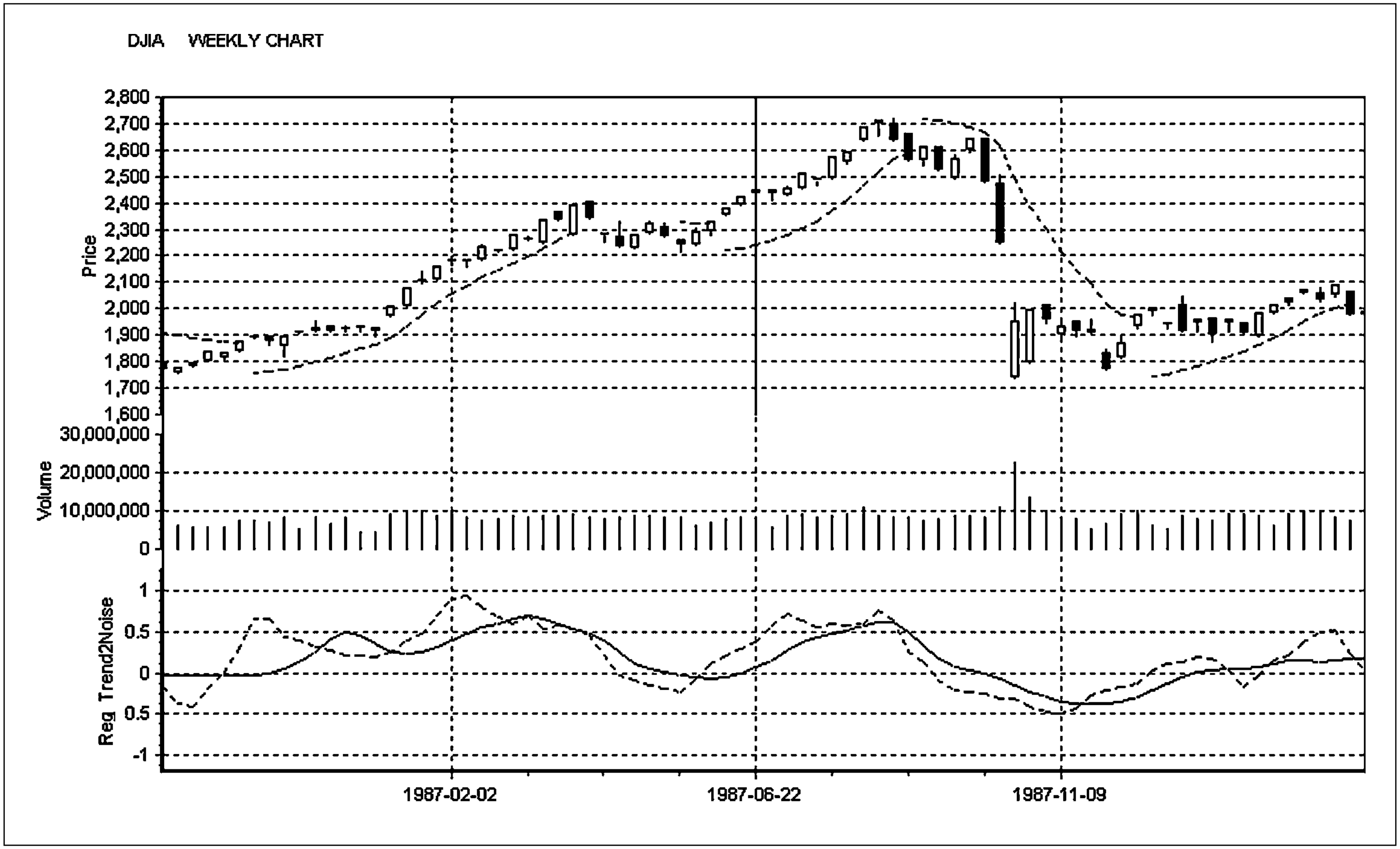


FIGURE 10.4

Trend2Noise indicators are shown (1) a fast line with a period of 8 and no regularization and (2) a period of 13 with a regularization of 1. Preliminary trading entry rules: -Long: The fast line positive, having come up from below –0.5, and both lines heading upward. Short: The fast line negative, having come down from at least +0.5, and both lines heading downward. In this market, the indicator looks no better than average, but it is less likely to get you into trouble in sideways markets—see Figure 10.5.

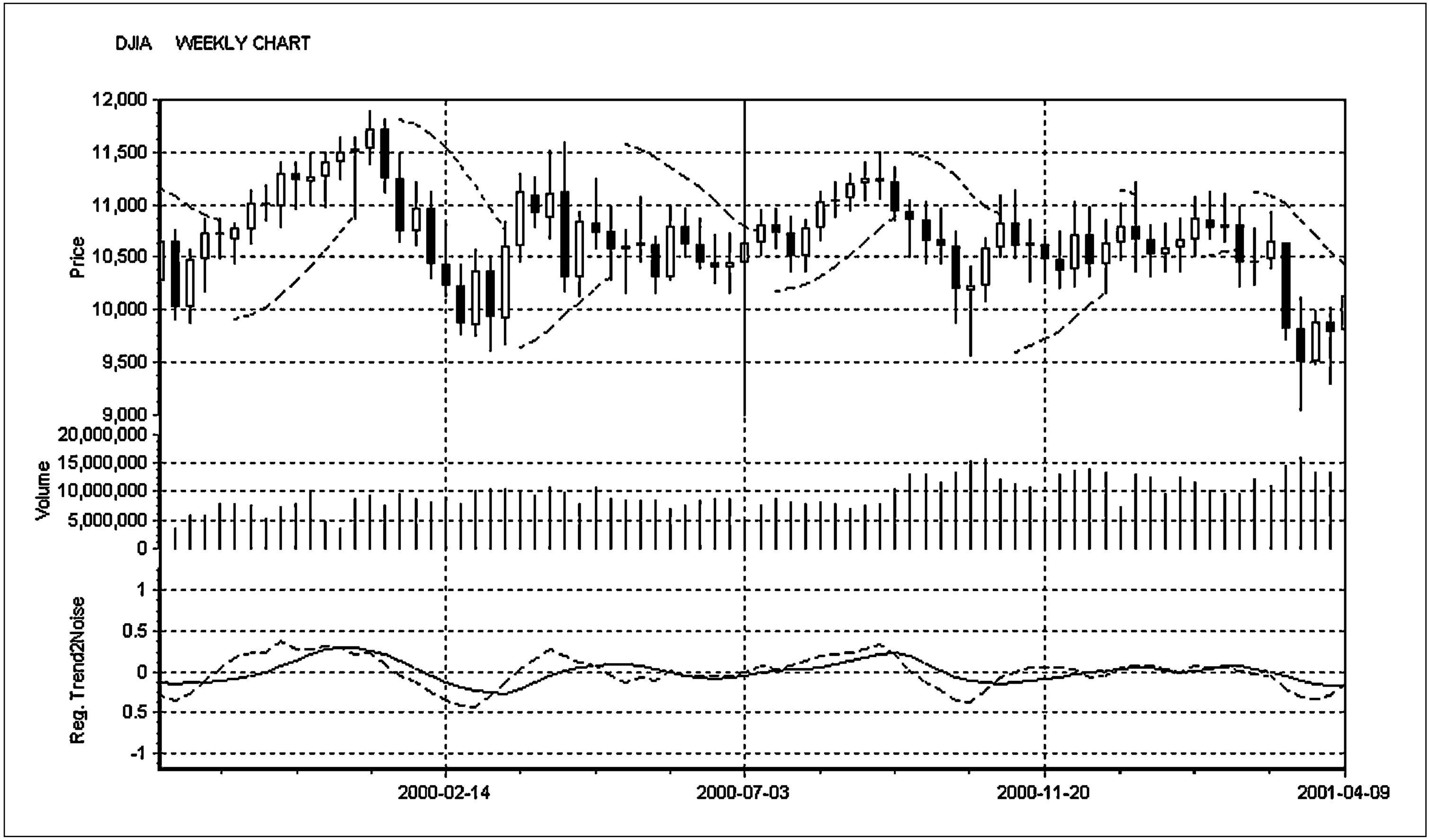


FIGURE 10.5

The parabolic and Trend2Noise indicators of Figure 10.4 are shown in this sideways market. Following the preliminary trading rules of Figure 10.4 should keep you out of troublesome markets where the parabolic SAR and most other indicator-based trading systems suffer significant drawdowns.

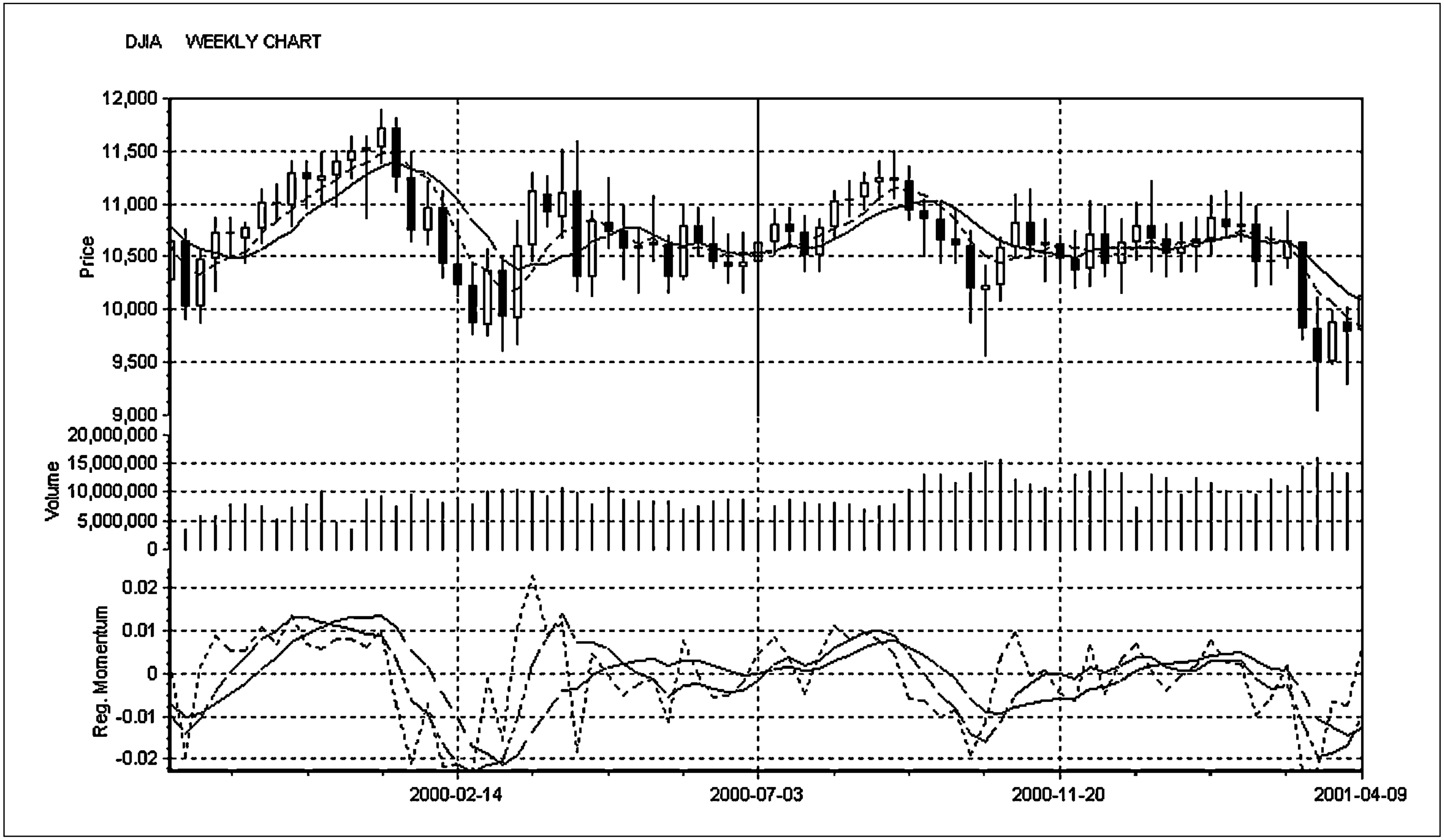


FIGURE 10.6

Parameters used for regularized momentum are the same as those in Figure 10.1. Absolute measures of momentum pay no heed to noise and may be subject to large swings in sideways markets, generating signals leading to whipsaw trades. The 5- and 8-week moving averages are plotted on the price scale, to demonstrate that in sideways markets, the large number of crossover signals they produce lead to overtrading.

- The Trend2Noise indicator attempts to address a strategic need for an indicator that helps to discriminate between momentum in a steady trend and momentum in a choppy trend or sideways market.
- Trading rules for using the Trend2Noise indicator will be developed in Chapter 17.

PRICE AVERAGES

In the midst of indicators that derive from exotic calculations, it is all too easy to overlook the value of price averages, simple and otherwise. Conventional price moving averages are usually used in a positional sense, one of which is to look for the one(s) that offer useful support in a trend, as outlined in Chapter 9. Figure 10.7 shows 8-, 13-, and 21-week moving averages plotted on our now-familiar chart of the Dow in 1987. The 21-week moving average offers useful support for about 12 months prior to the crash. It is penetrated by the closing price some 10 days prior to the crash and entirely penetrated by all prices in the week before the crash—some of those penetrations being almost 7 percent. It was clearly time to get worried and take immediate action. In contrast, waiting for a clear crossover of the 8/13 moving averages would have meant waiting for the closing prices of the week before the crash and not being in a position to take action until the morning of it. The message is clear: Monitoring moving averages and the degree to which they are penetrated offers a safer way to trade than does relying on crossovers that become calculable only after markets have closed. One of the reasons why using moving averages in this way is so effective is that the issue of which period to use *now* can be settled by seeing which one has offered recent support. In general, with other indicators, there is no parallel quick and easy method to find the period(s) that they should use.

Another way of using averages is with regularization. For people who prefer to take decisions from uncluttered charts, this offers an advantage. To avoid drop-off noise, exponential regularized moving averages are preferred. A combination of gradient and position logic can be used to make trading decisions. The period used and the degree of regularization are typically chosen to stay as close to the price action as possible but eliminate spurious turning points. In Figure 10.8 this is achieved with an 8-period indicator with a regularization of 1.5. Around April 1987, there is a possible turning point and penetration but no obvious confirmation that the trend has ended. In September and October 1987, another turning point, associated with more decisive penetrations, and in the week prior to the crash a 13 percent penetration, flags the fact that a change is on the way.

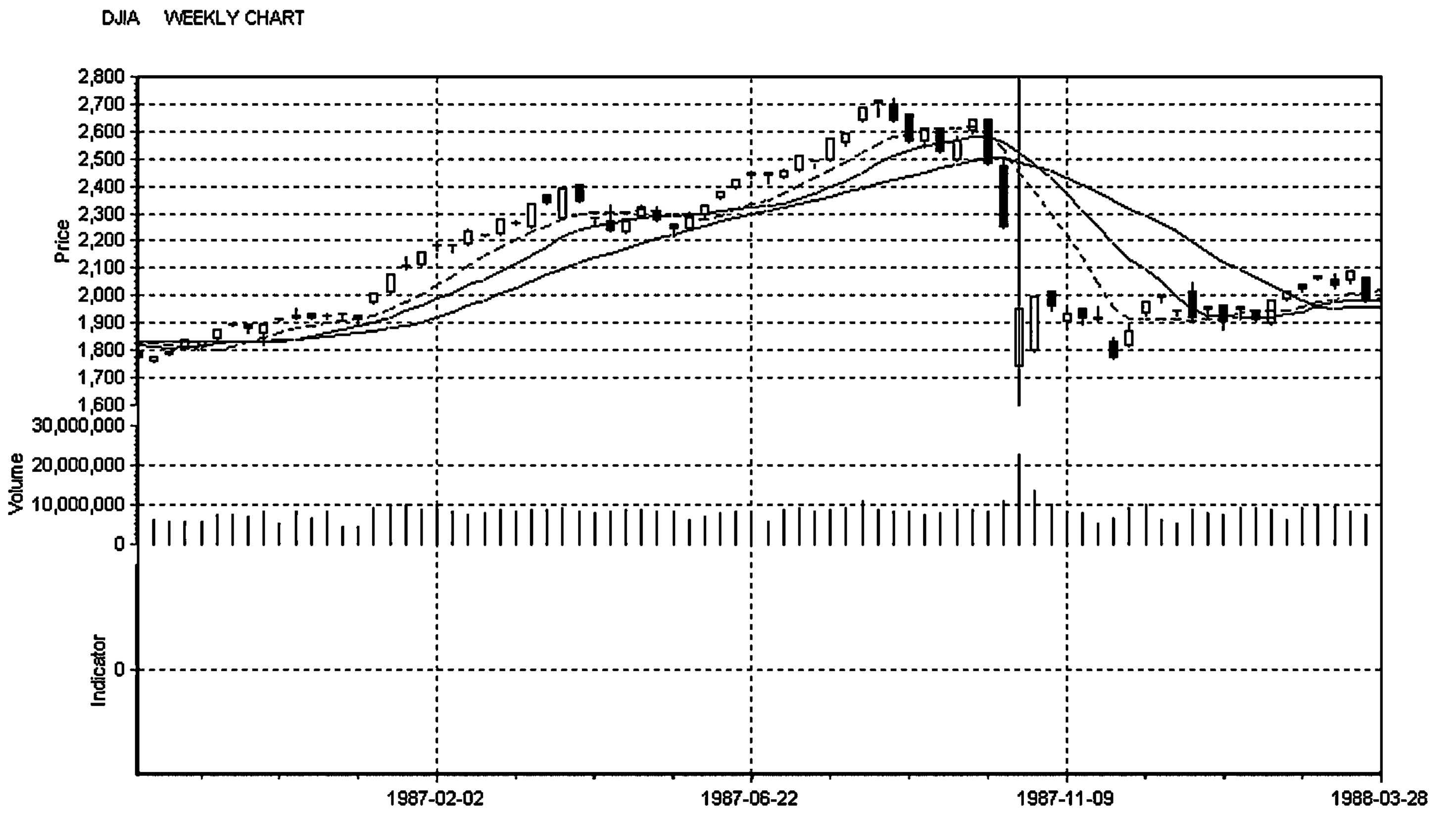


FIGURE 10.7

This figure offers a reminder that simple techniques still work. Three unregularized conventional moving averages are shown, 8, 13, and 21 weeks long. The 21-week moving average offered a reasonable support line for almost a year prior to the crash. It was wholly breached the week prior to the crash, which should have been a warning. Knowledge of the 8/13 moving average crossover, if based on closing prices, would not have been available until the morning of the crash, which would have been too late to be of much use.

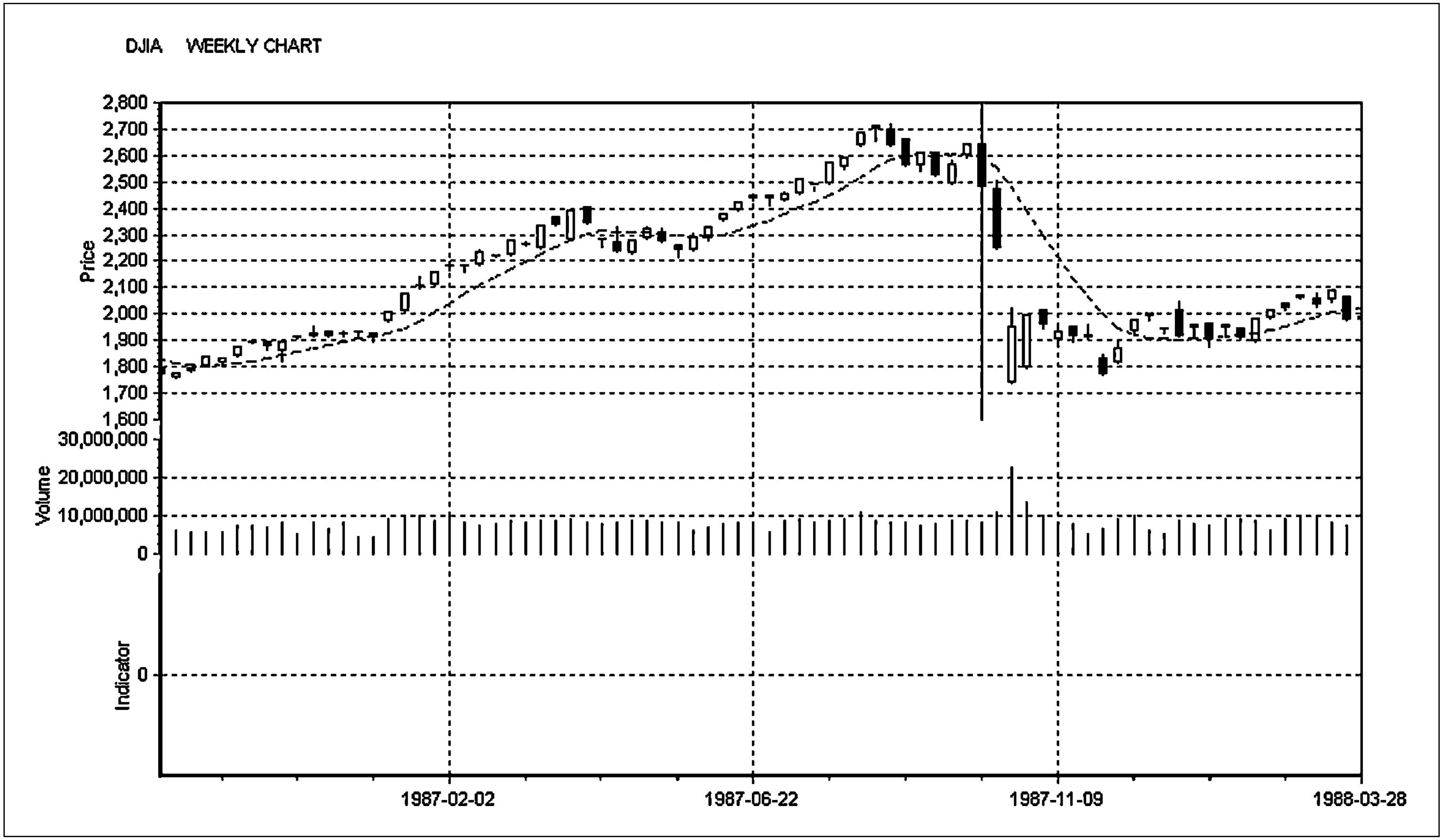


FIGURE 10.8

An 8-period 1.5 regularized exponential moving average is shown. The crash of 1987 represented a situation in which the indicator had turned downward and prices had already penetrated decisively below it. The two weeks before the crash were a worrying time and a good one for small investors to think about either hedging or liquidating their portfolios.

Price Averages Summary

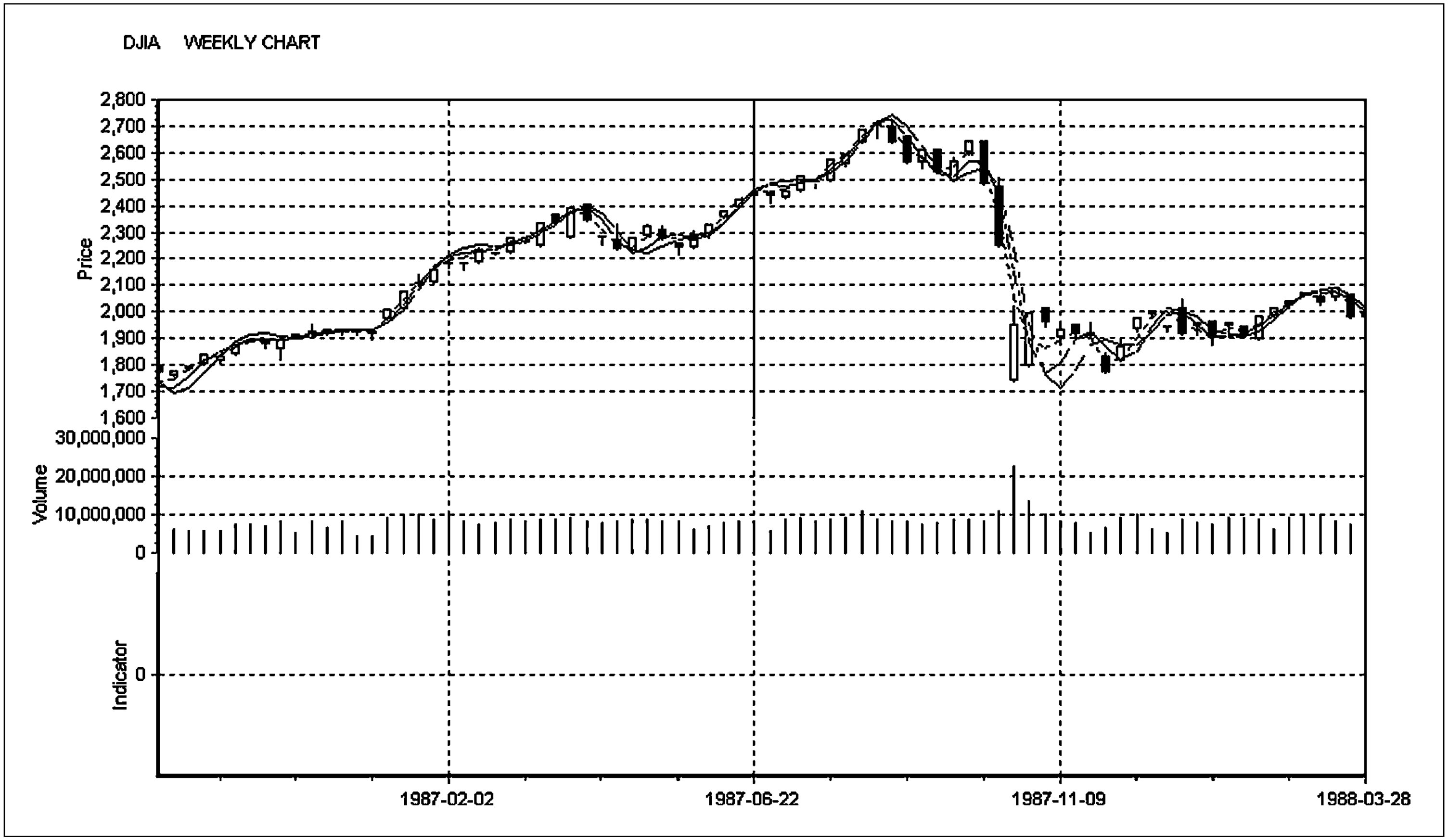
- Unregularized, conventional moving averages of price are sought as support or resistance indicators, so that when they are penetrated, a possible change of trend is flagged.
- A chart covered with moving averages of different lengths (such as Figure 10.7) can be inspected to see which moving averages (if any) offer indications of recent support or resistance.
- If prices "bounce" off a moving average that offers support or resistance indication for a trend, it tends to confirm that the trend will continue.
- An alternative approach is to find a faster regularized exponential moving average whose turning points and penetration can be used to make a decision. Suitable regularized exponential moving averages are found by trial and error.

FILTERS

Filters have been left until last because, in a sense, much of what has been discussed offers a form of filter. Normally, when talking about filters, there is an implicit assumption that a noise-corrupted signal needs to be interpreted to remove the noise and address the question of what the uncorrupted value of the signal is. That assumption is highly questionable for financial time series because price extremes likely to be dismissed as noise become highly significant in creating expectations of future price levels, as explained in cobweb theory in Chapter 2. Within science in general, and electrical engineering in particular, a literature has grown up around the assumption that a time series can be decomposed into its signal and noise components, and this, inevitably, has been applied to the markets. In general, this literature goes into more complex mathematical concepts such as *fast Fourier transforms*, *wavelets*, or *eigenvectors* that some readers will wish to avoid. For those that do not, Simon Haykin's book (*Adaptive Filter Theory*) offers a good account of contemporary filter technology, and John Ehlers's forthcoming book is eagerly awaited to see what the technology can offer the financial markets. Typically, higher-tech filtering techniques work by taking a window of values and transforming them into another space where signal and noise components of the data can be seen more easily. The noise part is then removed and the signal part transformed back to the original space as the filtered result. Note that any such filter is based on past values and is therefore likely to have some lag. It is possible to develop a simple technique, which, for the financial markets, should approach the quality of filter offered by more exotic methods. It does not aspire to their quality, but for reasons that will be explained, it is likely that for many practical purposes any differences will be of little consequence.

The "practical purpose" for which filtered lines are particularly useful is that of hanging *stops* from. We will look at stops in greater detail in Chapter 14, but they amount to conditional orders of the kind "If the price drops below this level, sell my position." For such orders estimates of "true" price and likely level of fluctuations are useful so that they can be placed outside of the range of reasonable fluctuations but close enough to the price not to lose too much in the event of prices moving against a position. One method of assessing values for stop orders is the parabolic. Filters with noise estimates provide another. A difficulty that is not widely appreciated is that time series filtering requires a sequence of values at known points in time. Unfortunately, information on price highs or lows usually arrives without any indication of the time they occurred. A classic cause of failure to simulate trading systems accurately is not knowing if the high came before the low or low before the high. (For future reference, the other classic mistake is to assume the availability of information before it has been generated.) The absence of time information for highs and lows means that time series filtering of price information is usually done on the basis of closing prices only, leaving unresolved the question of the impact of the high-low range of a price bar. It is possible to get a noise estimate of what closing prices are doing, but to get a realistic estimate of price noise, the impact of the price range within a bar must also be taken into account. The implication is that improving the technology of filter accuracy helps to a point, after which further improvements take the result into the region of uncertainty caused by price fluctuations within a bar and an ignorance of when they occurred.

In developing the Trend2Noise indicator, a linear regression technique was used to find a best-fit straight line through closing prices. The same technique can be used to generate a simple filter, which can then be regularized to the user's preference. The mathematics needed to do this are in Appendix 10.3. Results of this type of calculation are shown in Figure 10.9, demonstrating lines that follow price closely to provide suitable anchors for the calculation of stop orders. The principle behind a best-fit (straight-line) regression can be extended to finding a best quadratic fit *filter line*, from which multiples of the sum of (closing price) noise and average price range can be added or subtracted and plotted as *stop lines* on the chart. We will cover stops in more detail in Chapter 14, but for now we try to achieve a result similar to the parabolic (Figure 10.1) by imposing the following rules:



F I G U R E 1 0 . 9

Filtered lines are useful for addressing the question of "where is the true price now?" so that stop orders can be hung from them or placed above them. In this figure, such lines are generated using a 5-window linear regression, regularized with 0, 1, and 2. Uncertainties are present when the ranges of price bars are not accounted for, meaning that stop orders are usually just as good when based on a line such as one of the above, as they are when based on a properly filtered line based on closing prices alone.

- When an upper or lower stop line is cut, the line is ended and new one started on the opposite side of the filter line. This produces a stop line below the filter in bull markets and above the filter in bear markets.
- To ensure that lines are cut around turning points, a convention is adopted that a stop line below the filter line cannot reduce in value and a stop line above the filter line cannot increase in value.
- To avoid assuming the availability of information before it is generated, lines are calculated *only* from information available *prior to* the time when they are plotted. (Note that in this respect stop lines differ from the parabolic.)

Figure 10.10 shows a 15-period best-fit quadratic line as a central filter, with dotted stop lines above and below it. Note that if such a system were to be used for stop-and-reverse (SAR) trading, then the stop lines would be plotted one bar ahead of where they are on Figure 10.10 and multiples of noise chosen differently.

INDICATORS SUMMARY

- There are many more indicators than this brief summary has described.
- Indicators usually ignore support and resistance or other historic price levels and treat prices as noise-corrupted signals that need to be found.
- The chart of the 1987 crash used to illustrate most indicators is an example of an event that was well signaled. Most events will not be as well signaled.
- A simple and effective way of assessing when a trend is in trouble is to look for price penetrations of price moving averages that have previously provided good support or resistance for that trend.
- Moving average penetrations can be acted on before information becomes available for moving average crossovers—meaning that penetrations, rather than crossovers, offer a safer way to use moving averages.
- Unlike conventional moving averages, exponential moving averages do not suffer drop-off noise from blips exiting windows, and regularized exponential moving averages are preferred over their conventional counterparts for use with gradient logic.

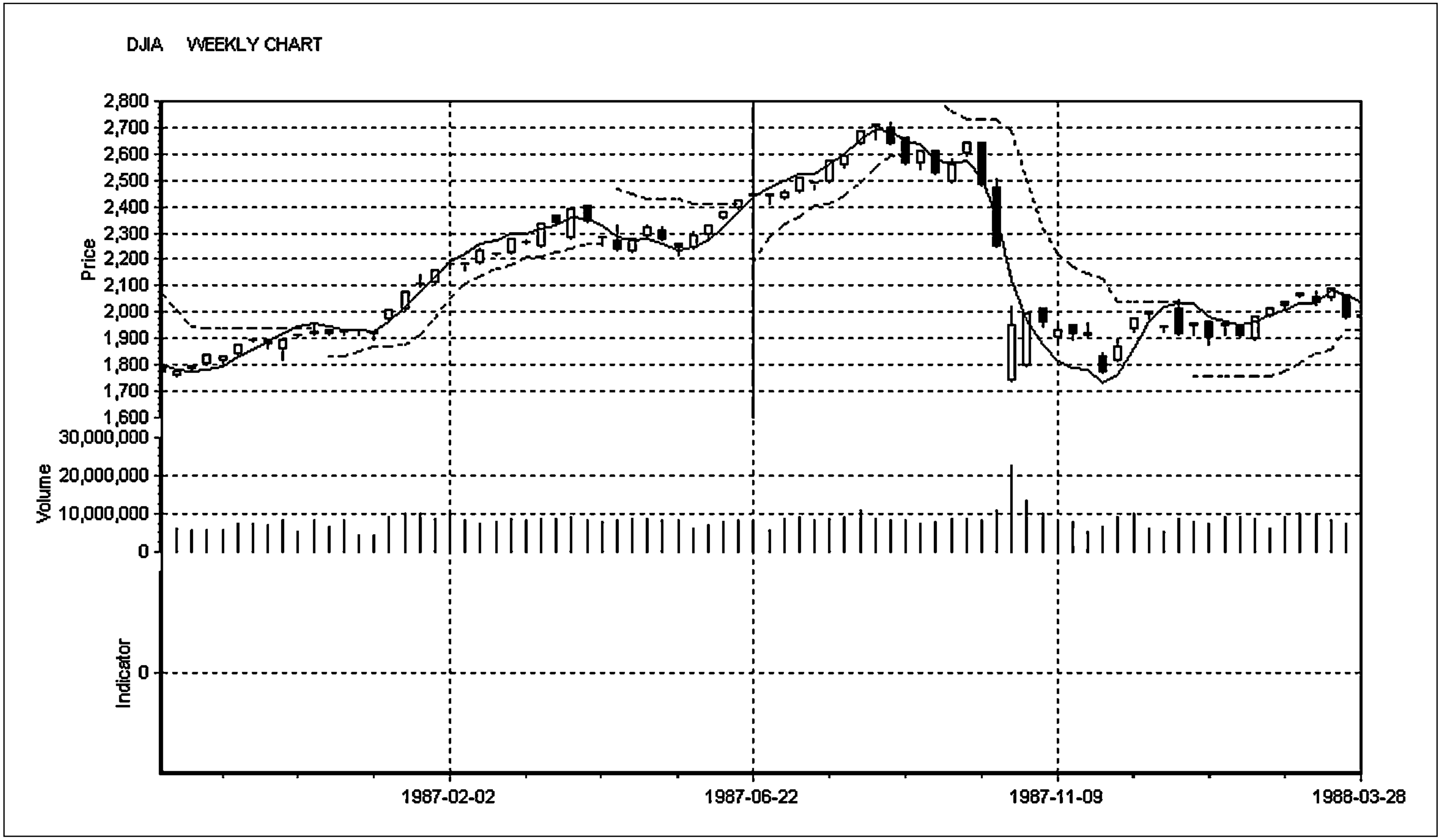


FIGURE 10.10

A 15-period unregularized regression to a quadratic forms the central filter line. From this, stop lines are formed by adding or subtracting multiples of the sum of (closing price) noise and average price range, with a proviso that lower stop lines can only increase in value and upper stop lines only decrease. When penetrated by price, a stop line is ended and an opposite one started.

- Absolute momentum is measured with conventional momentum indicators. These tend to wiggle, and they may need to be regularized to make much sense of them.
- If momentum is used to support a decision, then the value of a short-term unregularized momentum indicator (positive for long, negative for short) should also offer support for the decision.
- The Trend2Noise indicator represents an attempt to express momentum relative to price fluctuations around a trend on which it is based. It was developed to fulfill a need to help investors discriminate between absolute momentum in a steady trend and momentum in a choppy trend or sideways market. More will be said about it in Chapter 17.
- Stochastics are based on the current price relative to the prices of the recent past and can offer a less wiggly perspective on price trends. Signals are generated when prices emerge from extreme values.
- Filters offer an answer to the dangerous question of "where is the true price now?" and are useful for establishing a datum from which stop lines can be built.
- The parabolic SAR is an atypical indicator-based system that has other applications that we will meet later. It should not be thought of as being subject to some of the limitations afflicting "normal" indicators.

APPENDIX 10.1

Regularized Weighted Average Formula

NOTATION

$\mathbf{x}$ = a *window* of values in a time series for which a regularized average is sought

w = the number of elements in $\mathbf{x}$ and $\mathbf{w}$

$\mathbf{w}$ = a vector of weights that define the nature of the *average*. (For a conventional moving average of length w, each element will be equal to 1/w. Note that boldface and normal fonts distinguish vectors from scalars.)

f_t = the regularized average sought at time t

f_{t-1} = the regularized average found at time t – 1

f_{t-2} = the regularized average found at time t – 2
μ_t = moving average at time t
λ = regularization constant
E = an error function whose minimization leads to the formula required

$$\mathbf{w} \cdot \mathbf{x} = w_1 \cdot x_1 + w_2 \cdot x_2 + \ldots\ldots + w_n \cdot x_n$$

FORMULA

A moving average is just a special case of a weighted average, in which all the weights are equal to 1 divided by its length. The formula is therefore derived for the general case of a weighted average and a simpler version given for the case of a moving average μ_t at time t.

We begin by defining

$$E = (\mathbf{w} \cdot \mathbf{x} - f_t)^2 + \lambda(f_t - 2f_{t-1} + f_{t-2})^2 \qquad \text{(A10.1.1)}$$

With $\lambda = 0$, minimizing (A10.1.1) leads to the result that $f_t = \mathbf{w} \cdot \mathbf{x}$, which shows that the idea of minimizing an error function is another way of finding an average.

The second term in (A10.1.1) involves a constant λ and the square of a standard finite-difference approximation to curvature, details of which can be found in Abramowitz and Stegun (see bibliography).

Differentiating E with respect to f_t gives

$$\frac{\partial E}{\partial f_t} = -2(\mathbf{w} \cdot \mathbf{x} - \mathbf{f}_t) + 2\lambda(f_t - 2f_{t-1} + f_{t-2}) \qquad \text{(A10.1.2)}$$

Equating (A10.1.2) to zero, canceling, and rearranging leads to

$$f_t = \frac{\mathbf{w} \cdot \mathbf{x} + 2\lambda f_{t-1} - \lambda f_{t-2}}{1+\lambda} \qquad \text{(A10.1.3)}$$

For the special case where $\mathbf{w} \cdot \mathbf{x}$ is a simple moving average μ_t, (A10.1.3) becomes

$$f_t = \frac{\mu_t + 2\lambda f_{t-1} - \lambda f_{t-2}}{1+\lambda} \qquad \text{(A10.1.4)}$$

APPENDIX 10.2

Regularized Exponential Moving Average Formula

NOTATION

x_t = raw value, at time t for which a regularized exponential moving average is sought
f_t = the regularized exponential moving average sought at time t
f_{t-1} = the regularized exponential moving average found at time t – 1
f_{t-2} = the regularized exponential moving average found at time t – 2
α = a smoothing constant for the regularized exponential moving average
λ = regularization constant for the regularized exponential moving average
E = an error function whose minimization leads to the required formula

FORMULA

As before, we begin by defining a suitable error function, which in this case is

$$E = [f_{t-1} + \alpha\,(x_t - f_{t-1}) - f_t]^2 + \lambda(f_t - 2f_{t-1} + f_{t-2})^2 \qquad \text{(A10.2.1)}$$

Differentiating this with respect to f_t leads to

$$\frac{\partial E}{\partial f_t} = -2[f_{t-1} + \alpha\,(x_t - f_{t-1}) - f_t] + 2\lambda(f_t - 2f_{t-1} + f_{t-2}) \qquad \text{(A10.2.2)}$$

Equating to zero, canceling, and gathering terms gives

$$f_t(1 + \lambda) = f_{t-1}(1 + 2\lambda) + \alpha\,(x_t - f_{t-1}) - \lambda f_{t-2} \qquad \text{(A10.2.3)}$$

leading to

$$f_t = \frac{f_{t-1}(1+2\lambda) + \alpha\,(x_t - f_{t-1}) - \lambda f_{t-2}}{1+\lambda} \qquad \text{(A10.2.4)}$$

APPENDIX 10.3

Linear Regression with Regularization

NOTATION

$\mathbf{x}$ = a window of values in a time series for which a regularized average is sought
w = the number of elements in $\mathbf{x}$
t = the time step for which a regularized linear regression is sought
i = a local integer variable where $1 \leq i \leq w$
j = a local integer variable equal to $t - w + i$
f_t = the regularized average sought at time t
f_{t-1} = the regularized average found at time $t - 1$
f_{t-2} = the regularized average found at time $t - 2$
λ = regularization constant
E = an error function whose minimization leads to the formula required
m = the gradient of a linear regression
c = the intercept of a linear regression

FORMULA

Over some window of w values, ending at time t, a straight-line approximation is sought to the values in $\mathbf{x}$ that culminate at time t. The straight line has the mathematical form of $(m \times j + c)$, meaning that its final value at time t will be $(m \times t + c)$.

The error function required to reflect this for a regularized linear regression is

$$E = \sum_{j=t-w+1}^{t} (x_j - m \times j - c)^2 + \lambda(f_{t-2} - 2f_{t-1} + m \times t + c)^2 \qquad (A10.3.1)$$

The process proceeds as before, in this case differentiating with respect to m and c followed by equating to zero, canceling, and rearranging. Resulting equations are solved for m and c. To see how to do this, we introduce the notation

$$a_{11} = \lambda \times t^2 + \sum_{j=t-w+1}^{t} j^2 \qquad (A10.3.2)$$

$$a_{21} = a_{12} = \lambda \times t + \sum_{j=t-w+1}^{t} j \tag{A10.3.3}$$

$$a_{22} = w + \lambda \tag{A10.3.4}$$

$$r_1 = 2\lambda \times t \times f_{t-1} - \lambda \times t \times f_{t-2} + \sum_{j=t-w+1}^{t} j \times x_j \tag{A10.3.5}$$

$$r_2 = 2\lambda \times f_{t-1} - \lambda \times f_{t-2} + \sum_{j=t-w+1}^{t} x_j \tag{A10.3.6}$$

and solve the equations for m and c as

$$m = \frac{r_1 \times a_{22} - r_2 \times a_{12}}{a_{11} \times a_{22} - a_{21} \times a_{12}} \tag{A10.3.7}$$

$$c = \frac{a_{11} \times r_2 - a_{21} \times r_1}{a_{11} \times a_{22} - a_{21} \times a_{12}} \tag{A10.3.8}$$

leading to

$$f_t = m \times t + c \tag{A10.3.9}$$

CHAPTER 11

Trading Patterns

An entirely different approach to trading, which grew up on different continents, in different ways, at different times, comes from observations of price/volume formations that precede price movements. These are variously known as *trading formations, formations, trading patterns*, or just *patterns*. At their simplest, they reflect the ability of traders to learn from experience what typical market tops, bottoms, or trend continuations look like on charts and to categorize their experience as patterns. Unlike most indicators, patterns take price extremes fully into account. Patterns may or may not exist at key reversal or continuation points, and so they are used opportunistically when found. Unlike indicators, they cannot be guaranteed to exist at all entry and exit points, and therefore they cannot be used as the sole basis of a trading system, but as we shall see in Chapter 17, such indicator-based trading systems are fraught with their own limitations, which patterns can alleviate.

Patterns are the subject of an extensive literature, which includes books by Robert Edwards and John Magee, John Murphy, Steve Nison, and Richard Schabacker, listed in the bibliography. Despite their extensive literature, useful inferences that can be drawn from patterns are often understated. Specifications for what constitutes a valid pattern are usually couched in vague terms, sometimes leading to disagreements as to whether a pattern "failed" or whether it was an invalid example in the first place. Curiously, whenever a pattern succeeds, there seems to be little disagreement that it was a valid example.

One academic who studied patterns was moved to write words to the effect that they tended to exist in the eyes of their beholders. His comment highlights the frustrations of those who have attempted to study patterns objectively to see if they fulfill some narrow, quantifiable success criteria; but it also needs to be said that academics have generally failed to appreciate or study the less-easily quantifiable benefits that patterns provide and which their users value so highly.

Patterns originated from observations of market participants who tracked prices continuously and, over time, gained experience of price/volume changes that preceded major price moves. Nison's book mentions that Japanese traders have been using patterns based on candlestick charts for generations. Schabacker's book was based on a course he offered in the 1930s, and Edwards and Magee's book first came out in 1951. Trading pattern recognition was either the first, or a very early, form of technical analysis, and it developed in an age when decisions were taken more on qualitative judgments than quantitative information. What patterns did (and continue to do) was to offer perspectives to improve situational awareness of markets. But in an age where decisionmakers are bombarded with figures, the qualitative judgments that patterns support are tending to be overlooked, to the detriment of decision making.

The lack of common specifications for patterns can be explained in part by the experiences of their users. Different traders will have had different experiences with similar patterns. A stunningly successful trade from one pattern fixes an opinion about it in the mind of the trader who succeeded; and an unsuccessful trade with a similar pattern in another financial instrument, at another time, by another trader, will have fixed a contrary opinion in that person's mind. The result of diverging experiences with similar patterns is a divergence of opinion as to what really constitutes a valid pattern. Some of the reasons for these diverging experiences will be explored later.

Until around the beginning of the third millennium, recognition of some of the more complex patterns was a manual process. Every day, traders scoured charts, trying to see if they could recognize one of about thirty patterns. This was not only a laborious process but also an unreliable one and limited by human resources to a small number of financial instruments. Around that time, various software packages began to appear that allowed their users to input financial data to see if a pattern existed. How well these work I cannot say since I have never used them. However, to declare my own interest, in the summer of 2000, I accepted an invitation from the founders of Recognia Inc. to see if I would develop trading pattern recognition software, to be used as part of their venture to recognize all major patterns, across all world markets, to deliver the results to paying clients via the Internet. Since I have an interest in patterns and declared association with Recognia, I have to make it clear that views expressed on patterns are my own and may not reflect the corporate views of Recognia Inc. Much of the content of this chapter is based on results from work done in support of

Recognia. In 2002, its service was made available (via brokers to their clients) for North American markets and has since expanded to Europe.

Recognia has kindly provided some of the educational material on patterns from its restricted Web site, and this material is on the accompanying CD ROM. This material amplifies descriptions given in this chapter so as to offer a more comprehensive account of the subject. Recognia has also provided examples from its pattern library for daily patterns, which is on the same CD ROM. This content is intended to provide definitive descriptions of patterns and how they can be used and to offer familiarization to readers interested in using patterns as part of their investment strategies.

The longer-term investment horizons, which are the subject of this book, mean that this chapter is more concerned with weekly, rather than daily, patterns. Its figures are therefore based on patterns in weekly charts. In practice, differences between most weekly and daily patterns are minimal, but with certain patterns (for example, flags and pennants) defined by time horizons that restrict them to daily charts.

To resume the subject of automated pattern recognition mentioned earlier, the landscape of pattern recognition has now changed in that anybody with an account with a pattern-enabled, online broker can receive Web-delivered details of patterns, for almost any financial instrument, before markets open on the day following their confirmations. Alternatively there is a subscription service providing similar content. The critical (and as yet unresolved) issue has moved on from that of pattern recognition to the inferences to be drawn from them and how best to make use of those inferences. In saying this, I presuppose the acceptance of pattern specifications used for their automated recognition (on which the figures in this chapter will be based), and I believe that there will continue to be a rumbling dispute on the issue of pattern specifications until some long-overdue standards come into existence. For information, the specifications adopted for Recognia's automated pattern recognition software came from a combination of the literature and videotaped discussions between technical analysts, which were held in one of the late Twin Towers of New York City on 11 September 2000.

CATEGORIES OF TRADING PATTERN

There are five main categories of trading patterns:

- Complex reversal
- Simple reversal
- Complex continuation
- Simple continuation
- Rounded

To explain *complex* in a pattern context: In Chapter 2, cobweb theory was introduced, and Figures 2.5 through 2.7 showed zigzag price patterns that resulted from various combinations of supply and demand curves, and expectations. Complex patterns are zigzag patterns based on individual or combinations of patterns shown in those figures.

In contrast, *simple* implies a conclusion from a small number (as low as 1) of price bars, without any obvious connection to cobweb theory that generated the components to complex patterns.

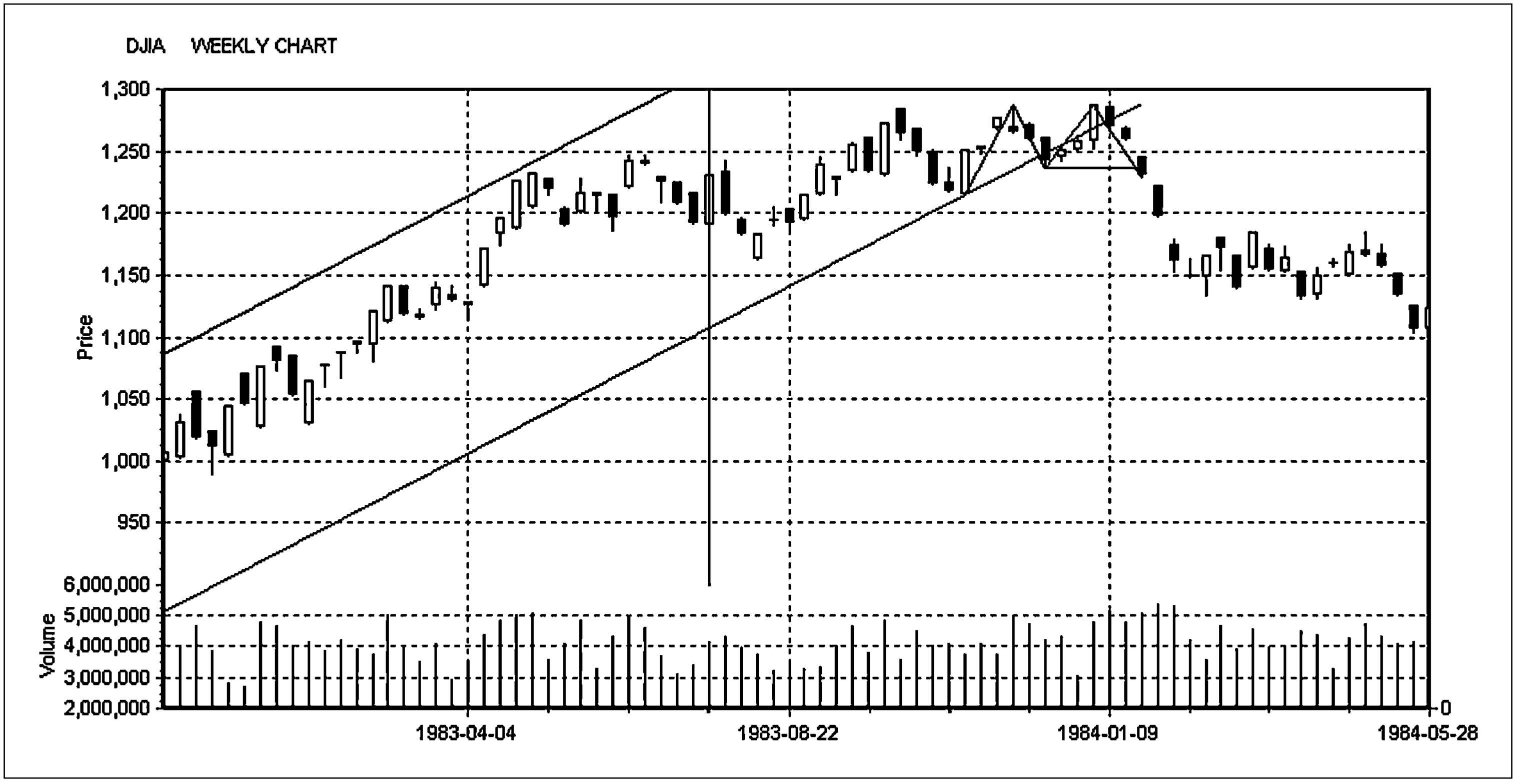
Reversal means that a main trend prior to a pattern is expected to reverse following the pattern's confirmation.

Continuation means that a trend that has been interrupted by a pattern and is now expected to continue after its confirmation by the pattern.

Rounded implies that a gradual price reversal, not associated with any zigzag formation, is taking place over a significant number of bars, greater than the number associated with simple patterns.

SOME EXAMPLES OF PATTERNS

Figures 11.1 to 11.7 give examples of complex reversal patterns, Figures 11.8 to 11.10 examples of triangular continuation patterns, and Figure 11.11 an example of simple patterns. The simple patterns need a little explanation. Apart from content on the CD ROM, a full and excellent description of these patterns is offered in Nison's book, listed in the bibliography. Many of these patterns were discovered independently in both western and eastern cultures, and the four types shown are representative of many others that Nison describes. To take these in the order listed on the chart: The *hanging man* (1) occurs after an uptrend, signifies a reversal, has the body of its candlestick (white or black) toward the top of its range, and a low that probes at least two body lengths below it. Its mirror-image counterpart at the bottom of a downtrend is known as an *inverted hammer*. The *bearish engulfing pattern* (2) occurs after an uptrend and has the whole of its (bearish) black body spanning the white body of a preceding (bullish) candlestick. Its mirror-image counterpart, the bullish engulfing pattern, occurs at the bottom of a downtrend and has the whole of its white body spanning the black body of a preceding (bearish) candlestick. The *hammer* (3) occurs at the bottom of a downtrend and signifies a reversal. Apart from its position at the bottom of a downtrend, it is similar to the hanging man and has the body of its candlestick (white or black) toward the top of its range and a low that probes at least two body lengths below it. The *shooting star* (4) occurs after an uptrend, ideally has a real body that gaps upward from the preceding bar, has a real body (black or white) at the bottom of its range, and signifies a top reversal, which in this case is very minor.



F I G U R E 11.1

A double top comes after a substantial uptrend, being formed by two peaks of similar size followed by a price penetration below the level of their central trough. A similar formation with three, rather than two, peaks is known as a *triple top*.

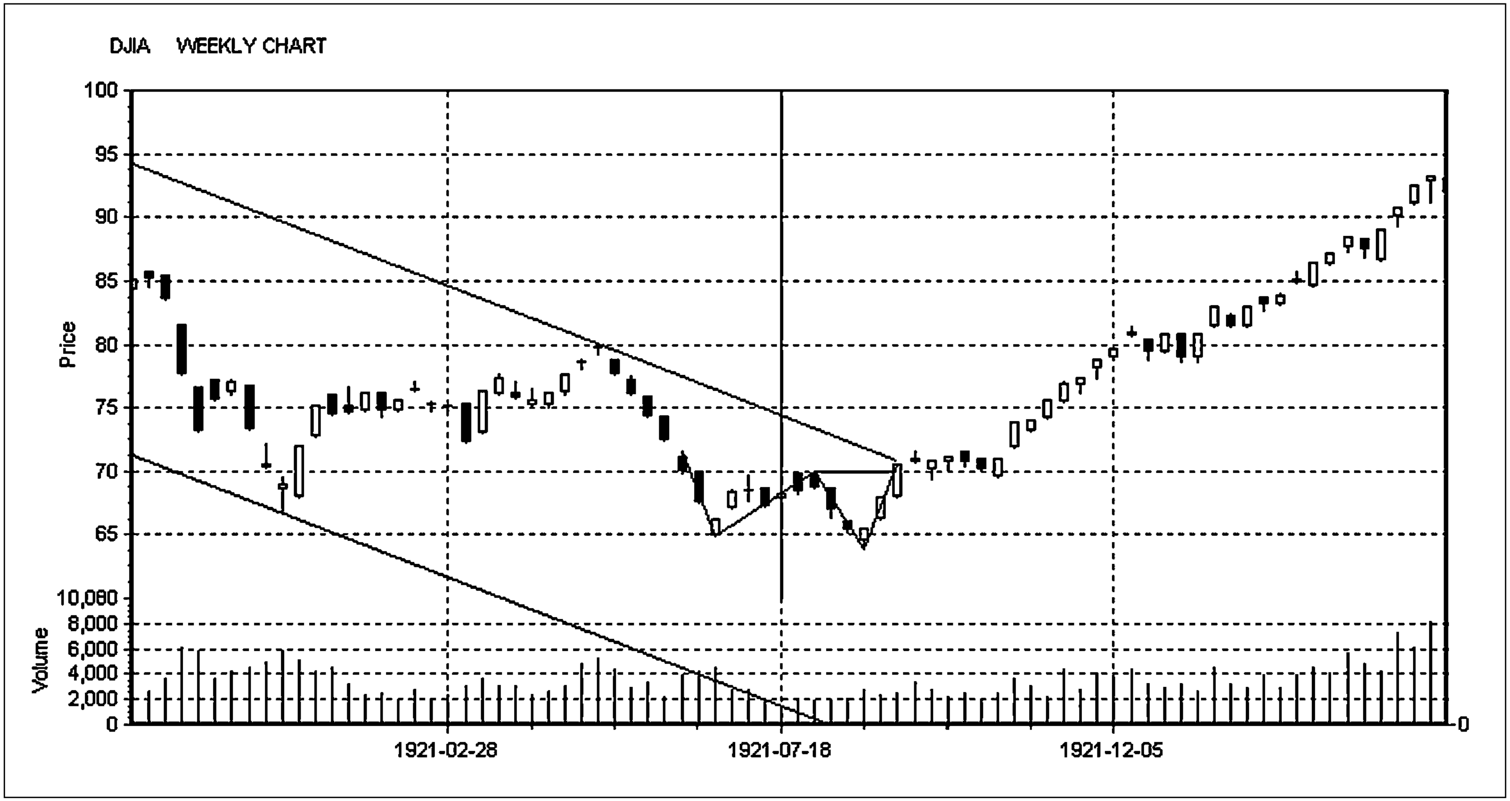


FIGURE 11.2

Most trading patterns have a mirror image. In the case of the double top (for example, Figure 11-1), the mirror image is known as a *double bottom*. This example of a double bottom heralded the great bull market of the 1920s. A similar pattern with three, rather than two, troughs is known as a *triple bottom* and has a mirror-image twin known as a *triple top*.

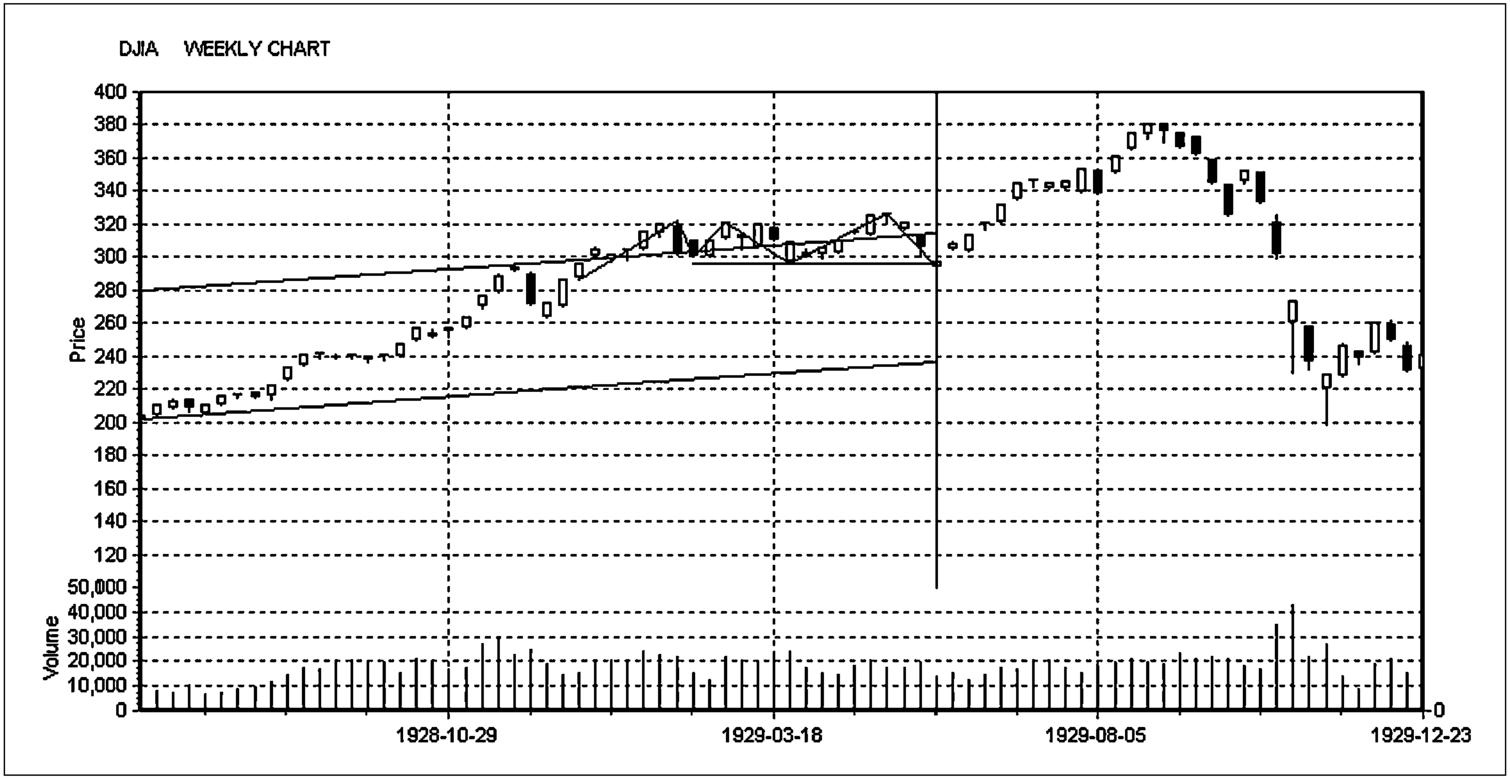


FIGURE 11.3

This triple top was confirmed in late May 1929. Received wisdom says that after a triple top, prices fall. In this case, following confirmation, prices had to fight the tide of expectations that had fueled the boom market of the 1920s, so they rose, and the triple top "failed." Nevertheless, the triple top was a warning that bears were having some success in fighting bulls and that the bulls might lose their next battle—which they did a few months later in October 1929.

FIGURE 11.4

The postwar recession was signaled by a pattern known as a *head and shoulders top*. Positioned after a major bull market, its features are a central peak known as the *head*, flanked by two smaller peaks known as *shoulders*, declining volume on upswings and increasing volume on downswings. A *neckline* is drawn from the two troughs between the shoulders and the head, and confirmation comes when this is penetrated. Sometimes, as in this case, there is a small price increase after confirmation known as a *return move* that precedes the final collapse. A mirror image of this formation, known as a *head and shoulders bottom*, can signal the end of a bear market.

F I G U R E 11.5

At a market bottom, the broadening formation (sometimes known as an *expanding triangle* or *megaphone*) consists of a series of three up-down zigzags of increasing amplitude, with increasing volume on the upswings. Confirmation comes when prices penetrate above the level of the second peak. In the case of the great depression, the absolute trough of around 42 was followed by a sharp upswing, then a fall, and then this broadening formation that signaled a more secure recovery. There is an equivalent pattern at market tops, which is known by the same name(s).

F I G U R E 11.6

In addition to an expanding triangle signaling the end of the 1930s bear market, it was also signaled by this bottom triangle, consisting of internal zigzags with at least two internal touches, increased volume on upswings and decreased on downswings, followed by a penetration of the trendline joining the upper two peaks of the internal zigzag line that defines the triangle. Note that this signal came earlier than the expanding triangle. An mirror-image pattern, known as a *top triangle*, helps to identify market tops.

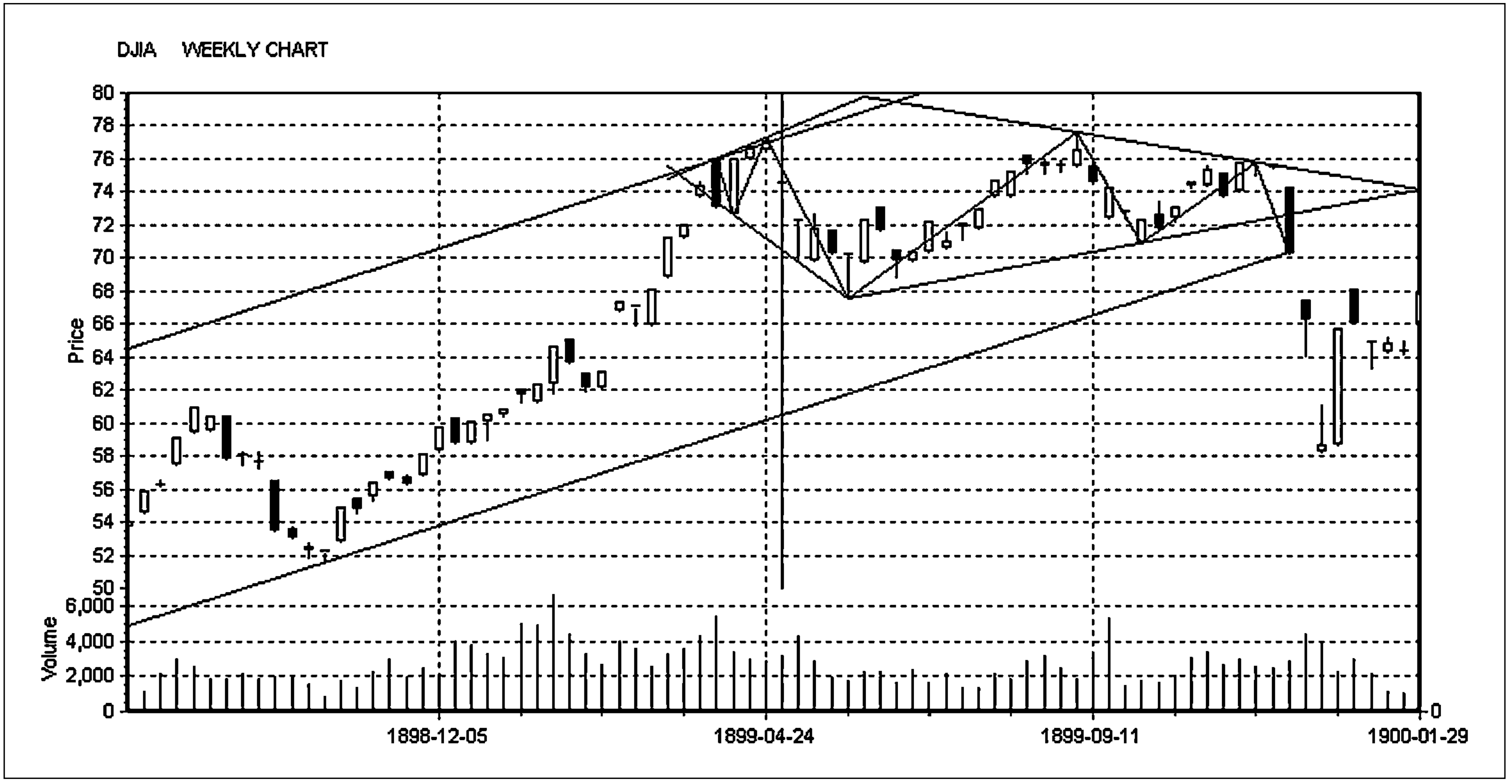


FIGURE 11.7

A *diamond top* consists of a broadening formation followed by a top triangle. Where the final penetration of the lower trendline is as decisive as it is here, a good signal is likely, which is what happened in this chart to signal a bear market in the Dow at the turn of the twentieth century. The diamond is also a continuation formation, so if prices bounce off the final lower trendline to penetrate the upper, a continuation of a bull trend is signaled. One of the problems with diamonds is that when penetrations occur close to their right-most apex, the direction of penetration becomes sensitive to small fluctuations in price, and so their value as a predictive pattern diminishes. The same general comment is also true of triangles that break out near their apexes.

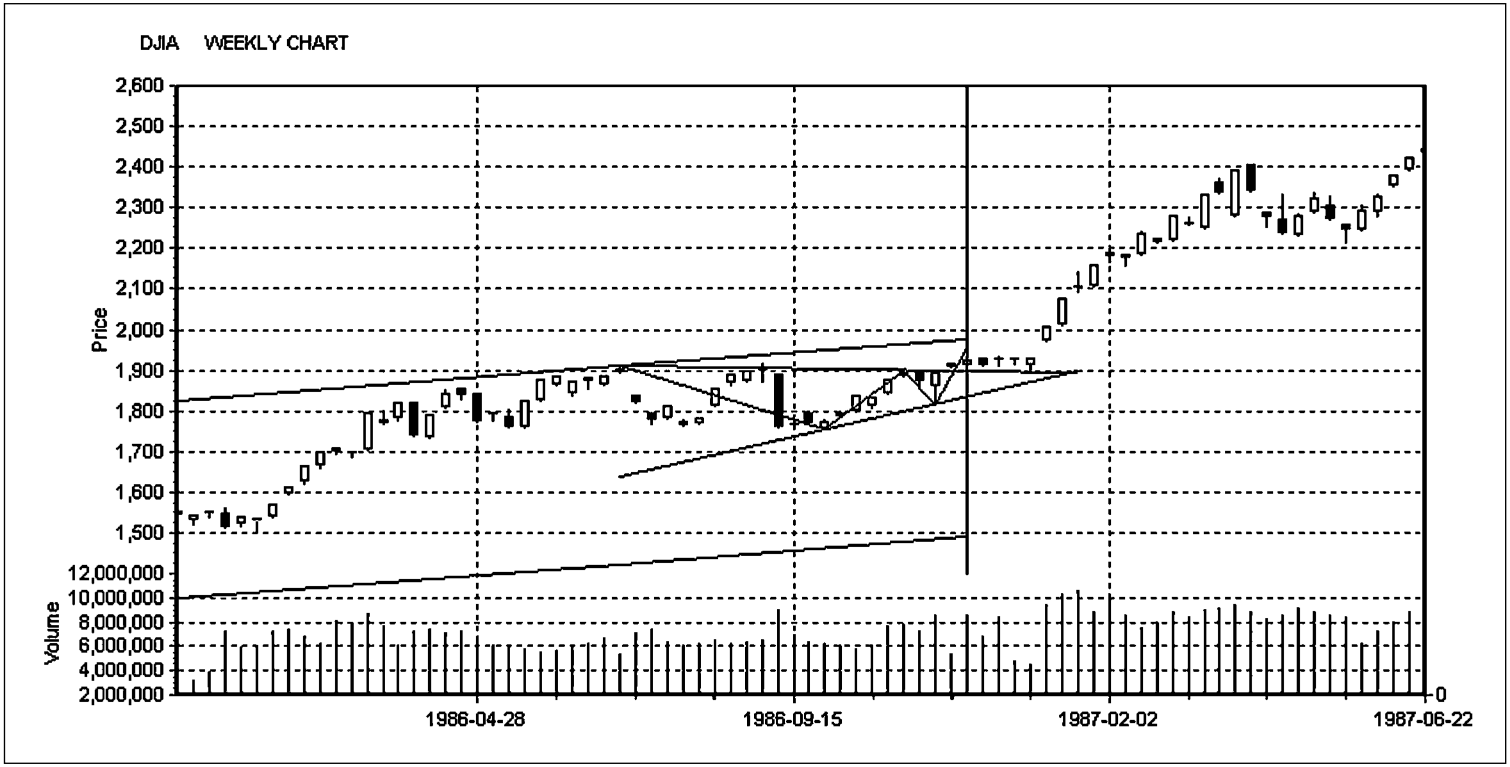
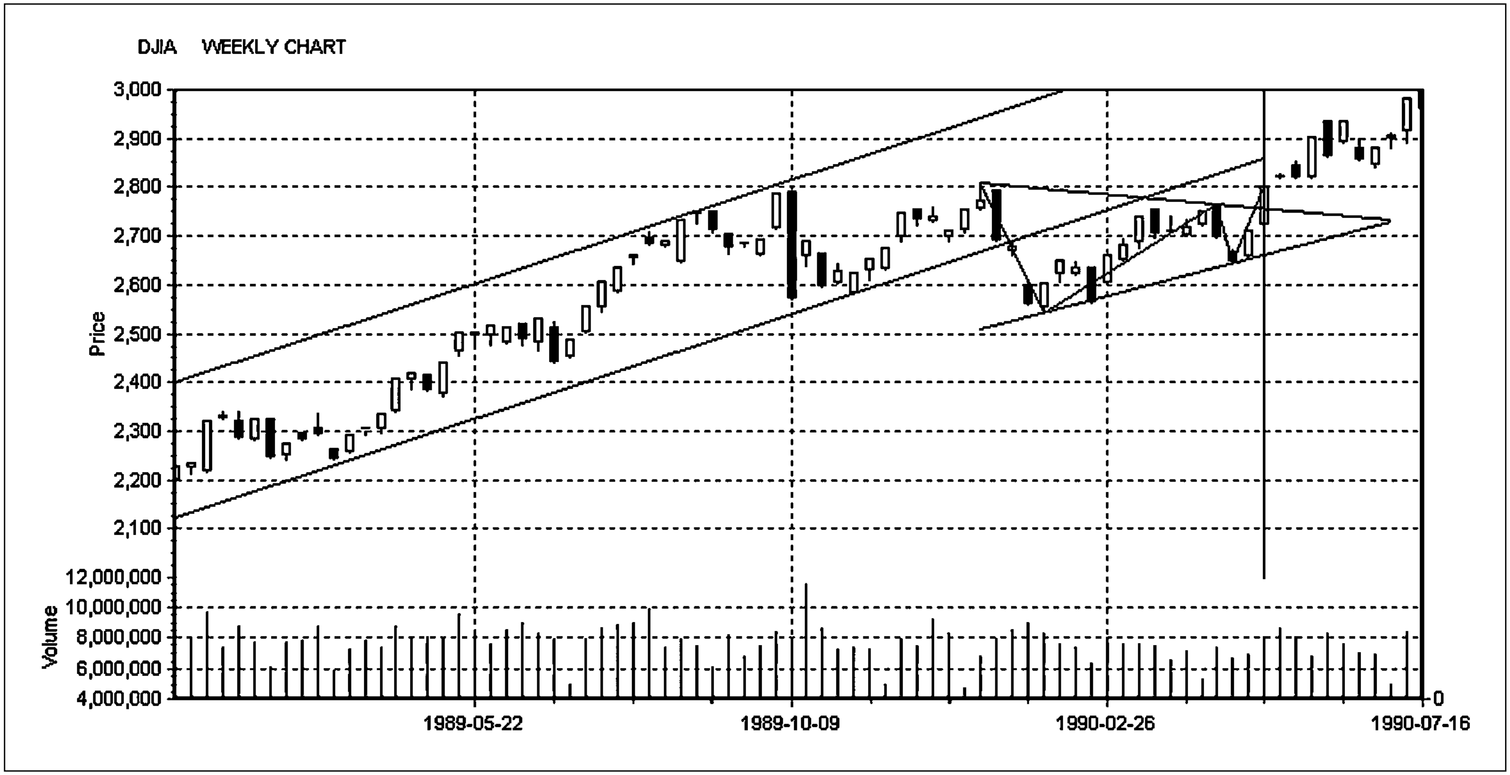


FIGURE 11.8

An *ascending triangle* consists of a near-horizontal upper trendline and an upward-sloping lower trendline. Both trendlines must be touched at least twice prior to a breakout through the upper trendline. The ascending triangle is a continuation pattern that signifies the continuation of a bull trend. A *descending triangle* is a mirror image of an ascending triangle that signifies the continuation of a bear trend.



F I G U R E 11.9

The *symmetrical triangle* has a downward-sloping upper trendline and an upward-sloping lower trendline, at least two touches on each, and (in a bull trend) a decisive breakout to the upside to signify continuation of the bull trend. When a bear trend is similarly interrupted by a symmetrical triangle, which is a mirror image to that shown here, its continuance is signaled by a breakout to the downside through the lower trendline.

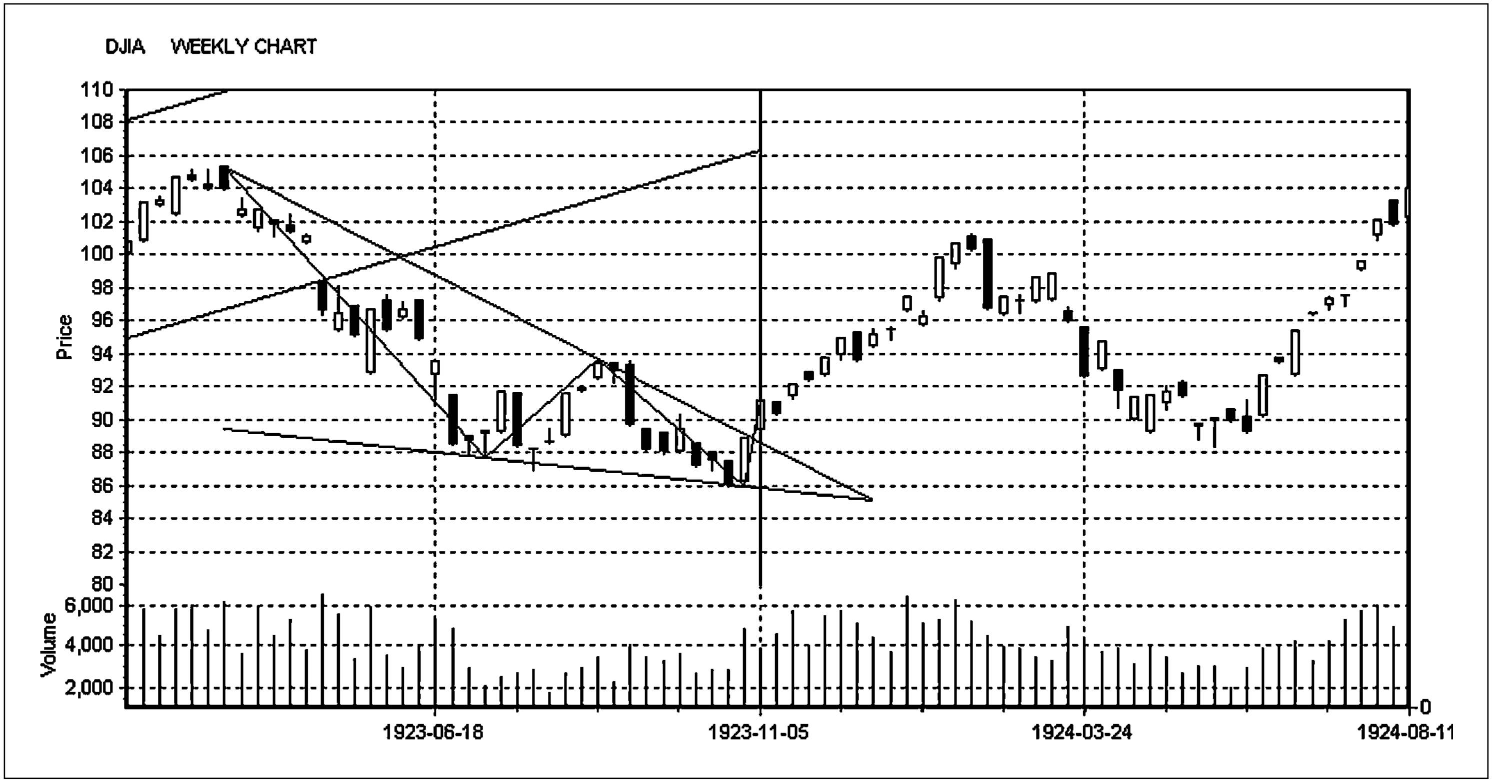
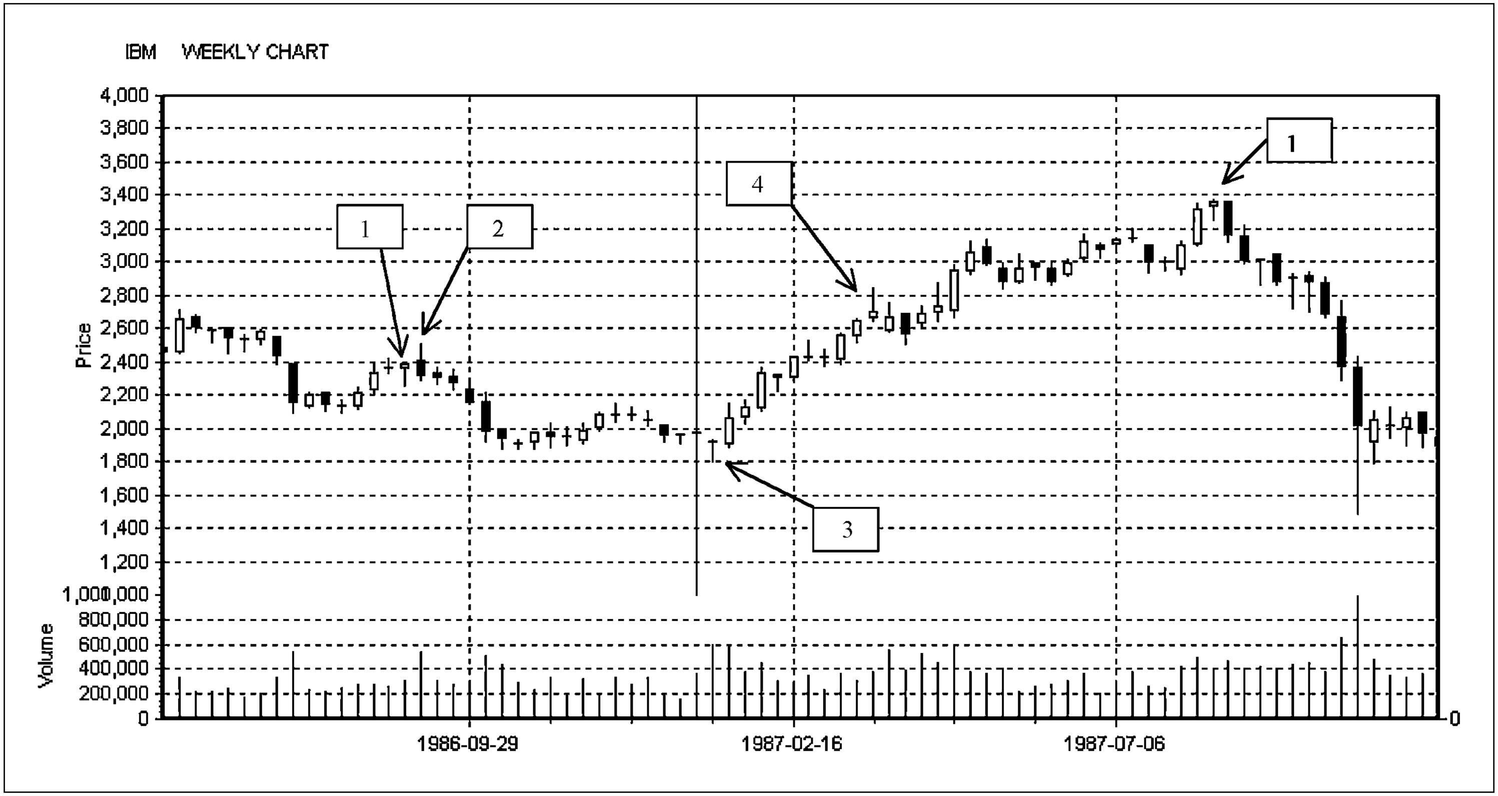


FIGURE 11.10

A wedge in a bull trend has two downward-sloping trendlines, both touched twice, with a breakout to the upside. It signals the continuation of that bull trend, which in this case lasted a further six years. A wedge in a bear trend is the mirror image of the pattern shown here.



F I G U R E 11.11

One-bar patterns are usually thought to have short-term predictive value. Four types are shown on this chart: (1) a hanging man, (2) a bearish engulfing pattern, (3) a hammer, and (4) an inverted hammer. Nison's book is the definitive work on this type of pattern.

PATTERN FUZZINESS

Figures 11.1 through 11.10 all involve the penetration of a level or trendline derived from a pattern's geometry. Different people have different ideas on what constitutes a penetration. For some it is enough that a simple price penetration of a line is achieved; others require a penetration of a line by a defined quantity of the line's value (typically 3 percent); others require the line to be penetrated by a close—and there are many other custom penetration criteria in use.

Another issue is volume. There is a general principle that, through a pattern, volume should generally increase with price moves in the direction of breakout and decrease with price moves contrary to that direction. Unfortunately volume is a very noisy variable, which leads to the words *generally increase* and *generally decrease* being open to differing interpretations.

In many of the figures the word *touch* is used to describe a situation in which price approaches a line or level and then bounces off it. Sometimes, trendlines are drawn that involve touches with small penetrations; other times not. The fuzziness in defining *touches* cascades through to affect price levels and bounding trendlines, and in turn, patterns.

One of the most contentious issues is that of defining conditions to precede a valid pattern. In Figures 11.1 through 11.10, words are used to the effect that complex reversal patterns follow a substantial bull or bear market and complex continuation patterns interrupt them. This presupposes that definitions exist for *substantial, bull*, and *bear* and was one of the areas where individual technical analysts were found to have strongly held but differing opinions.

There is a tendency to read books on patterns and come away with the idea that if a perfect specimen of a pattern can be found, then the perfect trade will result. Some very limited performance studies to date do not support that view but instead, point to a need to appreciate the broader market situation, rather than the finicky details of pattern specifications. Regrettably, such studies were done using very narrow success criteria and failed to simulate the way patterns would have been used in practice. More will be said on this subject in Chapters 14, 15, and 16.

EXPLANATIONS OF PATTERNS

In *Technical Analysis Explained*, Martin Pring uses a simile of trench warfare to explain how a battle between buyers (bulls) and sellers (bears) can fail to penetrate prepared defensive positions, with the result that successive attacks by either side oscillate between them. The situation in double or triple tops and bottoms is well represented by this simile, where, if defenses are penetrated, new territory can be invaded. I like this simile, but the explanation that I prefer derives from cobweb theory, which can explain more complex patterns. In Chapter 2, cobweb theory was introduced in an agricultural context, where farmers with perishable crops had to make a decision on what to grow. Where their decisions were heavily influenced by an expectation that the current year's prices for the choice of crops they could grow would continue, then the quantities of those crops available in the following year would oscillate between glut and shortage, with consequential price oscillations from imbalances between supply and demand.

For the most part, owners and potential owners of shares do not see them as perishable and have the options to sell, buy, or hold. Unlike the agricultural situation, these additional options mean that supply and demand curve gradients may change more quickly with time and are subject to influence by overall market sentiment, as well as general and specific news. In Chapter 2, Figure 2.5 showed the price oscillations resulting from supply and demand curves of equal magnitude but opposite sign. They are identical to those found in "rectangular" patterns such as double and triple tops and bottoms. Figure 2.6 showed that when the magnitude of the supply curve gradient exceeded that of the demand, the internals of a symmetrical triangle pattern resulted. Figure 2.7 showed that when the magnitude of the demand curve gradient exceeded that of the supply, the internals of an expanding triangle formation resulted. Diamond formations can be explained by shifts in the supply and demand curve gradients, where initially the demand curve gradient exceeds that of the supply (to produce an expanding oscillation), and after the diamond's apex, the supply curve gradient exceeds that of the demand (to produce a damped oscillation). Something similar happens with head and shoulders patterns, which begin with an expanding oscillation and finish with a damped one.

In a trend, there is a running fight between bulls and bears, but where there is a complex trading pattern, this becomes more of a pitched battle from which either a trend continuation or reversal may occur. Cobweb theory does not explain the outcome, but does help to explain what is going on inside complex patterns and flags the fact that a substantial fight is taking place. Pring's simile about defensive positions being breached on breakouts can be extended to say that cobweb models end on breakouts, and their bounding trendlines are their last defense prior to a brand-new price/time relationship taking over to govern price movements. In this context, a reminder is given of the introduction to technical analysis in Chapter 8, where the point was made that heuristics representing price last for a while and then break down. The confirmation of a pattern often represents a point where such a breakdown occurs—leaving the pattern user with the knowledge that an interesting point in the market has been reached and there is a need to make a judgment on price/time relationships that follow confirmation. One of the key issues in pattern research is to explore these postconfirmation price relationships and discover what they depend on. More will be said about this in the next section.

In rounded patterns, the running fight (between bulls and bears) of a trend continues, slowly grinds to a halt (without severe price oscillations), and slowly changes direction, with increasing volume, to produce the trend reversal.

POSTPATTERN PRICE BEHAVIOR: QUANTITATIVE BENEFITS OF PATTERNS

Literature on patterns admits that they do not always "work" in the intended sense, and that admission is supported by the limited studies that have been done to date. The major problem with these studies is that they treat patterns in a vacuum and fail to use them with other evidence that would be used in (professional) practice to assess their chances of success. In Chapter 15, we will describe how trends can happen in waves and how continuation patterns can form part or all of intermediate corrections between such waves. In Chapter 16 a description will be given of the use of momentum for overbought and/or oversold states and divergences with price, to assess chances of price reversals. In Chapter 4, the general point was made that the multiperspective viewpoint leads to fewer errors, which in this case means that averaging raw results of postpattern price movements (without first using additional information to assess whether or not a pattern is likely to work in the first place) is going to produce suboptimal results.

Descriptions in Chapters 15 and 16 form part of the missing ingredients to the limited studies on patterns I am aware of to date. Without wanting to be critical of such studies (my own carried out for Recognia included), a failure to simulate realistic pattern usage means they are of little practical value.

From another perspective, when patterns exist, they form an important part of judgments concerning trend continuations or reversals. Unfortunately, current practice of weighing evidence from multiple sources is subjective and difficult to quantify for pattern efficacy studies. The result is that until the time and resources exist to do proper simulations of professional pattern usage, objective evidence of their efficacies is not going to be available.

Indirect evidence of pattern efficacy exists from the simple fact that there are a number of cases in which the same patterns have been independently identified and written about, by traders on different continents, with very different cultures and languages, working in different markets, over different historical timescales.

The studies of pattern efficacy that are available do not simulate professional practice and were conducted mainly for patterns confirmed in the bull market of the late 1990s and start of the subsequent bear market after 2000. During the strong bull market, prices after any bearish pattern had to fight against a tide of investment frenzy, with badly diminished chances of success. By contrast, bullish patterns in this period appeared to perform well. Once the bear market had started, the reverse was true, with bearish patterns performing well and bullish patterns badly. Such time-varying behavior is called *nonstationary*. An investigation into the performance of different subspecies of patterns, to try to identify better-performing specifications, was generally inconclusive because performance differences between the different subspecies were not large.

The earlier warning about failures to simulate professional practice leading to unrepresentative results is repeated, and a warning given that conclusions of studies to date are both tentative and provisional:

1. Precise details of pattern specifications are less important than initially believed.
2. If we assume that patterns have a random variation of price movements following their confirmations, then the behavior of those price movements should be stationary. The fact that postconfirmation price behavior is nonstationary (that is, varies with time) suggests that patterns are signifying something.
3. Since the variation of postconfirmation price movements shows some correlation with market sentiment, it follows that a wider appreciation of market conditions needs to be taken into account in forming a judgment as to what a pattern signifies and where prices are likely to move after its confirmation.

In terms of the Bayesian logic of Chapter 4, the wider market conditions (that is, everything known about the market in general and investment climate for the financial instrument in question) can be expressed as a prior probability and the probability of some performance target being met (after a pattern has been recognized) as the likelihood. When these are combined, a posterior probability of a performance target being met in a predefined investment climate can then be found. At the time of this writing, work of this nature is in its formative stages, but it looks as if some results should become available in the next few years. In particular, work to date indicates that the view that a pattern automatically has a specific probability of meeting a performance target is incorrect—as it implicitly assumes that investment conditions following pattern confirmation are either irrelevant or constant. If either of those possibilities were correct, then postconfirmation price behavior would have been stationary, unlike the nonstationary behavior observed.

The summary of this section is that a simplistic view of pattern performance that ignores overall market conditions is significantly suboptimal. Professional practice of pattern usage needs to be simulated before viable results of efficacy become available. Pattern specifications and performance seem to be only weakly related, and within a Bayesian framework, more work needs to be done to relate prior probabilities to market conditions before significant progress on the issue of pattern performance is likely.

All of this ignores a raft of qualitative benefits, which historically have been of at least equal importance to the professional trader, which we now proceed to examine.

SITUATIONAL AWARENESS: QUALITATIVE BENEFITS OF PATTERNS

Situational awareness is a phrase commonly used by the military, particularly aircrew, to express the threats and opportunities they face in an unforgiving environment where bad decisions cost lives. It is an appropriate phrase to transpose to the markets, where bad decisions damage wealth and good decisions enhance it. Patterns improve situational awareness by revealing where battles between bulls and bears take place so that their outcomes can be used to assess market strengths or weaknesses. If a new trend starts with a reversal pattern and is subsequently confirmed by continuation patterns, the investor has an idea of where they currently are in any bull-bear cycle. But in any event, patterns, successful or not, are a useful way of assessing trend strength. Near a market top, it is not unusual to see a sequence of "failed" top reversal patterns, but the fact that they are forming at a place where a top might appear is a warning that should be heeded and a sign that a long position should be more closely monitored or exited. A parallel situation arises at market bottoms. Having patterns provide alerts for impending tops or bottoms is extremely useful because it helps in assessing prior probabilities for any Bayesian logic needed to assess the chances of later price reversals.

Frequently, reversal patterns are followed by sideways price movements preceding an actual reversal. Alternatively, a preceding trend may continue for a short while, which was the case for the failed triple top shown in Figure 11.3, confirmed in the early summer of 1929, which provided a timely warning that the bull trend of the 1920s was under attack and might end soon.

A typical action in response to a reversal pattern might be to exit a position or move a stop order closer to price in anticipation of a reversal.

Further action might be to monitor the financial instrument concerned to look for a trading opportunity. Apart from their value as trading signals, a regular basket of Web-delivered patterns also serves to narrow routine searches for candidate financial instruments offering investment opportunities.

The situational awareness of market battlegrounds between bulls and bears that patterns offer is difficult to put a value on, but it is something that experienced traders have used to their advantage for generations. Chapters 14, 15, and 16 will help to show how patterns are typically used. The value of situational awareness is difficult to convey to the inexperienced, but clues to trend strengths and price movements are numbered, and perspectives offered by patterns contribute to the story of a financial instrument that helps traders to form judgments about the future direction of its price. An example of this may be seen from Figures 11.5 and 11.6, where a bottom reversal in the Dow from the early 1930s bear market is signaled by two different trading patterns, of very different lengths, confirmed on two successive price bars. Their message was clear: that the various probing of extremes by price, both long term and short, gave strong (pattern) signals that prices would rise—which they did.

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CHAPTER 12

Forecasting Technologies and Their Limitations

Never forecast, because when you are right they never remember and when you are wrong they never let you forget.

Apologies to Mark Twain for paraphrasing his work.

If we could forecast, then most of technical and fundamental analysis would no longer be needed. The fact that they are reflects a combination of limitations in our abilities to forecast and impediments to the distribution of forecasts that are produced. All is not lost and some financial forecasts offered in some legislative regimes are going to find their ways to online investors; so this chapter describes the issues and what to expect, and it explores the frontiers of predictive technology.

Mark Twain's warning has not inhibited people from attempting to forecast prices—but it is not easy. Forecasting technologies are in an unstable evolutionary state, so the best technological forecasts are likely to be restricted to experts and their masters until their distribution can be widened. It is also important to know that, although they are heading toward an improved understanding of forecasting problems, experts are wrong more often than they would like. When good forecasts are available, decision making is simplified, and it may become possible to take or close a position near the end of a price move with minimal slippage. Additionally, a temporary trend reversal can probably be identified as such, and a bad trade, typically signaled by indicators, can be avoided. Forecasts should attempt to use all relevant previous knowledge and data to anticipate future prices. In contrast, indicators, patterns, trendlines, and the rest of technical analysis rely on prices to have moved in a direction before giving a signal, and the forecasting values of such signals is open to question. If regulatory and other problems can be overcome, price forecasts of varying qualities are likely to become readily available over the Internet, which is the working premise of this chapter. Assuming such forecasts become available, there then is an issue of appreciating their inherent limitations.

ISSUES IN FORECASTING

There are numerous problems that conspire to thwart good forecasting, so before getting into the subject, some background on these is needed.

Issue 1. Does a Basis Exist for a Forecast?

Before there can be a forecast, there needs to be a basis for one to exist. This means that a sufficiently consistent relationship has to be found to express future prices in terms of variables that are expected to be available to provide forecasts.

The implications of this simple statement are profound. In the worst cases, prices to be forecast may be pure noise, implying that no basis exists for forecasting them. Where prices are related to something, then that relationship needs to be detected and modeled so that it can provide the basis for a forecast. With economic time series, such relationships are generally weak and often subject to erratic variations, meaning that forecasts are unlikely to be consistent in quality. With regard to "erratic variations," the behavior of an individual company's share price is subject to a great many such variations, from causes as diverse as acquisitions to class actions related to its products. In contrast, the erratic variations of a stock index tend to be fewer—because many individual "blips" afflicting prices of its constituent stocks are smoothed out by the averaging process used to create the index. Gold is a haven for money in troubled times, which makes it subject to erratic behavior and difficult to forecast for any distance ahead. In general, the intrinsic strengths and consistencies of relationships needed for forecasting exist to different degrees in different financial instruments—leading to wide variations in accuracies of financial forecasts that are unrelated to methods used or abilities of the forecaster.

Put simply, if a sufficiently strong and consistent relationship exists to provide a basis for a forecast, then a forecast is possible; otherwise it is not. Thus, accuracies of Web-delivered forecasts can be only as good as the strengths and consistencies of relationships on which they are based. Since these vary with different financial instruments, it will be impossible for any supplier to offer a comprehensive forecasting service of consistent quality.

Issue 2. Availability of Variables for Forecasts

This issue concerns the mechanism whereby past and current data are used to create a forecast. Two common options exist to make variables available for forecasts.

The first option is to gather information up to a datum and then attempt to use those variables to forecast. One way of doing this is to find n relationships between current variables and prices from 1 to n time steps ahead to provide a sequence of n forecasts. This has been tried with the result that the further ahead (that is, increasing the value of n) the forecast horizon stretches, the worse the accuracy becomes.

A second option is to build forecasting models for all variables needed to support forecasts for the price in question. These models need forecast only one step ahead. They are initially applied to current variables to forecast a set of variables for a single time step ahead. Once obtained, the one-step-ahead variables can then be used with the same models to forecast another step ahead. In theory, this process can continue indefinitely for any forecast horizon. In practice, forecasting errors accumulate as the process continues, affecting the validity of the inputs used in the forecasting model(s), causing accuracies of later forecasts to degrade the further ahead of the starting point the process goes.

To the best of my knowledge, there is no way of getting around the problem of accuracies of financial forecasts degrading as they are pushed further beyond their starting points. Even with other classes of forecasting models, such as weather, the same rule of degrading accuracy with increasing forecast horizon also applies.

Issue 3. Separating Signal and Noise

Most models of economic time series implicitly or explicitly separate them into signal and noise components. *Noise* can be defined as random fluctuations in price that are superimposed on to a *signal* that is capable of being modeled. In this respect, forecasting models usually bear more resemblance to common indicators than patterns. An exception to this is the formula derived in Appendix 8.1, which predicts turning points for cobweb models. Typical forecasting models are based on *windows* of values from the target series to be forecast and any associated time series capable of contributing information to the forecasting process. The subdivision of a time series into signal and noise components may show some sensitivity to any window size used.

Issue 4. How Complex Should a Model Be?

In an ideal world, a perfect theory would exist to define the model, and this issue should not arise. In the real world, if a model is too simple, it fails to represent the signal optimally, and if it is too complex, then it models unrepeatable noise—with the result that it generates poor forecasts on previously unseen data. In data modeling, this issue is called the *bias/variance dilemma*, and it is explored more fully in Chris Bishop's book *Neural Networks for Pattern Recognition* (listed in the bibliography).

One way around this problem is to separate the data into a *training set*, to be used to find model parameters, and a *test set* to see how well a model performs on unseen data. Errors on the training (in-sample) data should be reduced with increasing model complexity whereas that on the test (out-of-sample) data should initially reduce (as the signal is modeled) and then increase (as increasing model complexity begins to incorporate unrepeatable noise from the training data). The model resulting in optimal signal/noise separation is the one whose complexity minimizes the test error—but as everybody who has tried this knows, a graph of test error against complexity is often noisy, and identifying a true minimum and associated complexity is an imprecise and subjective process. This means that a good many models of differing complexities need to be produced to generate the graph of test error against complexity before an attempt can be made to find the level of complexity that minimizes test error.

Strictly, the whole process should be repeated many times to ensure the model obtained is not specific to any lack of randomness in data separation into training and test files. The drawback with this process is that it is lengthy and fails to make the best use of the data—but it is simple in concept and the one that is probably most used. Note that the signal/noise separation comes through limiting the model complexity so that it cannot represent noise.

Two other techniques are described in Bishop's book. One is the *maximum a posteriori*, or MAP, technique, which involves complex multiple integrals that limit its application to low-dimensional problems. Another is known as the *evidence approximation*, and it is more widely applicable. Scientifically, the method has been categorized as *type II maximum likelihood*. Its origins lie deep within Bayesian theory, but the basic idea is to begin with a model that is too complicated and represents some noise, and then regularize it to achieve an optimal representation of any signal. An impression of the effect of regularization can be seen from the lower graphs of Figure 10.1.

The evidence approximation begins with the assumption that for a given type of model, if the probability of the model being correct is expressed as a function of the values of its parameters, the resulting multidimensional hypersurface of probability will be Gaussian in character—sharply peaked with a unique maximum. There is a criterion to identify conditions at the peak of such Gaussian hypersurfaces, and various optimization methods can eventually arrive there. This method is used (see Satchwell, James, and Bradley) to produce millions of nonlinear models monthly in support of around 30,000 monthly forecasts. Its big advantages are that all the data are used to support the forecasts; complexity optimization is objective; if the data are too noisy to be forecast, a criterion exists to recognize the situation and abandon the attempt; and it lends itself to a degree of automation.

Issue 5. Should a Forecast Come from Just One Model?

In Chapter 4, around equation 4.5, it was noted that the error from a committee of fully uncorrelated models was inversely proportional to the number of such models. In the absence of the perfect forecasting model, an improvement in forecasting accuracy can usually be found by generating many diverse models, assigning a credibility factor to each, and summing credibility-weighted results. The mechanism for doing this is essentially identical to one we shall see later in a context of portfolio theory, and the rationale is identical: Just as it pays to diversify investments to minimize portfolio risk, so it pays to diversify the credibility invested in any single forecasting model to minimize the portfolio forecasting error.

Issue 6. Does a Forecasting Model Need Explanations?

Where a forecasting model is being created to explore policy options (for example, the effect of changing interest rates on a country's economy), then an audit trail is useful to understand causes and effects. Robert Cialdini noted that explanations added credibility to a result, which is often the reason that explanations for forecasts are needed, so that a story can be prepared for, say, a bank loan or to convince somebody that an investment is worthwhile. Clive Granger notes that different economists would be likely to produce different econometric models for the same data, the implication of which is that explanations from all but a perfect model will not be unique and may be contradictory. At best, scope for lack of uniqueness compromises the value of explanations and, at worst, makes them illusory.

We noted earlier that multiple models could reduce errors. By the time they have been properly weighted and summed, the scope to offer intelligible explanations has all but vanished. This creates a dilemma in that a requirement for an intelligible explanation leads to a single-forecasting-model solution, and that for low forecasting errors to a multiple, diverse model solution. The practical choice is usually between a forecast derived from diverse models lacking explanations but having an expectation of greater accuracy or a single, usually linear, model with nonunique "explanations" that are very much open to question. Put another way, if explanations are insisted on, they may not be valid, and the potential to achieve the best possible forecasts is compromised.

Issue 7. The Statistical Nature of the Problem

The mindset of most people is that a forecast should be produced as an indicative value, which can then be found to be either right or wrong, depending on future actual values. This view fails to acknowledge that price forecasting models are incapable of anticipating the influence of future random events that have yet to happen. Consequently a better type of forecasting model would provide a series of probability distributions for future prices at future times. This would be termed a *stochastic forecasting model*. At best, conventional forecasting models provide the means of such distributions without an indication of how the distribution is likely to expand as time progresses. In other words, they purport to calculate a single indicative value of price for some future date. This is called a *deterministic forecasting model*. The nature of the forecasting problem is stochastic, not deterministic. So offering a deterministic answer to a stochastic problem will always leave scope for inquisitors to point their fingers at forecasts to claim they are "wrong." From the viewpoint of making investment decisions, if a series of probability distributions for prices at future dates were available, then probabilities of being stopped out or making a profit might be sensibly calculated—which they cannot be with unrealistic deterministic forecasts.

ECONOMETRIC FORECASTS

This type of forecast is the one that generally receives the most publicity and consequently is the one that tends to come to mind first. Typically, they are developed in a "bottom-up" fashion, with the particulars of the data to be forecast, and helpful explanatory variables, related through some economic theory that is usually linear. They offer one of the few ways of getting at "explanations," and, after considerable development, many have proved useful tools in guiding economies with a combination of their "what-if" capabilities and credible audit trails. Where there is limited data, economic theory can provide a basic framework (the equivalent of a prior probability) to make the best use of whatever data exist. But these types of forecasts have no track record of success in the markets, and there are a number of reasons why I believe them to be inappropriate for investors:

- Their forecasting abilities are compromised by the dilemma of Issue 6.
- They rely on human judgment and expertise to create and update. In the context of forecasts likely to be available to investors, the resources needed to create and update good econometric forecasts for thousands of financial instruments are unlikely to be justified by the price at which they can be sold.

- Perceived advantages of what-if capabilities and (nonunique) explanations are of questionable value to individual investors whose only ability to affect price is to buy or sell shares, without knowing what other investors are doing.

This is not to criticize econometric forecasts but to point out that for investors, other types of forecast are likely to be more relevant.

LINEAR TIME SERIES FORECASTS

There is a vast literature on this subject, but one account likely to be of interest is that given in the *Numerical Recipes* series of books (see Press et al. in the bibliography), which are available in a number of computer languages and contain code for a type of linear time series forecasting under the heading of "Linear Prediction." Its parameters are found by a technique known as known the *maximum entropy method*. Commercial software packages also exist for this technique of prediction. With a window of N elements, price P, and error ε, then weights **w** are sought to satisfy

$$P_n = \sum_{j=1}^{N} w_j P_{n-j} + \varepsilon_n \tag{12.1}$$

There are numerous variations of this technique, some involving models of errors ε_n, with some success being achieved. In the early 1990s I implemented some linear forecasting routines and showed the results to my then-employers, who rejected them. They subsequently bought a canned software package that worked on the same lines and decided not to proceed with that either.

The experience brings us to a fundamental point about the expectations that can reasonably be made of this kind of expression. In effect, it is saying that any forecasts produced must come from weights **w** and N previous values. Where this is sufficient to embody all the knowledge of all the history of the time series, it should work—which it does fairly well when there is a well-defined seasonal fluctuation of the time series and the length of the window size is matched to that seasonality (for example, multiples of 12 for monthly, seasonal data). For many market situations, the expression (12.1) is just too simple to reflect the complexity that exists, and a more complicated expression offers a better representation of the underlying relationships, and consequently a better result.

An issue that crops up time and again in the literature on this is that of stationarity. If the weights **w** are derived from, say, Dow price data, then the raw price data vary from about 30 to 13,000 between 1897 and 2000.

If a moving average μ_n is made from the last N values, terminating at and including P_n, then the weights can be computed for:

$$P_n = \mu_n \sum_{j=1}^{N} w_j \frac{P_{n-j}}{\mu_n} + \varepsilon_n \tag{12.2}$$

This may seem unnecessarily complicated, but it serves a useful purpose in that values of P_{n-j}/M_n tend to lie in a common range, which allows all the data in the series to be equally important in the weight calculation process, instead of its becoming biased toward the characteristics of the larger price values.

Another issue is that of stability. If we go deep into the mathematics of this process, we find that it does not work for values advancing in a geometric progression, such as the prices of Entrust Technologies (ENTU) in the dot-com boom, shown in Chapter 9. The *Numerical Recipes* routine has an ad hoc fix for this, which prevents forecasts from becoming unstable; but by doing so, it denies them the opportunity to behave in an interesting expansionary manner. A better solution is to convert the time series values to logarithms, as shown for ENTU in Figures 9.16 and 9.17, do the forecasting in log space, and convert the forecasts from log back to normal space after they have been obtained.

In research for this book, I reimplemented the (*Numerical Recipes*) routines I used in the early 1990s, looked at the results, and concluded that my then-employers were right to reject them. At the time, the commercial package probably gave better results and should have been improved with new tricks over the course of the ensuing decade.

There is an important point about linear forecasting software packages that needs to be appreciated. Anybody can buy a user-friendly software package and get a forecast for their data almost straight away without having to learn much about how to use it. Over time, the user can gather experience to judge when to trust its results and when to ignore them. Linear forecasting is unlikely to give the best possible results. But it should work reliably and consistently, and it is not too expensive, so for many, it offers the most practical forecasting option.

SOME BASICS OF NONLINEAR FORECASTING

In the late 1980s, amid great hype, neural network software packages for PCs began to appear. Neural networks offer a way of generating nonlinear models of data. At the time they were first marketed, they were used naively—typically without appreciating some of the following:

- Relationships that were being modeled would vary in strength and consistency for different financial instruments.
- Problems of complexity optimization existed, which meant that it was not good enough just to specify a mathematical architecture and expect good results.
- A time series needed to be made stationary before its characteristics could be modeled.
- There is value in using a carefully weighted portfolio of forecasting models to arrive at a final forecast.

Users were disappointed with their results, and overhyped neural networks got the blame. In many quarters their potential to deliver useful results with more skilled usage was not appreciated. That was unfortunate because, when used correctly, neural networks offer a way to model any consistent relationship that exists in time series data. They are *universal function approximators*, which is a way of saying that if a relationship exists, neural networks can (in theory) find it and model it. They differ from econometric models in that there is no audit trail from which an "explanation" can be offered. For those who want to try them, software packages are readily available, and they should have improved considerably since their overhyped introduction of the late 1980s.

At this stage I am going to become a little mathematical, but I will sum up the salient points in a nonmathematical fashion afterward.

Neural networks vary in form, but a typical one, a simple *multilayer perceptron* (MLP), can be represented by an expression of the kind

$$y = \lambda_0 + \sum_{j=1}^{M} \lambda_j \times \Phi_j(\mathbf{w}_j \times \mathbf{x}) \qquad (12.3)$$

where y is the output, $\mathbf{x}$ a vector of inputs, Φ_j a series of functions (typically logistic or hyperbolic tangents), $\mathbf{w}_j$ a series of weight vectors to ensure that each Φ_j receives a different input, λ_0 a constant, and λ_1 to λ_M a series of weights, known as *output weights*, that weight the outputs from Φ_1 to Φ_M.

The process of finding values for λ's and **w**'s is called *training*. In the case of an MLP, a problem arises because a nonlinear function $\Phi_j(\mathbf{w}_j)$ exists between the output y and weights $\mathbf{w}_j$ that need to be found. For each output variable y, there needs to be a sufficient number of representative examples of inputs and associated output(s), known as *patterns* ($\mathbf{x}_n$, t_n), for the training process to proceed. An error function is set up as

$$E = \sum_{n} [t_n - y(\mathbf{x}_n)]^2$$

and gradients are found for the variation of E with respect to λ_j and w_{jk}. This establishes the directions that λ_j and w_{jk} need to be changed to minimize the error function E. There are then a number of algorithms for changing λ_j and w_{jk} to minimize E, that go by such names as *gradient descent* or *scaled conjugate gradients*. Weights are usually initialized with small values and the optimization algorithm applied. There is no guarantee that it will reach a global optimum. It can get stuck at a local optimum well short of the global or find itself in a situation known as *saturation*, in which gradients are effectively zero and the optimization process effectively ends. Fortunately, the algorithms work enough of the time for them to be useful, but they need watching. For those who want to investigate further, the books by Chris Bishop or Simon Haykin, listed in the bibliography, are recommended.

A different approach, originating from D. S. Broomhead and D. Lowe, is that of *radial basis functions* (RBFs), which usually takes the form

$$y = \lambda_0 + \sum_{j=1}^{M} \lambda_j \, \Phi_j(\mathbf{x} - \mathbf{x}_{0j}) \tag{12.4}$$

In this case $\Phi_j(\mathbf{x} - \mathbf{x}_{0j})$ might be a multidimensional Gaussian distribution centered on $\mathbf{x}_{0j}$. With RBFs, the idea is to create a model based on a series of functions that radiate outward from predefined centers $\mathbf{x}_{0j}$. The centers are usually chosen by a clustering technique applied to values of $\mathbf{x}$ in the training data, the idea of which is to find appropriately positioned clusters to offer a representative description of the input space for which training data are available.

For most basis functions there is also a need to specify another parameter, known as a *receptive field*, that tunes the basis function's spread. In the case of the Gaussian distribution mentioned earlier, the receptive field is the standard deviation. If a highly peaked basis function is sought, its receptive field is chosen to be small; if a basis function with a wide spread is sought, its receptive field is chosen to be large. Various heuristics exist to define receptive fields, one based on the average distance to, say, the four closest clusters scaled to ensure a smooth variation of the aggregated basis functions between centers. Once centers and receptive fields are defined, values of λ can be found by multiple, linear regression—which is an extension of the ideas in Appendix 10.3.

RBFs are relatively easy to train and offer the opportunity to embed prior knowledge through the choice of centers and receptive fields. However, they have no mechanism for automatically diminishing the importance of irrelevant input variables, which means that where uncertainty on input variable relevance exists, homework needs to be done on the choice of which input variables to use. Comments made later in this chapter on mutual information indicate a way of doing this.

To sum up:

- Sufficient representative data, containing examples of input and corresponding output variables, need to be available to calculate weights.
- *Radial Basis Functions* (RBFs) are a way of producing nonlinear models that can be automated.
- *Multilayer perceptrons* (MLPs) require more supervision (and much more time) over their training and are less easy to automate.
- Finding weights for an MLP can be problematic, and results need to be checked for sanity in case the optimization process that is supposed to find them has gone awry.
- MLPs and RBFs are universal function approximators and offer no audit trail from which a result can be "explained."

SINGLE TIME SERIES FORECASTING

Single time series forecasting involves producing a forecast solely from values within the target time series. There is an intellectual basis for this, which is a theory that conceives of a high-dimensional surface onto which the movement of a past time series can be mapped. The process is reminiscent of mapping the progress of past hurricanes on nautical charts; if their usual routes are known, the next time one appears, the progress of previous hurricanes close to the present can be examined to see where this one is likely to head. Using this principle, a suitably sized "window" of prior values is mapped onto the high-dimensional surface, and trajectories from nearby points on the surface are used to determine future price direction. A well-written reference on this and other ideas of nonlinear forecasting is Holger Kantz and Thomas Schreiber's *Nonlinear Time Series Analysis*.

Let me say at this point that I have no conclusive experimental evidence to support this theory for financial forecasts, but in trying to find some, I have generated some interesting results. A paper describing the basis of the method used, by D. Lowe and N. Hazaraki, is listed in the bibliography. The idea is to define a window of values, transform it into another space, do the forecasting in that space, and convert the forecasts back to the original.

As an example of how this might work, in Chapter 10, Figure 10.10, a window size of 15 was used, and prices were represented by a quadratic expression:

$$\text{Price} = a_0 + a_1 \times t + a_2 \times t^2 \tag{12.5}$$

If a sequence of such windows is moved progressively through the time series and values of a_0, a_1, and a_2 calculated for each, then three new time series are generated, for a_0, a_1, and a_2. Values of a_0, a_1, and a_2 can then be forecast and (12.5) used to convert them back to price.

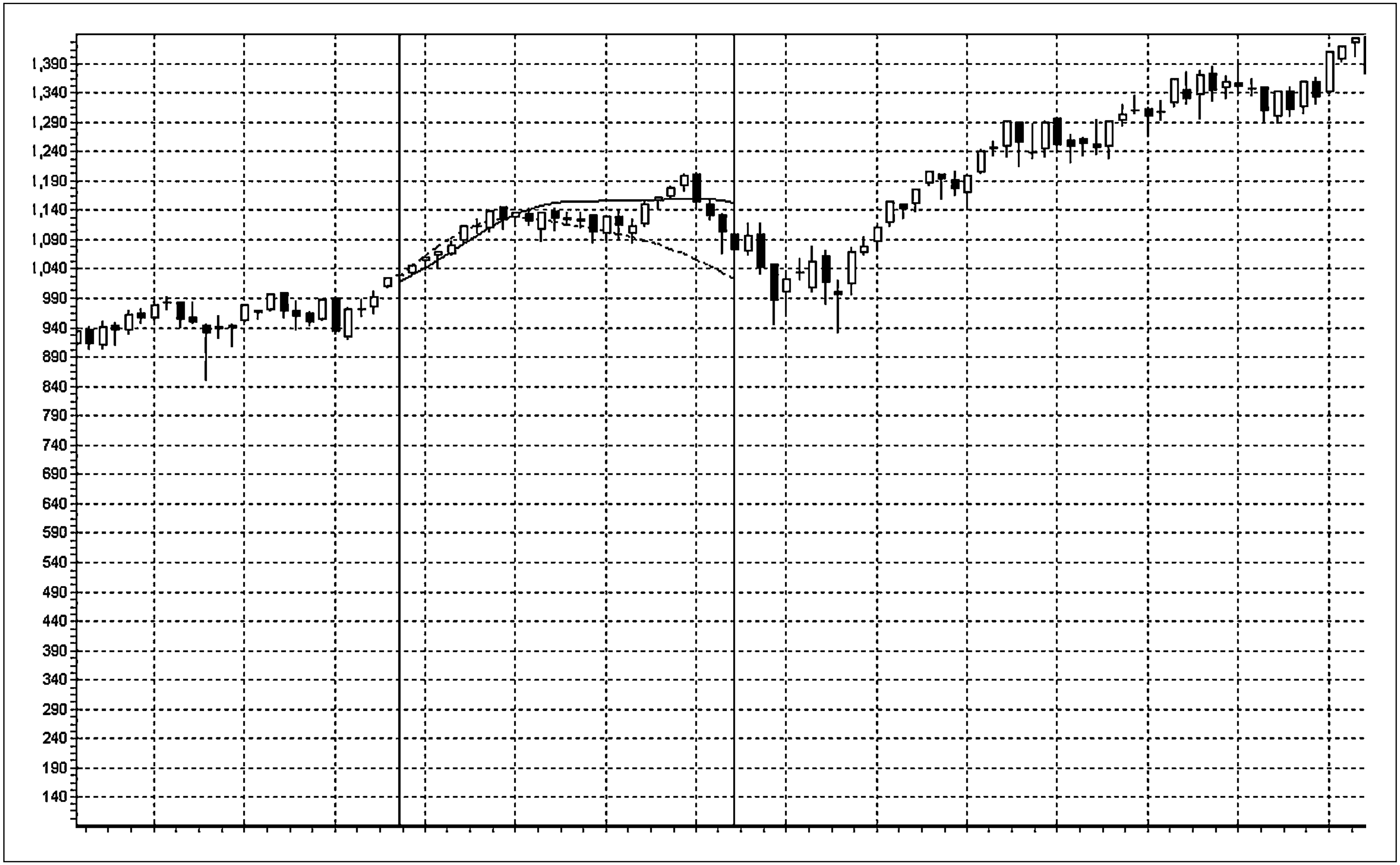
In practice, more complex mathematical transformations are usually used—the idea being to find a transformation that maps price into a space where forecasting methods can work more effectively. Typically, the forecasting method would be a nonlinear model from which the next value is expressed as a function of current values of the transformed variables. This is then used successively to generate forecasts as described in option 2 of Issue 2. Once again, this is a process that improves forecasting ability but moves ever further from the explanations that economists and others seek. How well this works seems to depend on

- The window size used.
- The degree of corroboration between forecasts from windows of different sizes.
- The starting point for the forecast—for example, forecasting from a point just after a trend has started seems to produce a good forecast, and forecasting just after a market has received a shock, a bad forecast.
- The financial instrument being forecast and the strength and consistencies of relationships between current prices and previous ones.

Unfortunately, forecasts come without guarantees, but this guidance is the result of looking at a good many forecasts derived from this method. Figures 12.1 through 12.3 show the results of this kind of forecasting on the S&P 500 during 1998 and 1999. A series of three, consecutive 26-week forecasts are made with window sizes of 26 and 38. The first two of these have corroborated forecasts and are generally correct. The final forecast reflects a more uncertain situation in which corroboration is not present, the 38-week forecast is fairly good initially, with the 26-week forecast being incorrect, and the reverse situation being the case some 18 weeks into the forecast.

CHOICE OF VARIABLES FOR MULTI–TIME SERIES MODELS

In classic time series forecasting, such as the linear method mentioned earlier, a future value is expressed as a function of previous values. With econometric-type forecasts, future values may additionally be expressed in terms of values from other time series. Questions therefore arise as to how many previous values of the target time series to use or which other time series to use. Within the context of linear modeling, these can be resolved by correlations, but with nonlinear modeling, the situation is more complex.



F I G U R E 1 2 . 1

Out-of-sample 26-week forecasts for the S&P 500, between 13 February 1998 and 14 August 1998 are shown for a 26-week window (dotted line) and a 38-week window (solid line). Had the forecast been started 2 weeks earlier, it would have been less good.

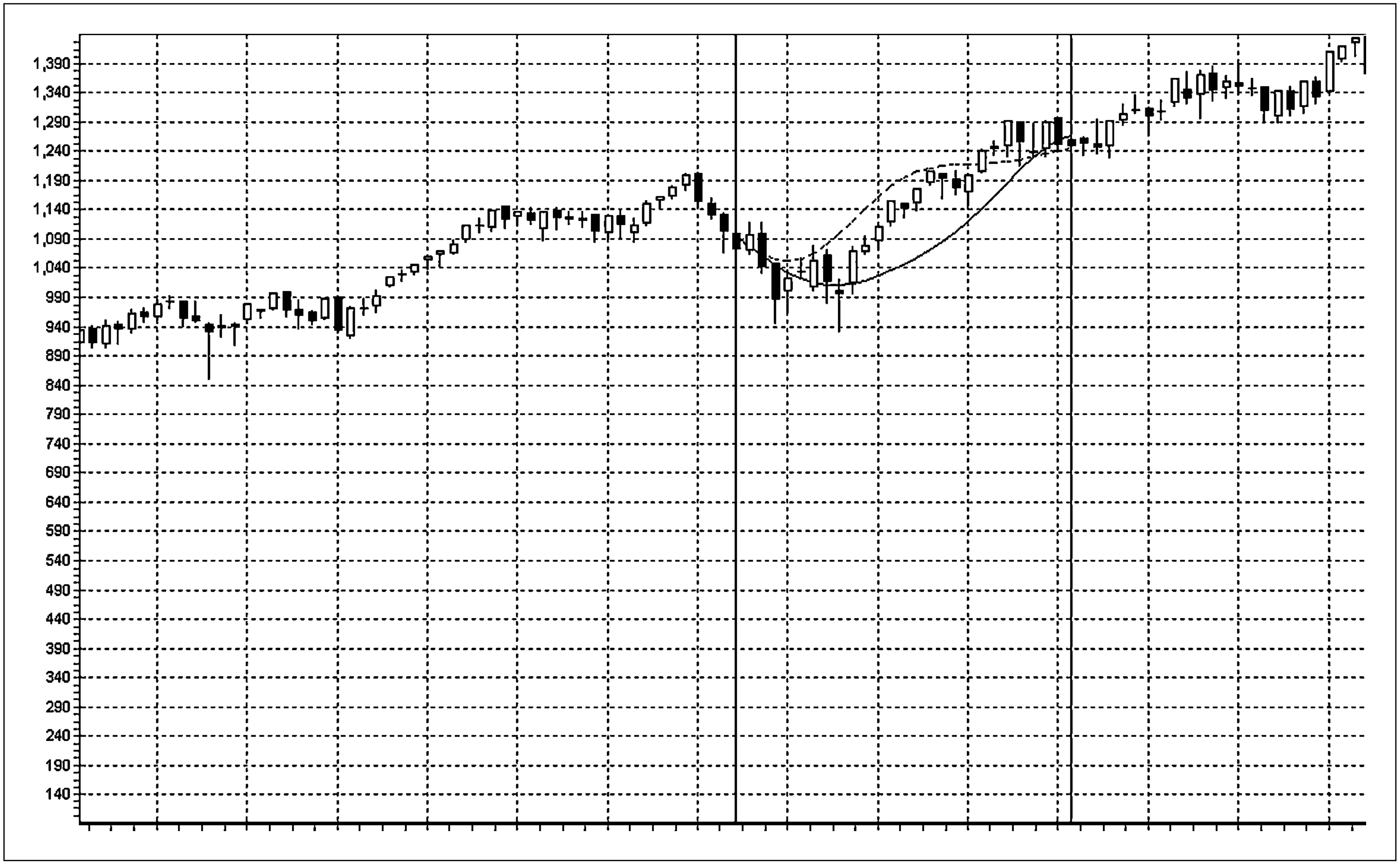


FIGURE 12.2

This forecast follows directly from the last date of Figure 12.1. It shows out-of-sample forecasts for a 26-week window (dotted line) and a 38-week window (solid line). From this starting date, the (bottom) turning point is well predicted, and the forecast could have been used to avoid being sucked into a short trade that might have been signaled by indicators.

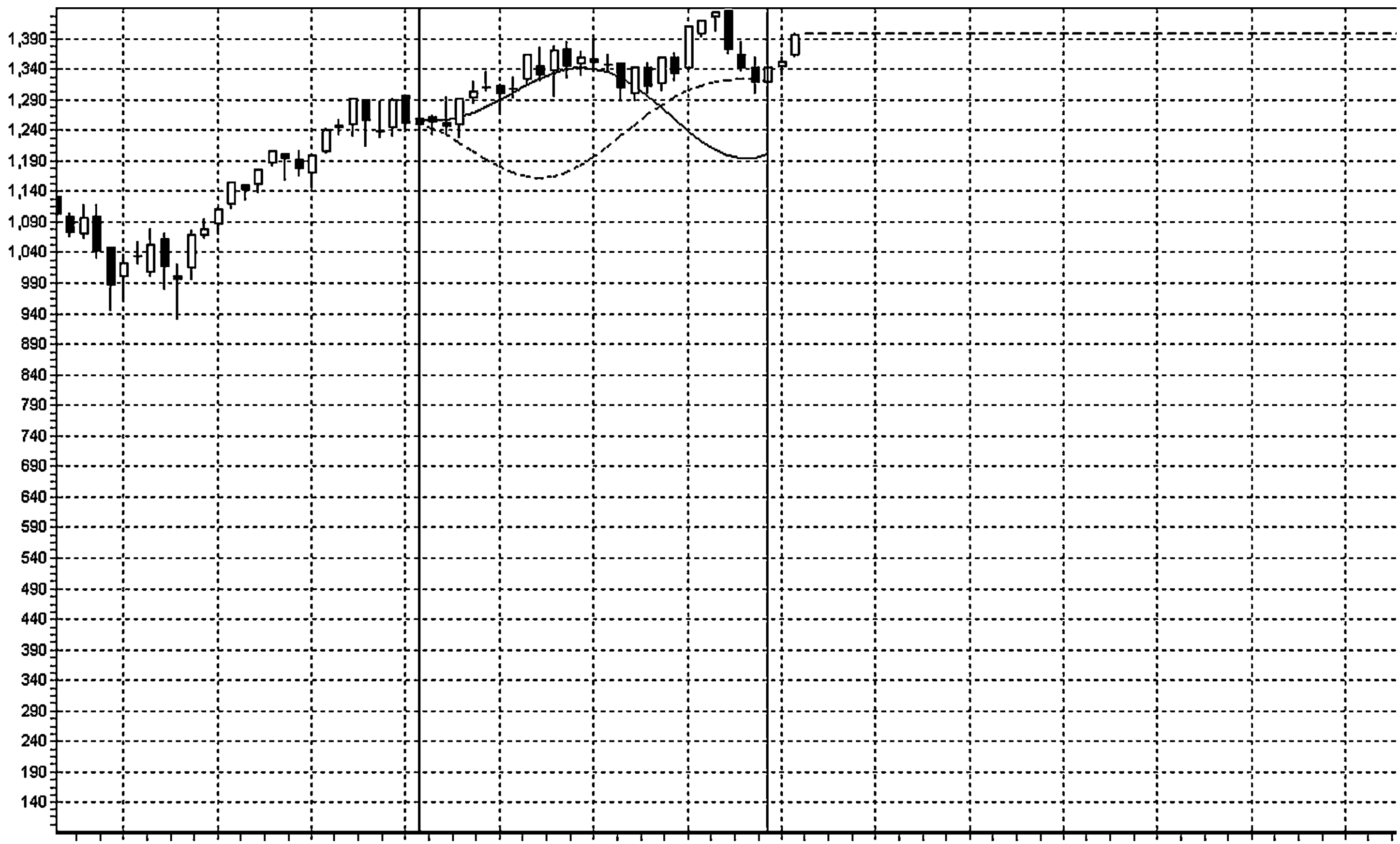


FIGURE 12.3

In these out-of-sample forecasts, between 12 February 1999 and 13 August 1999, the 26-week window (dotted line) forecast disagrees with the 38-week forecast (solid line). This lack of corroboration is an indication of uncertainty in the forecasts and is a situation in which less credence would be given to them.

To illustrate the difficulty, consider the correlation between two sine wave time series with a varying phase shift. With zero or 360-degree phase shift, correlations are 1. With a 90- or 270-degree phase shift, correlations are zero. With a 180-degree phase shift, correlation is –1. Thus, despite the two time series being identical in shape, a simple phase shift can produce any feasible value for their correlations.

A better way of measuring the degree of association between two time series is through the idea of mutual information. This is described in Simon Haykin's book on neural networks, and related routines to calculate the strengths of associations between variables are given in *Numerical Recipes* (see Press et al. in the bibliography).

The idea of mutual information derives from information theory. A frequency distribution (usually in the form of a histogram) of time series values is prepared from which a measure of disorder in the data (known as *information entropy*) is calculated. The second time series is now introduced and a two-dimensional frequency distribution obtained, from which the disorder in the first time series, after seeing the second, is calculated. Any reduction in disorder (known as *mutual information*) represents the information the second time series can contribute to forecasting the first.

This provides a basis whereby candidate time series can be assessed for the information value they can contribute to the forecasting of the target time series. With more than one contributing time series in the forecasting process, this calculation becomes more complex. But the general problem of finding the optimal combination of contributing time series can be addressed with sophisticated routines that optimize mutual information.

There is a word of warning here: There should be reason to believe that all candidate time series from which an optimal combination is being sought should be genuinely (and not coincidentally) related to the target time series to be forecast. This is an area where economists' observations are usually worth listening to.

Apart from time series forecasting, mutual information provides a basis for finding a combination of input variables that offer the strongest association with an output variable and therefore offer the best choice for a nonlinear model to forecast the output.

MULTIPLE TIME SERIES

A commercial multiple time series forecasting process that uses the ideas of this chapter is described in Satchwell, James, and Bradley, listed in the bibliography. The program was developed to forecast monthly data for relatively short time series, which raises another issue, that of finding a suitable forecasting method for the available data. When a time series is short, it may provide too small a snapshot of its possible behavior for its data to be adequately representative, in which case the model is applicable only for the conditions represented by the data. Usually, the addition of other time series not only contributes information but also allows smaller windows to be used with the target time series. The result is that the shorter the time series, the more the information that should be sought from other sources.

The idea behind this method is to generate a large number of models, designed to be as uncorrelated as possible, and then average them to get a forecast. Each model is based on a twin time series consisting of the target series and one associated series, chosen on the basis of mutual information. The process is separated into separate modules for forecasting associated series and (later) target series. Associated series consist mainly of econometric data, to be forecast 60 months ahead.

To focus first on the module that forecasts associated series: An initial program uses mutual information to find the optimal preprocessing and window size for each possible associated series. Successively, each associated series is treated as a target, and twin-series forecasting models are developed using its values and (for each model individually) those of the 10 other associated series contributing the most mutual information to it. These models are then reinitialized and a further 40 models generated from the same input data. When 50 such forecasting models have been completed for each associated series, the averages of their outputs are used to obtain forecasts for all associated series for a single time step ahead. This generates the information needed to produce forecasts for the next time step, and the process continues up to a forecast horizon. The result is a five-year forecast representing the country's economy. Having completed the econometric side in the first module, the second module uses a similar process to find the 10 associated series having the most mutual information with a target series. Again, some 50 forecasting models are developed and the target series forecast from them, based on the preforecast associated series. This is unlikely to be the most sophisticated forecasting operation, but it indicates the direction in which improved forecasting technology is heading. It is described here partly to make the point that this kind of forecasting requires a data marshaling and validation operation and the ability to produce millions of nonlinear models on the fly, which are problematic to deliver as a simple software packages.

Unlike the earlier types of forecasting mentioned, it is unrealistic to offer these data-heavy, processing-intensive systems as software packages, but it is realistic to offer results from them as a forecasting service. To generate improved forecasts is therefore likely to require large data acquisition and cutting-edge modeling capabilities, which will take us to an era where a service is capable of delivering better forecasts than a data-poor software package. For the individual investor, the current situation in financial forecasting can be likened to that of weather forecasting of a bygone era, where local observations of wind, temperature, pressure, and clouds were all that an individual had to assess the future weather. For the individual investor, there is currently no parallel financial forecast to those of the large supercomputers that digest worldwide weather observations and process them into moving weather maps to be delivered by television and Internet to millions of users. Looking into the future, a better-informed investing public is likely to tire of being restricted to the financial equivalent of the thermometer and barometer and quite reasonably ask for the financial equivalent of a moving weather map to help them with their decisions. At the time of this writing, one impediment to this quite reasonable expectation comes from regulation.

REGULATION AND FORECASTS

In many countries, legislation exists to prevent excessive claims of financial performance from being made in order to protect investors' savings from rogue salespeople. Such legislation usually has three principal tenets governing the sellers of financial recommendations: They should be competent, they should be regulated, and they should know their clients' financial circumstances. A forecasting service could be considered to be financial advice and so could be caught by such legislation. Thus, while the position remains unclear, businesses cannot be built on the basis of unregulated distribution of financial forecasts. The vague position of Internet-distributed forecasts is a matter that needs to be resolved to establish if a viable commercial basis can exist to sell them and, in so doing, generate the finance for the development of forecasting technologies. The fundamental inequity with the present situation is that some major financial institutions have the advantage of access to the results of good forecasting models that are, in part, denied to the small investor by the (presumably) unintended consequences of legislation designed to protect their interests.

PART FOUR

Trading Decisions

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CHAPTER 13

Introduction

The purpose of the three preceding parts of this book was to supply the background for this, its final part. In this part, techniques will be given to aggregate the diverse components talked about so far into strategies for making decisions, an example of which will be given in Chapter 19.

Before then, chapters on exits, trends, and contrarian techniques are offered to show how the ideas presented so far can be used as ingredients for trading systems, which will be described in Chapter 17. Giving exits a chapter to themselves acknowledges that they are a more difficult problem then entries. Before an entry is made, there is the luxury of leaving cash on deposit and not risking exposure. After making an entry, exposure exists, and its associated risk needs to be properly managed. Failing to make a good entry might mean that a potential profit opportunity is missed. Failing to make a good exit means that real money is given back to the market. The net result is that there is less room to be choosy about exits than there is for entries.

Trends are usually said to be the trader's friend, which is why they merit a chapter to examine their characteristics. The importance of trends for the small investor is that they probably offer them the best chance of making money, and so ways of recognizing and exploiting them need to be studied. Trends often involve moves followed by temporary reversals, and various "wave" theories have been developed to describe their behaviors. The study of trends leads to the idea of what is not a trend—which is a sideways market—and hazards will be described for the unwary who mistakenly use trend-following methods in such markets.

At the start of any trend, there is uncertainty as to whether an innocuous price move will develop into a full-blown trend and a conflict between wanting to take a position early to exploit a trend and the need to avoid taking a position until there is reasonable confirmation that a trend has developed. The basic problem is that uncertainty about a trend's continuance lingers for long after it has started. Some technical trend confirmation signals are triggered just when a temporary trend reverses. It is quite common to see a damaging succession of such signals during sideways markets.

Contrarian techniques exist to try to identify likely turning points or confirm them soon after they have started. Fundamental techniques that take positions against the direction of price movement are implicitly contrarian as they work on the premise that a mismatch between fair value and price will be corrected. Other techniques will be examined, notably something called *relative strength* and signals given by *divergences* between peaks and troughs in price momentum and corresponding extremes in price. If you are a little confused by the terminology, do not worry—all will be explained.

Some of the techniques described will be incorporated into an example of a trading system, and various issues to do with parameter optimization explored. Trading systems can produce files of data to show their historic profitability on different instruments. These files can be used by *modern portfolio theory* to work out how much to invest in each instrument for a portfolio that delivers the minimum risk for a given return.

Issues to do with portfolios are not obvious, so they merit a chapter of their own. One such issue concerns how to construct a portfolio to be insensitive to overall market price movements.

Our final chapter is more of the "how-to-do-it" variety and shows how a job-friendly portfolio can be built and managed using weekly signals, weekend study, and orders placed for execution on Monday opening.

CHAPTER 14

Exits

Exits are vital to any investment strategy that is to enrich the investor's monetary position, rather than his or her estate, which is why exits merit a chapter to themselves.

Prior to making any investment, exit routes should be researched for both expected and unexpected scenarios. Since exits feature before entries in an investor's task list, it follows that they should also precede them in this part of the book.

Exits are more difficult than entries. Without a position, there is the option of doing nothing until good signals appear for an entry. With a position, a responsibility for managing it arises. If a position is taken on an opportunist signal such as a pattern, there is no guarantee that a similar opportunist signal will occur at the ideal exit point; and, in general, there are likely to be fewer clues to define the best exit than there were to suggest the original entry. The result is that exit decisions often have to be made in circumstances where the signals for them are unclear, but where *not* exiting on those signals carries a greater risk of loss than exiting on them.

WHAT IS THE EXIT TO BE FROM? NOT ALL EXITS ARE EQUAL

Exit strategies need to take into account the nature of the financial instruments to be exited. Selling shares in a thinly traded small company on a junior exchange requires a very different strategy to selling them in a major company trading on the NYSE. The small company might have days when there is no trading in its shares. And, on the days when there is trading, average transaction volumes might be small relative to the size of the sell order, requiring the complete order to be dribbled into the market through a series of smaller ones, whose selling pressure may well drive prices down. Spreads for such shares can sometimes be a good proportion of their value. Those who find themselves in the position of having to dispose of such shares as a result of unfulfilled original expectations will probably learn from the experience and develop better criteria for their future share purchases. All need to learn that exits need to be considered *before* positions are taken and not after.

When prices are booming, and a crash imminent, any protective stop-loss order may be ineffective—as prices may crash though its level without finding a buyer. Under such circumstances, an exit may need to be planned and executed on the way up and not after the market has turned. This tends to be more of a problem with tops than bottoms, but all short positions eventually have to be covered, prices do sometimes jump upward (for example, in response to an acquisition announcement), and the parallel situation with short trades does happen.

For shares or financial instruments that have higher liquidity and lower spreads, these considerations are less of a problem, but there is still likely to be variable slippage, which needs to be considered. When a market is moving with a position (upward for long, downward for short), there should be less slippage for a position exited *with* the market than one that exited *against* it. As an example, a long position exited in a rising market should suffer less slippage than a long position exited in a falling market. Note here that if indicators and complex patterns are used for exits, both require some market movement against a position in order to generate their signals—which is likely to mean relatively higher slippage. Looking at volumes and bid/ask spreads takes only a minute on the Internet and should help to provide a considered judgment on slippage levels, which should be considered prior to taking a position.

The basic objective should be to get an idea of likely exit options and establish if there is anything specific to a financial instrument that may affect the exit of a position taken in it.

EXITS AND INVESTMENT OBJECTIVES

Other things being equal, if there is an investment opportunity as good as, but not significantly better than, an existing one, it pays to stay with it rather than suffer the overhead of commission, slippage, and possibly taxes. This reality colors the way many handle their investments and deters them from change. On the other hand, an investor may have spied opportunities whose prospects he or she believes to be good enough to justify taking a hit on an existing investment in order to take advantage of. The choice of whether or not to exit becomes a matter of research, judgment, investment style, and objectives, and it is difficult to make general comments on. Barring crashes and other major reversals, the main point is that there are no "right" exit points for everybody as they depend on personal preferences and opportunities.

INFLUENCE OF NEWS

The effect of news on the markets is difficult to judge. Where the market is flat and searching for a direction, it can become news sensitive, and news can have a dramatic effect. This was the case in 1940, shown in Figure 14.1. The Dow had been hovering around 150 for a while when, after a successful lightening strike by Germany in early May 1940, the French government sought an armistice. Over a three-week period, the Dow passed through most of its eventual 27 percent fall to a value of around 110. In troubled times, dramatic events that have not been discounted by the markets are likely and markets vulnerable to changes unrelated to the fundamentals of an individual company.

In contrast, America's entry into World War II (Figure 3.6) and the Cuban Missile Crisis barely registered on the Dow, but the events of 11 September 2001 did, as Figure 3.7 shows.

Markets that are grossly overbought are going to be sensitive to bad news and probably insensitive to good. On the other hand, markets that are oversold will probably be sensitive to good news and insensitive to bad. Markets that are searching for a direction are likely to become sensitive to any news, and the flat prices of the Dow in the early months of 1940 may have made its reaction to the news of the fall of France greater than it might otherwise have been.

The issue here is to be aware that such changes can happen (even if they cannot be foreseen) and to have a contingency plan to deal with them. This may involve a decision on whether you should be in the markets at all in uncertain times. Exiting for cash is one option. Another is to develop a hedging strategy to protect against market falls. One of the simplest ways of doing this is to introduce a number of short positions into an otherwise "long" portfolio. In the event of the overall market falling, the profits on the short positions are there to offset the losses on the long.

An adage from Part 2 about selling stocks you hold when their stories change also belongs in this section. It may not apply when stories change for the better, or as a result of some entirely unforeseeable and unforeseen event, but when a new plausible tale emerges to replace one that did not work out as planned, the credibility of the new tale will usually merit less credibility than the original.

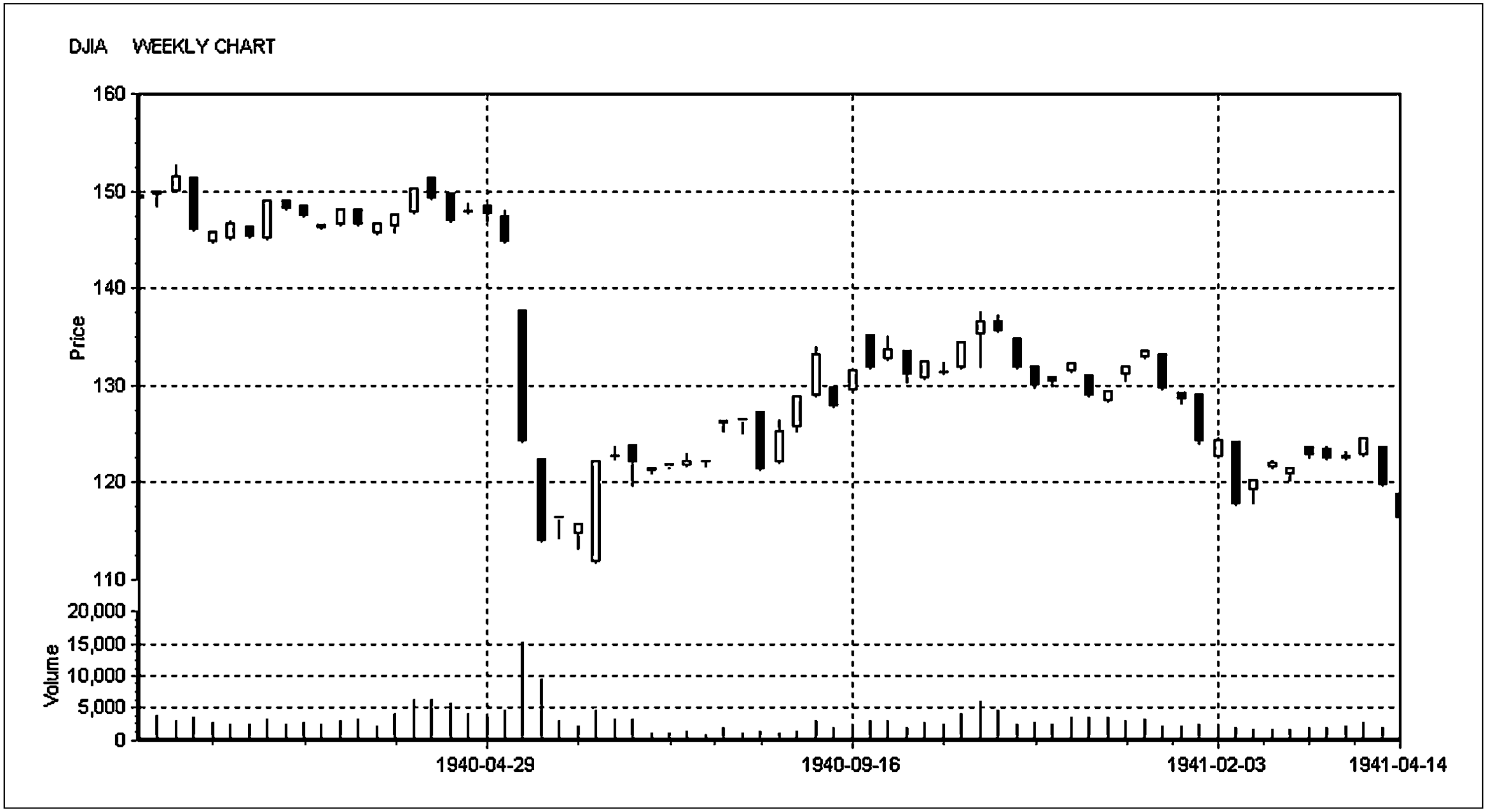


FIGURE 14.1

There are times when the market is sensitive to news. One of these is when it has been flat for a while and is searching for a sense of direction. The massive drop in early May 1940 coincided with the unexpected German victory in France and, in Britain's darkest hour, an expectation that it too would succumb shortly after.

VALUE EXITS

In Part 2, fundamentals were examined, and the basic idea was to take a long position in an underpriced company or (less obviously) short position in an overpriced company, in the expectation of prices moving toward an intrinsic value. The point was also made that share prices are not a clearly defined function of fundamentals, making it difficult to time any decision on the basis of them. There were two particularly relevant criteria: the value represented by a share relative to its peers and to the market as a whole. The principal variable is price/earnings (P/E) ratio, which, even if justified by earnings, growth rate, and accounting ratios, may cease to be justified by the market's perception of a company's future trading conditions. In such cases share prices are likely to fall. A *value exit* is a situation in which a decision is made that a share is too over or under-priced to justify continued exposure to the threat of a price correction.

OPPORTUNITY EXITS

This is a situation in which a position is exited because a better opportunity exists to use the money locked up in it. A pertinent question to ask when reviewing a portfolio is, If you did not already have your current position, would you enter it now?

EXITS ON PRICE TARGETS

It was mentioned earlier that one of the considerations before taking a position should be to assess if having a price target is prudent. One situation in which this is likely to be the case is where prices are behaving logarithmically—that is, advancing or declining as part of a geometric (rather than arithmetic) progression. Such advances or declines (particularly advances) are likely to end with sharp reversals, but they may revert to a slower advance before that happens, which, with luck, might be detected by a trendline drawn on a logarithmic chart. A less risky option is to decide on a target profit for an investment and exit when the price that achieves that objective is met.

Support and resistance levels are also widely used as targets. Financial instruments sometimes trade within ranges that are well defined by two specific support and resistance levels. Typically, a long position would be taken just after prices had bounced off the support line, a (sell) stop order placed just below that support line, and a (sell) price target set just below the resistance line. The corresponding short trade would involve a short position taken just after prices bounced off the resistance line, a (buy) stop order just above the resistance line, and a (buy) price target just above the support line. There are many other strategies that use support or resistance lines to base targets or stops on, which is one of the reasons why they represent hurdles to price movement. Support and resistance lines are compelling to decision makers because they represent actual levels at which prices have faltered or turned in the past, thereby creating an expectation that they may do so again at the same levels.

Fibonacci ratios (derived from the quotients of two large numbers in a Fibonacci series) offer another way of setting targets that is fairly widely used. To recap, the ratios of two (relatively small) values in the Fibonacci series, 144 and 233, are either (233/144 =) 1.618 or (144/233 =) 0.618. Interestingly, to three decimal places, 0.618 times 1.618 is 1. The number 0.618 was known in ancient times as the *golden ratio* for the two different lengths of a rectangle. Its proportions had a major influence on classical art and architecture. Given such mysterious and well-known properties, it is not surprising that people should look for price movements in terms of Fibonacci ratios. Before going into the details of how they are used, we need to establish a series for these ratios. If we begin with the number 1 and develop a series where each number is 0.618 times its previous value, then the series develops as 1, 0.618, 0.382, 0.236, 0.146. Similarly, if we again begin with the number 1 and develop a series where each number is 1.618 times its previous value, the series develops as 1, 1.618, 2.618, 4.236. Merging these two series creates one that contains most of the Fibonacci ratios used in the markets—that is, 0.146, 0.236, 0.382, 0.618, 1, 1.618, 2.618, 4.236. The final number—which is widely used but does not actually belong to the series but is associated with it—is the midpoint between 0.382 and 0.618, which is exactly one-half (0.5).

The ratios are often used to set targets for price retracements in a trend. If prices rise and then fall back (that is, *retrace*), targets for the level at which a retracement ends are calculated as a Fibonacci ratio of the previous rise. To put some figures to this, if prices rose by 100c, to 200c, and then started to retrace, levels at which the retracement ends might be at $(200 - 0.382 \times 100) = 161.8$c, $(200 - 0.5 \times 100) = 150$c, and $(200 - 0.618 \times 100) = 138.2$c. Likewise, if prices fell from 200c down to 100c and then started to rise, levels for the end of the retracement might be at $(100 + 0.382 \times 100 =)$ 138.2, $(100 + 0.5 \times 100 =)$ 150c, and $(100 + 0.618 \times 100) = 161.8$c. The extent to which these levels "work" remains an open question, but after support and resistance levels, this is probably the next most popular way of determining reversal levels, and for that reason alone they are difficult to ignore.

Although they are very much in the minority at present, forecasts offer another option to guide price targets. For figures shown in Chapter 12, in the case of Figures 12.1 the forecast would have provided a good target.

Figure 12.2 would have probably been interpreted to avoid a short trade and in that sense would have "worked" even though a target was inappropriate. In Figure 12.3, uncertainty over the forecasts might have suggested the use of other methods to set a target.

TRADING PATTERN EXITS

Trading patterns were described in Chapter 11. Reversal patterns indicate an opportunist exit is available. Moves expected from complex patterns are greater than those from one-bar patterns, and this may need to be taken into account with varying trading styles, with the more nervous (sometimes with good reason!) taking every pattern exit and the more laid back, only those patterns that are complex. Note that one-bar simple patterns offer "hair-trigger" exits, which can be particularly useful when a move that has produced a profit looks as if it is coming to an end. In Chapter 16, in a context of contrarian decisions, the combined use of patterns and momentum will be discussed. The techniques described there are particularly useful for exits near to price turning points.

There is one type of pattern, although not usually categorized as such, that we have not yet covered. These are various kinds of wave formations that we shall meet in the next chapter. They are interesting because they are anticipatory in character and provide clues for exits prior to their confirmation.

INDICATOR EXITS

Indicators, described in Chapter 10, generate buy or sell signals that can be used as exits. Two indicators in particular (the parabolic and filtered line) were singled out in Chapter 10 for use in developing stops. These will be examined in further detail later in the chapter.

STOPS

Planned exits are fine, but in the markets it is useful to have a fall-back position to try to protect wealth in the event of a significant and unanticipated adverse price movement. That is the primary function of stops, although by sequentially moving them to follow price, they can be used to allow a profitable position to run, offer some protection against loss, and provide a reasonable exit when prices finally reverse. This is the assumption that will be used, and appropriate stops will be developed for it.

A long position may be protected by a *sell* stop order, placed at a lower price than current prices, which is an order to the effect that if prices fall to its level, an action is triggered for the position is to be liquidated (that is, sold). There is no guarantee that the price obtained will be as high as the level of the sell stop order.

A short position may be protected by a *buy* stop order, placed at a higher price than current prices, which is an order to the effect that if prices rise to its level, an action is triggered for the position to be covered (that is, shares or contracts bought to pay back the debt to the broker from whom they were borrowed when the order was placed). There is no guarantee that the price at which they are bought will be as low as the level of the buy stop order.

When prices gap upward or downward on open, stop orders that were not triggered at the close of the previous day are often triggered by a substantially changed open price, at levels that may be significantly different from those specified in the order. The result is a worse loss than anticipated when the stop order was placed.

Stop orders are usually valid for the day on which they are placed but may, in theory, be placed on a more extended good-till-canceled (GTC) basis. Unfortunately, these sometimes get forgotten, and some investors prefer to place their stop orders on a daily basis to avoid problems with overlooked GTC orders. If GTC orders are needed (which they may well be if the chore of placing daily stop orders needs to be avoided), then a broker's ability to offer an efficient service to handle them should be among an investor's broker selection criteria.

A *trail*, or *trailing stop*, is a sequence of stops whose values change with time to follow price moves that are favorable to a position. The reason for doing this is to try to protect profits accumulated in a position after favorable price moves. The basic rule is that *sell* trail stops (protecting long positions) can move only upward and *buy* trail stops (protecting short positions) can move only downward. This means that they can be moved only to follow a profitable position but stay still if prices reverse against the position.

As an example: A long position is taken at a price of $10 and a (buy) stop order placed at $9.50. The price moves up to $12. If the stop is moved up to $11.50, then if prices reverse and the stop is executed near to the level at which it is triggered ($11.50), a profit of around $1.50 ($11.50 – $10) should still be obtainable. On the other hand, if prices reverse and the stop is still at its original level of $9.50 when triggered, the paper profit from the $12 high is never realized, and the trade is exited for a loss of around 50c. By moving a stop to keep it close to price, any paper gain is much more likely to be realized.

The difficulty with trail stops is to keep them close enough to price to protect any gain but not so close as to be triggered by normal price fluctuations.

A popular solution is to use the parabolic indicator described in Chapter 10. One drawback with that indicator concerns its starting value (of the extreme price found prior to its last cut) and relatively slow development. This can produce situations in which a parabolic stop is distant from price, putting an investment at risk by having a large potential for loss before it is triggered. (In pointing this out, it is important to bear in mind that the parabolic was never designed as a stop, and it is a compliment to its designer that it has found a use in this role.) Having stated the drawback with the parabolic stop, let me now introduce the good news. The parabolic indicator is designed to move closer to price as a trend proceeds. In some trading strategies this is a very useful property. If a position is initiated near the start of a trend, then as the trend proceeds the parabolic stop moves closer to price to minimize the amount of money given back to the market by any price reversal.

The idea of bringing a stop closer to price is called *tightening the stop*. A stop that is close to price is said to be *narrow*, and one that is far from price *wide*. If a stop is too narrow, minor price fluctuations will trigger it, and if too wide, too much money will be lost in the event of a price reversal. Striking the right balance involves knowing the value of a filtered price and the likely level of fluctuations around that value. This takes us back to the discussion in Chapter 10 around Figure 10.10, where techniques for finding these were first introduced. In addition to filtered values and fluctuations, personal preferences and tactical considerations also determine the final level of a stop. Shortly after a position is taken, it is usual to give it some breathing space to develop. After a paper profit has developed with a position, there is usually urgency and concern about protecting it from price reversals. These concerns often result in a strategy of using wider stops at the entry to a position than after it has made a paper profit that needs protecting.

Stops based on filtered lines may be tedious for the individual investor to calculate, but they are the kind of investor-friendly product likely to become available over the Internet sooner rather than later. For that reason alone it is worth spending a little time to understand them. Filtered lines in Chapter 10 were done simply. If done "properly," a small advantage might accrue, but the main point to grasp is that however they are calculated, filtered lines endeavor to provide a value P for a "correct" current price after fluctuations have been accounted for. Fluctuations come in two parts: the price range within bars and the variations in closing price unaccounted for by the filter. To deal with the second part first, unaccounted variations in closing price over the *window* on which the filter is based can be found as a standard deviation σ as part of the filter calculation. An average price range R can be found over the same window, and the analysis extended if needed to find a standard deviation of range, but we will keep it simple for the moment. If z is a user-definable constant for a preferred stop width, then stops are calculated as

$$\text{Buy stop} = P - z \times (R + \sigma) \quad (14.1)$$

$$\text{Sell stop} = P + z \times (R + \sigma) \quad (14.2)$$

In the associated indicator software, when a single filtered line is selected, z is the user-defined stop width parameter. Examining (14.1) and (14.2) in detail, if users are supplied with values of P and $(R + \sigma)$, then they can calculate their own stops. Looking forward, this might be one manifestation of an Internet-delivered product. Alternatives might be services whereby the client specifies a value for z, and possibly the way z is to vary with price movement, and the broker would then work out stop values and either (1) offer them as recommendations for their clients to confirm, or (2) have the authority to calculate and place stop orders for their clients in line with their chosen policy.

In Chapter 3, investment psychology was discussed and a number of general points made about the need for humility and flexibility, and an appreciation of the possibility that any financial decision is likely to be wrong. There was no shame in a timely admission of error, but in professional circles any reluctance to admit error after it is self-evident is likely to be viewed as incompetence. The point was also made that feeling a need to prove consistency of character by sticking with a financial decision should be avoided. After spending a good deal of effort in coming to a decision, there is a fairly natural tendency to want to stick with it and give it every chance to work. It can be difficult to let go of a decision as early as it should be and move on to something else. Such tendencies are sometimes the cause of investors' either canceling or failing to place their stop orders.

In R. E. McMaster's *The Art of the Trade*, there is another interesting observation on stops, which is that by having them, the psychological capital that would be expended in worrying about a losing position is released to exploit better opportunities. McMaster makes a number of other interesting points, among which is a suggestion that humility is a more profitable quality than arrogance and that appropriate stop-loss orders should always be placed and observed.

There are a number of lesser-used stop exits that can be helpful in some situations. One of these is an *inactivity stop*: If the market has failed to move with the trade for a certain number of bars, the investor exits the position rather than continue to accept the risk of an adverse move. Another is the *dollar loss stop*. This is used where a paper profit exists and is set at a price level to exit the position if the paper profit (not price) falls by a fixed percentage.

Setting and observing appropriate stops can be a character test, and the psychological pressures associated with them can be at least as great as those in any other area of investment. In general, action is preferred to dithering.

SUMMARY

- Exit signals tend to be fewer and weaker than entry signals, which makes exits harder than entries. But since a position exists, the cost of *not* acting on exit signals can be much greater than the cost of acting on them.
- Establish likely exit options *before* taking a position, not after.
- Check liquidity.
- Exits depend on personal style—there is no "right" exit point for everybody.
- In uncertain times, consider if you should be in the market at all or hedge.
- Before taking a position, consider if it needs to have a target price for an exit and if so, how to calculate it.
- If a position is exited when the market is moving with it, slippage is usually less than when the market is moving against it.
- Differences from intrinsic values, better opportunities elsewhere, and trading patterns and signals from indicators can all provide exits.
- If the story for a stock changes or becomes unrealizable, consider an exit.
- Exits on complex patterns are useful; hair-trigger exits on one-bar patterns are also useful but potentially premature.
- Contrarian techniques, to be described in Chapter 16, often involve patterns and can provide a surer basis for an exit than patterns alone.
- Exits on wave formations will be examined in the next chapter.
- Stops can be used in an attempt to create a financial safety net or, with trail stops, the principal means of exit.
- There is no guarantee that a stop will be executed at the level at which it is triggered.
- Gap openings often create situations in which stops that were not triggered on the previous close are triggered well away from their levels, with consequent higher losses than anticipated.

- Trail stops are moved to follow favorable price movements, in such a way as to keep close enough to price to minimize losses but far enough from price not to be triggered by normal fluctuations.
- The parabolic indicator is sometimes used as a trail stop.
- Trail stops based on filtered lines and noise estimates, scaled according to client preferences, are currently calculable from the associated software, but slightly better versions are likely to be Web-enabled in the future.
- There are often psychological pressures to stick with an entry decision long after it should have been abandoned. Any exit can be a character test, including exits on stops.
- Consider (1) if you did not already have your current position, would you enter it now, and (2) if you exit now, are you likely to be able to reenter at a more advantageous price in the future should you choose to?
- In the long run, received wisdom is that it pays to set appropriate stop orders and stick with them.
- Where action is needed, do not dither; act.

CHAPTER 15

Trends

For small investors, identifying trends and staying with them probably represents their best opportunity to make money from the markets. The old adage “the trend is your friend” is fully consistent with the Bayesian philosophy advanced in this book that the final (or posterior) probability depends on the prior probability—which in the case of a trend will be a distinct idea about the direction of prices. If you are in a trend and get a countertrend signal, you need to make a decision as to whether it is a genuine reversal or a temporary correction to an existing trend. That is an issue that has taxed clever minds for a long time, is at best only partly resolved, but has produced some associated observations that are useful and worthy of study.

One of the first people to study trends was Charles Dow, who observed that trends rarely progressed smoothly, but more often in a series of waves with intermediate wave corrections counter to the direction of a primary trend. This theory predated a later one that we will examine in more detail.

Apart from taking advantage of a trend, the prior expectation of price direction it creates cannot be ignored. This idea is encompassed with a second adage of “do not trade against the trend.” Thus, long before Bayesian ideas become common currency in the investment community, many of their consequences are well known to it and have been acted upon for years. Whether coming at investment from an investing, trading, or just a Bayesian perspective, one thing is clear: If a trend exists, for a variety of reasons its existence needs to be identified so that its consequences can be taken into account to improve decisions.

WHAT IS A TREND?

An *uptrend* is a sequence of higher highs and higher lows.
A *downtrend* is a sequence of lower lows and lower highs.
In contrast, a *sideways market* exhibits no clear trend.

WHY ARE TRENDS USEFUL?

Markets provide little help to their participants, but trends represent a situation in which some help is available. Once a trend is identified, the sense of price drift is available, and the usual options are to trade with it or stay out of the market. Trends offer opportunities for the type of large price moves that can justify the overhead (commission, slippage, and investor time and emotional capital) that investors need to take a position. In sideways markets, price moves are generally much smaller and less predictable, and it is not uncommon to see volume trailing off as investors seek greener pastures elsewhere. Opportunities to make money tend to be restricted to day traders and brokers, and most other participants lose, which is why many investors exit markets that become sideways to seek (trending) opportunities elsewhere.

STARTING CONDITIONS FOR TRENDS

Uptrends and downtrends tend to begin in very different ways. At a market bottom, it is common for prices to jog along fairly flat before deciding to advance. This process is sometimes called *base building*. Occasionally there is a very sudden advance from a bottom, but that is less common than a gradual one. One other advantage of a market bottom is that there will be previous price history and usually, support lines to help determine its level. Market bottoms attract institutions and value investors seeking to take advantage of low prices, meaning that the money coming in is knowledgeable. Unlike market tops, positions can be accumulated quietly and without panic, from disillusioned longs that have seen their investments fall in value and are probably grateful to unload. The process can continue until buying pressure eventually forces prices to increase, at which point the instrument comes to the attention of other types of investors, who may wish to invest or trade.

A market top is harder to call than a market bottom. Prices may have advanced to levels where no previous history exists, there may therefore be no resistance lines, a very significant advance will almost certainly have attracted speculative rather than investment money, and knowledgeable investment money might already have left if better value is obtainable elsewhere. Market tops are often characterized by sudden falls, when the volatile, speculative money departs, to initiate a downtrend. Market tops can develop slowly (as rounded tops), but they are less common. Once, when looking at rounded patterns, I noted that far more rounded patterns were found in the NYSE than the Nasdaq, despite the Nasdaq's having many more ticker symbols. I took this to be an indication that the volatility of the instrument being traded also needs to be taken into account in judging the likelihood of a price fall from a top. In commodities, market tops can be signaled by a price fall coincident with a fall in open interest—the implication of which is that market participants are moving toward an agreement that the price fall is correct.

Ideally, an uptrend should begin from a grossly oversold condition and a downtrend from a grossly overbought one. If a trend begins from a fairly valued price, it may be short lived.

ELLIOTT WAVE THEORY

This is an extensive theory of market behavior that is described in a number of references, including the specialist books by A. J. Frost and R. R. Prechter, and Glenn Neely. Frost and Prechter make the point that Elliott waves are not primarily a theory to forecast the market, although some successful forecasts have been obtained by using them. The theory is quite complex to grasp fully (which is why specialist books exist to describe it), so I am going to restrict my comments to certain aspects of it that are relevant to trends.

The Elliott wave theory is an extension of a theory proposed earlier by Charles Dow. It envisages markets moving in a series of waves, with sequences of eight waves forming a complete Elliott wave. This is illustrated in Figure 15.1. One point that needs to be clarified is that the eight waves need not form the advance and correction shown in Figure 15.1 but could exist in a bear market, trading range, or triangle pattern, or they could form part of a reversal pattern. Elliott waves are not only confined to the bullish sense shown in Figure 15.1 but they also exist in a bearish sense, which can be pictured by an upside-down version of Figure 15.1.

To know where you are in an Elliott wave, it is necessary to identify a starting point and begin counting waves. This may not be as easy as it sounds as the theory also says that Elliott waves are *fractal* in nature (that is, there may be waves within waves) and that waves may sometimes have extensions. A key point is that waves are counted relative to their predecessors, but their lengths may vary to produce arbitrary formations, not just the conventional one shown in Figure 15.1.

John Murphy (see bibliography) comments that he uses Elliott waves when he sees them, which I believe to be good advice, and I suggest that

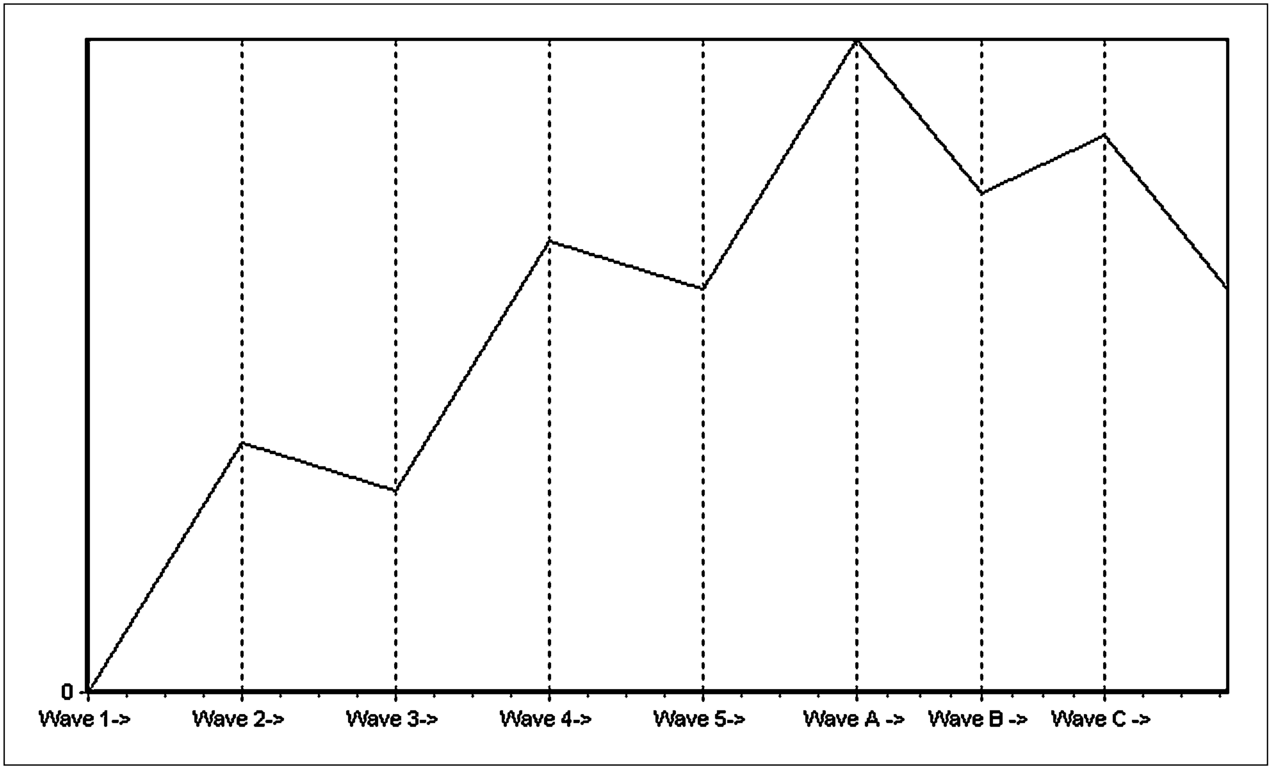


FIGURE 15.1

The premise behind the Elliott wave is that prices advance through a series of up waves and down waves. The classical explanatory diagram is that shown, but waves have to be measured relative to their predecessor, and a formation such as a double top could comprise waves 3, 4, 5, and A. A bull trend ends when the high of wave 5 is less than the high of wave 4, and a bear trend ends when the low of wave 5 is higher than the low of wave 4.

unless you want to invest the time and effort to read the specialist literature, look for simple Elliott waves that are forming and use them as you see fit. Bear in mind also that like all heuristics of technical analysis, it may work for a while but then break down unexpectedly. Unfortunately, the interpretation of Elliott waves is as ambiguous as it is for trading patterns, so several charts may need to be scrutinized before they begin to make sense.

As far as Elliott waves in trends are concerned, they anticipate three waves in the direction of the trend with two intermediate reactions against, before reaching the extreme of a trend, at the end of wave 5. In the case of a bull trend, the first upsurge is likely to be a reaction to an oversold condition, the second, a rise in price in a region that is fairly valued, and the final, a rise in price generated from expectations that momentum of past price increases will continue, taking the instrument to overvalued price levels. The final three waves, A, B, and C, bring prices back to a fair value. This interpretation of Elliott waves may enable fundamentals (for example, price/earnings ratios relative to their historic levels) to be used to help assess where prices are in a complete Elliott wave. As mentioned earlier, waves may be of irregular lengths, and so this idealized picture is not always the case. The theory says that an uptrend is over when the high of wave 5 fails to make the high of wave 4, and a downtrend over when the low of wave 5 is higher than the low of wave 4.

Referring again to Figure 15.1, in an uptrend, if you think you are entering or are already in a B wave, consider exiting any long position and avoid buying into it. This is a situation in which a B Elliott wave might be used to filter signals generated by indicators. There is also a clear overlap between Elliott waves and trading patterns, so if you see patterns starting to form, try doing a wave count backward to estimate where you currently are in any Elliott wave. In particular, if you are long and think prices are rising up the head or right shoulder of a head and shoulders pattern, or the final peak of a double top pattern, and a wave count suggests this is a B wave, consider making a graceful exit with minimal slippage while prices are still rising. In this situation, some Elliott wave users would sell into a B wave in the hope of making a profit on the C wave. The opposite applies for short positions.

Comments made about B waves are also applicable to 5 waves, but they are usually more difficult to identify.

Finally, let me emphasize that this is only a quick snapshot of the Elliott wave theory. There is much more that could be said and many other useful properties that they have, and the specialist literature exists to explain the theory more fully. Software to define Elliott waves is beginning to appear, but at the time of this writing, its efficacy is not known.

PATTERNS AND ELLIOTT WAVES

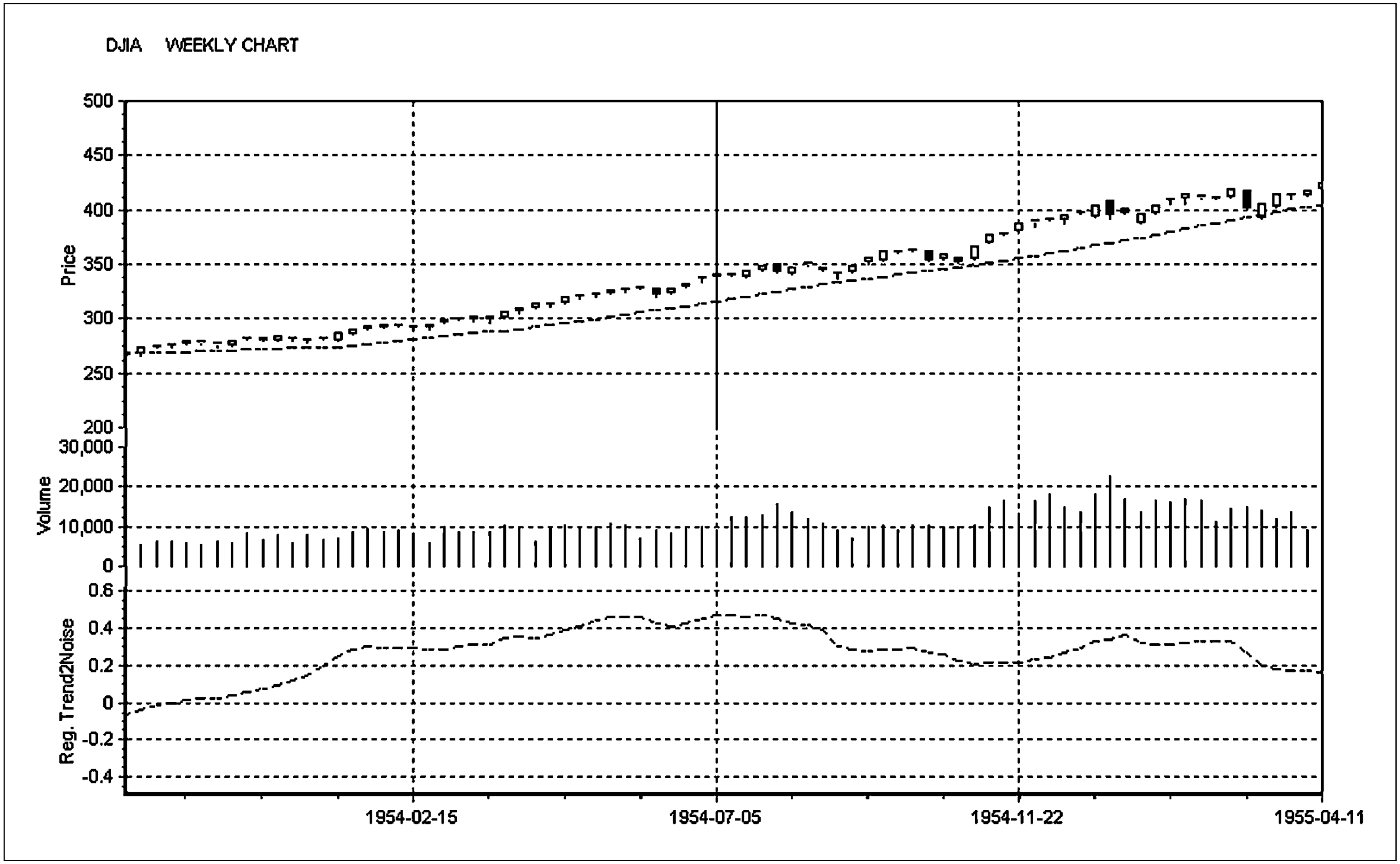
Elliott waves may encompass many trading patterns. In Figure 15.1, troughs at the start of waves 5 and B could define a neckline, and its penetration by wave C confirm a head and shoulders top. Sometimes corrections in a trend make up all or part of a complex continuation pattern, such as a triangle, and one-bar patterns often flag the start of new waves. In conventional pattern literature, a (falling) triangle with both its bounding trendlines descending, which is preceded by an uptrend, is thought to be bullish and called a *falling wedge*. Rising equivalents of this pattern may be found in downward trends, are bearish, and called *rising wedges*. In Elliott literature, wave 5s are sometimes formed from rising wedges (that lack the substantial prior bear trend required to qualify them as trading patterns) and are considered bearish indicators of an impending wave A. In a downward-trending Elliott wave, falling wedges of this type signal a likely uptrend.

TREND CHARACTERISTICS AND IMPLICATIONS FOR EXPLOITATION

The Elliott wave theory describes some, but by no means all, trends. An ideal trend would be that of the Dow in the mid 1950s shown in Figure 15.2. This chart has a 21-week moving average plotted on the price axis and a 21-week Trend2Noise indicator plotted on a lower axis. All closing prices are above the moving average, and, with the exception of a single minor penetration, all lows are above the moving average. The Trend2Noise indicator can be used to monitor trend strength, which becomes positive early in the trend, climbs to a healthy positive value, and stays there. Such ideal trends can be found, but they are very much the exception, not the norm.

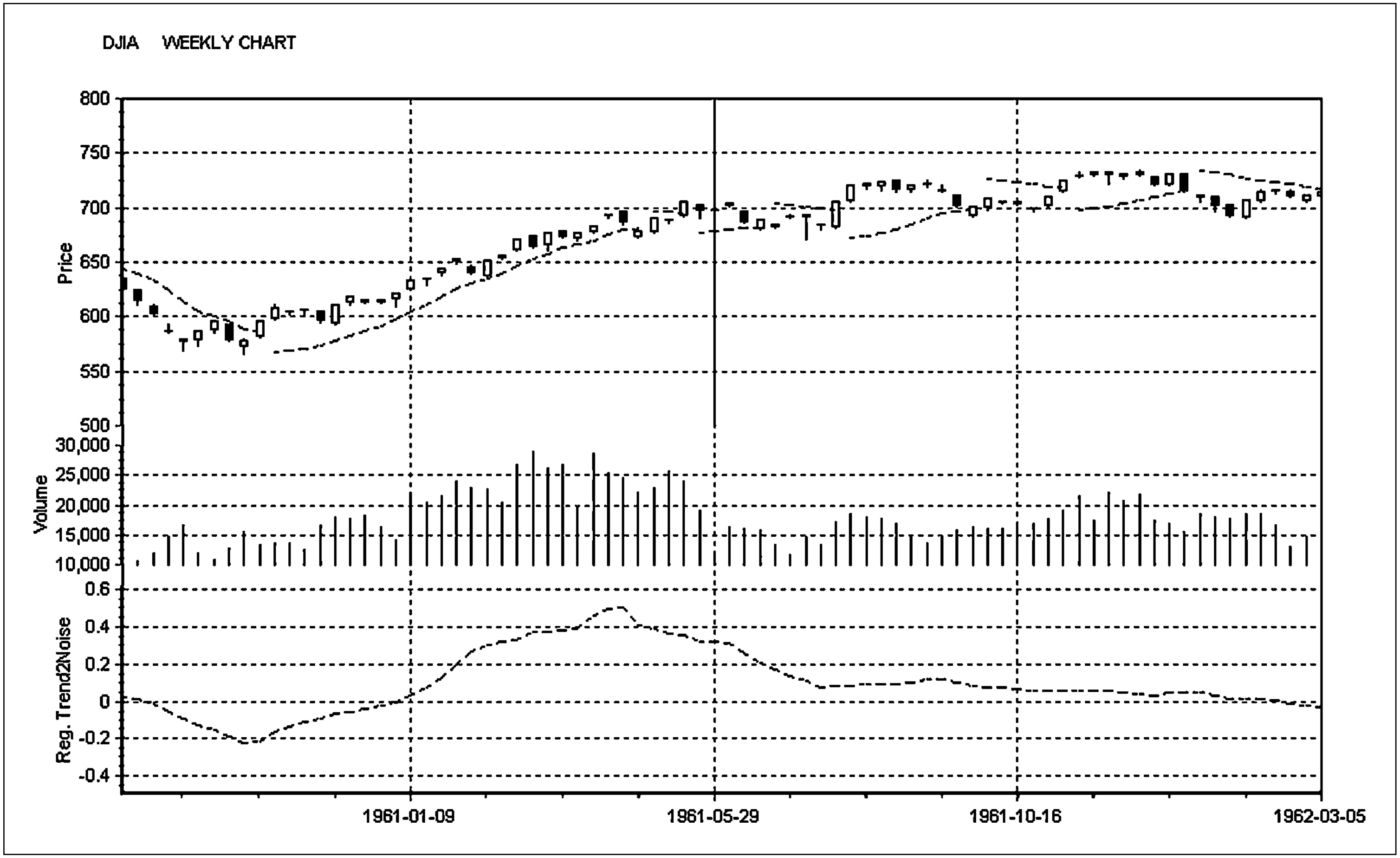
A more typical situation, which highlights many of the practical problems in trading trends, is shown in Figure 15.3. This shows the 21-week Trend2Noise and parabolic indicators. The idea is to use the Trend2Noise indicator to get a strategic sense of the trend direction and the parabolic as a tactical entry and exit tool to trade in the trend direction only. On the left of the chart, the parabolic is cut in the autumn of 1960, but the Trend2Noise indicator does not become positive until early January, delaying a long entry by several weeks and losing some profit in the process. This is a price that has to be paid for being more certain that a new trend direction has begun and that the upturn following the autumn cut of the parabolic is not going to be a "blip" or develop into a sideways market. Bottom reversal patterns, if present, would offer further confirmation that the trend had reversed and earlier confidence for entry into a long position.

The parabolic indicator stays long until April, when it is cut. At this point the Trend2Noise indicator is very positive, indicating a primary bull



F I G U R E 15.2

This graph shows an ideal trend. Prices rise steadily, and, apart from a minor penetration, they are always above a relevant moving average (in this case, 21 week), and a 21-week Trend2Noise indicator becomes positive early in the trend and stays (healthily) positive throughout.



F I G U R E 15.3

This is a common situation in which a trend develops into a sideways market. In this case the 21-week Trend2Noise indicator can be used to assess trend strength and direction, and a moving average/price penetration, or parabolic (shown) used for tactical exits and entries in the trend direction only. In this case such a strategy would halve losses from whipsaw trades by trading one side of the market only. An even better strategy is to recognize the market is sideways, that there is no money to be made in it, and stay out until another trend starts.

trend, and so a short position is *not* taken, but the long position is exited. The parabolic is then cut and recut by prices—the implications of which need to be examined.

If signals were taken on the basis of the parabolic alone, then successive long and short positions would both lose. As mentioned earlier in the book, such losses are known as *whipsaw trades*. If positions are entered only in the direction of the primary trend (as shown by the positive value of the Trend2Noise indicator), then losses in the sideways market are halved—in this case by excluding all short trades. Fairly early in the sideways market, the Trend2Noise indicator descends to a low positive level and stays there. Introducing a minimum threshold for the Trend2Noise indicator, below which trades would not be accepted, would have the effect of eliminating some bad trades and reducing losses further. But it would also have the effect of losing some initial profit as a result of delaying the first entry into the trend until the Trend2Noise threshold was passed. Toward the right of the chart, the sideways market eventually develops into a well-formed head and shoulders pattern that flags a significant reversal.

In Figure 15.4, which shows a difficult sideways market for investors trying to make a profit from the Dow, the low values of the Trend2Noise indicator could have been used with suitable qualifying thresholds to filter signals so as to avoid taking trades during this difficult period.

Sideways markets are bad news for investors but good news for day traders and brokers. On many strategies used by online investors, they generate large numbers of signals for loss-making whipsaw trades. For the longer-term strategies, which are the main focus of this book, sideways markets are best avoided, and, if suspected, they should encourage the investor to look for opportunities elsewhere. A stochastic approach might be used to trade sideways markets, but this tends to put the investor in a high-risk/low-reward position, likely to be inferior to the risk/reward ratios that can be found with other investment opportunities—particularly those involving trends where prices are moving toward intrinsic values but with some way left to go. In any event, online investors are likely to have higher trading costs and inferior facilities to monitor prices and finesse orders than professional day traders, and so automatically they operate at a disadvantage in any “churning” market.

R. E. McMaster’s observations about the drain of emotional capital may also be relevant when trading sideways markets, as for many, having a position in a trend with a protective trail stop, possibly converted to a dollar loss stop once a profit has been generated, offers at least the same profit opportunity for less expenditure of emotional capital.

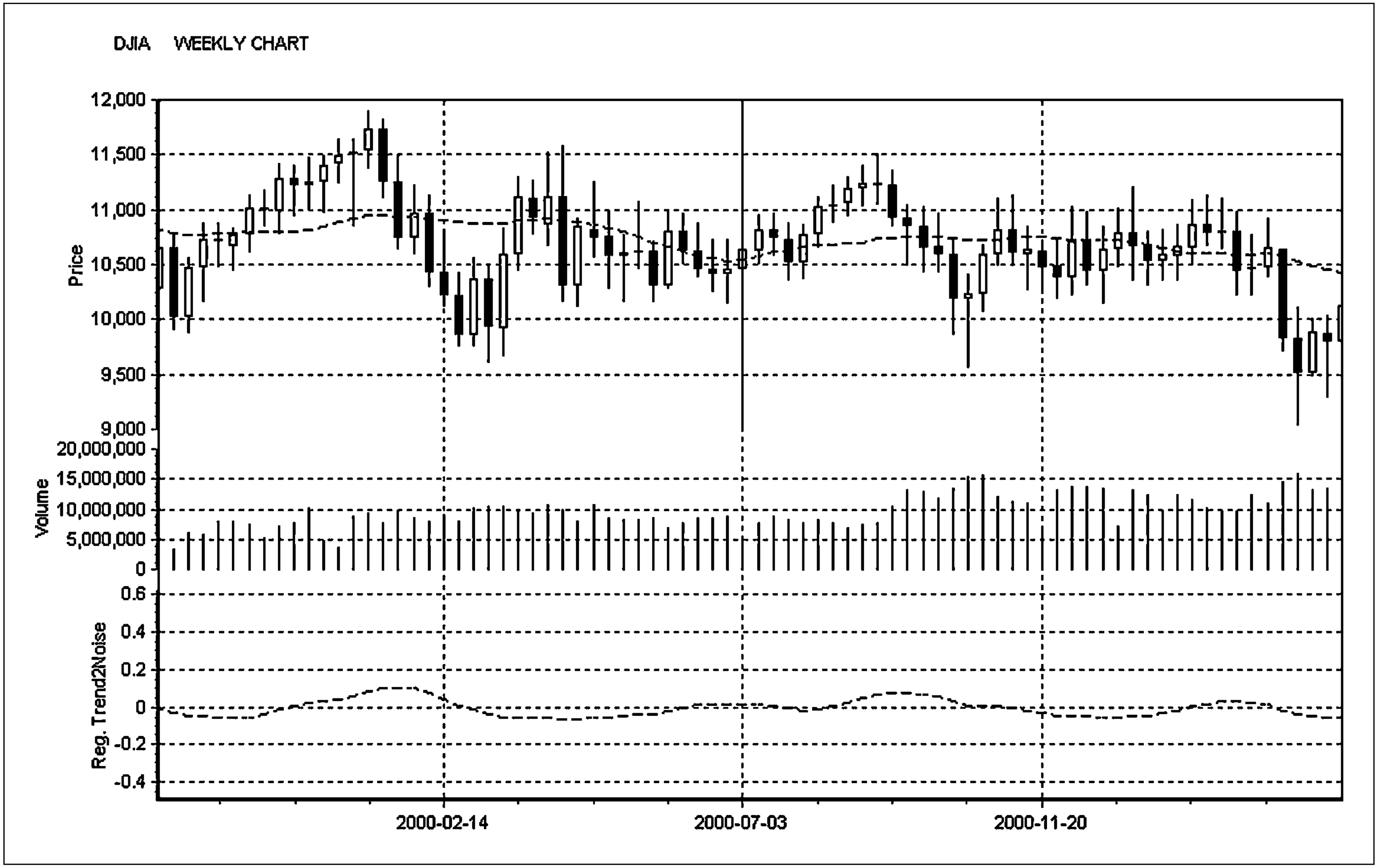


FIGURE 15.4

A 21-week moving average and 21-week Trend2Noise indicator are shown. The idea of thresholds for Trend2Noise indicators before trades can be taken is useful for sideways markets, especially when using price/moving average penetrations as entry signals. Setting thresholds of >0.1 (for long trades) and < −0.1 (for short trades) would avoid trading in this sideways period completely, but at a small cost in terms of delayed entries following trend reversals.

ISSUES INVOLVED IN TREND EXPLOITATION

The previous section was been written as an on-the-job example of how trends can be exploited. General issues involved are worth expanding on to define the requirements needed for strategies (other than those already suggested) to exploit trends.

- Holding any position involves risk. The risk involved in a trending market is that of a reversal. Major reversals to long positions are most likely when the instrument is grossly overvalued and to short positions when they are undervalued. From the viewpoint of risk assessment, therefore, it is prudent to be aware of the fundamentals, which, as a minimum for stocks, should be price/earnings ratios and bond ratings. For commodities, prices relative to historic levels and other financial instruments should be considered. Awareness of fundamentals will also help in assessing if a trend is likely to continue.
- There is a need to assess the direction of a primary trend. This will not be known until either some time after a trend has started or prices have moved substantially in the direction of a new trend. The use of the Trend2Noise indicator has already been mentioned, but more conventional means of assessing trend direction are the penetration of a long-term moving average by price, moving average crossovers, reversal patterns at genuine tops and bottoms, and trendline penetrations.
- There is a conflict between the need to take a position early to take advantage of a new trend and the need to wait to make sure it has started, so as to avoid whipsaw trades. The ideal situation would be V bottoms, straight trends, and inverted-V tops—but tops and bottoms are often messy affairs with a nasty tendency to whipsaw most investors most of the time. The use of thresholds with the Trend2Noise indicator is a way to address this problem, but the length of the indicator and threshold may need to be optimized for each individual financial instrument on the basis that each, potentially, has its own unique characteristics. Other authors take the view that whipsaw trades are inevitable and propose optimizing moving-average-based trend selectors to minimize them. I do not share their view and have been looking at market classifiers for some time with the specific objective of identifying sideways periods likely to prove loss making to investors. At the level of indicators, Trend2Noise, used with appropriate positive and negative thresholds, represents my best offering to date.

- During a trend, there are likely to be reactions and sideways markets. Some of these, particularly around Elliott waves 4, 5, and A, may be identifiable trading patterns of one sort or another. Received wisdom is that the best (long-term) strategies are either to retain a position in the trend direction, or exit, but *not* trade against the trend. This means that the market classifier needs to be tuned to whatever the investor considers a trend to be and (ideally) not be fooled by reactions and sideways markets. The fractal character of trends suggested by Elliott wave theory raises the issue that shorter-term investment styles may want to exploit "trends" that longer-term styles view as "reactions." Inevitably this means that investment style may feature in any final choice of market classifier characteristics, no matter what method the classifier is based on.
- Some strategies for exploiting trends look for exits when prices rise far above moving averages or use dollar loss or trail stops after initial (paper) profits have been achieved. The tool for tactical entries and exits needs to include the ability to reenter a trend once it resumes. If found, continuation trading patterns offer one such method. In Figure 15.3, the parabolic was used for this purpose. This may not deliver the best result. For the period shown in Figure 15.2, a tactical system based on a 21-week moving average would have worked better. In Chapter 9, Figures 9.10 through 9.13 show how covering a chart with moving averages facilitates identification of the ones providing support lines for trends, enabling an entry to be made on a "bounce" from a suitable line. Moral: In trends, do not overlook the simple moving average support/resistance line "bounce" method because much of the time it works as well as, if not better than, more complex methods.
- Within a trend, reactions are not always followed by an obvious resumption of the trend but sometimes by a series of waves drifting gently in the direction of the primary trend. These often trigger technical signals that result in whipsaw trades and can be difficult to exploit. Such a situation is shown in Figure 15.5. In this instance, most of the trouble can be avoided by using the Trend2Noise thresholds of ± 0.1 to define sideways markets, trading only with the primary trend, using a 21-week quadratic filtered line with stops (based on equations 14.1 and 14.2) and z value of 1.5 for tactical entries and exits whenever they are penetrated. These parameters have not been optimized but nevertheless indicate the nature of a possible solution to the problem of avoiding losses in this kind of market.

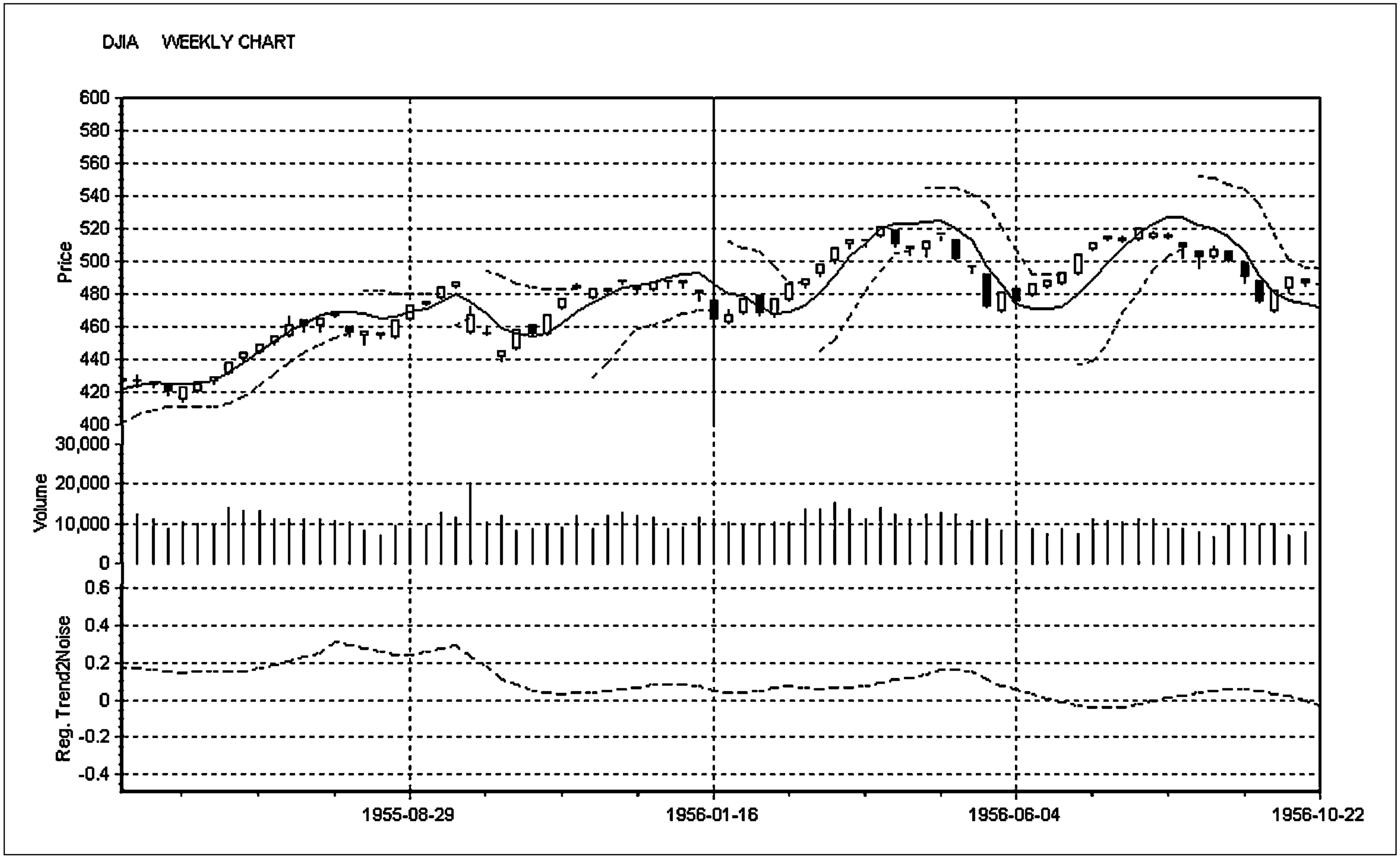


FIGURE 15.5

In a weak "wavy" uptrend, many technical indicators produce whipsaw trades. A 21-week Trend2Noise indicator, quadratic filtered line, and stops based on a z value of 1.5 (see equations 14.1 and 14.2) are shown. Using Trend2Noise thresholds of ±0.1 to define sideways markets, trading only with the primary trend and the triggering of stops for tactical entries and exits, one brief entry signal (around April 1956) for a loss-making trade occurs during the "wavy" period.

- Received wisdom for stocks is that in a healthy trend, volume should be increasing with price movement in the direction of the primary trend and decreasing with price movement against that direction. This also applies for commodities, for which additionally, healthy trends are indicated by an increase in open interest with price movement in the trend direction. A scorecard-based trading system, known as *Comdex*, is built on these observations.
- So far, nothing has been said about the influence of other financial instruments on a trend. The performance of an instrument relative to a representative index can be an important indication of the health of any trend. Additionally, there may be cyclical relationships between financial instruments, which enable a turning point in one to flag a turning point in another. These ideas will be developed further in the next chapter, but they are relevant here in the context of assessing when trends start and finish.

SUMMARY

- Trends are important because they offer an idea of price direction, which reduces the risks involved in positions taken that profit from their movement.
- Trade with the trend; do not trade against the trend.
- Trends are sequences of higher highs and higher lows, or lower highs and lower lows.
- Sideways markets exhibit no clear trend.
- Trends may occur in a variety of ways, but often they do so in a series of waves. In a bull trend the first wave corresponds to a correction to an undervaluation, the second to a price movement within a fairly valued region, and the final one is a movement to a peak that is overvalued. Between these waves, there may be countertrend reactions. After the peak, prices are likely to correct to a fair valuation in two down waves with an intermediate up wave reaction between them. This intermediate up wave may be the last opportunity to exit long positions gracefully and offers an opportunity to sell into the rally to make a profit on the final down wave. The opposite logic applies to bear trends.
- Look for trading patterns, especially unusual wave 5 wedge formations that sometimes precede major reversals.

- An awareness of fundamentals can be helpful in assessing the risk of a trend reversing.
- For long-term investors, trends probably represent their best opportunity to make money from the markets.
- In sideways markets, technical signals produce loss-making whipsaw trades, so they are best avoided.
- To exploit trends, a market classifier is needed. Ideally, this will differentiate between uptrends, downtrends, and sideways markets.
- Exploiting trends can be done with a strategic trend classifier and a tactical means of entering and exiting positions consistent with the trend. Examples are given in this chapter of how the Trend2Noise indicator can be adapted for this task.
- If tactical exits are made partway through a trend, there needs to be a mechanism for reentering a position when the trend resumes. Continuation patterns and signals from indicators are commonly used reentry methods.
- In healthy trends, volume (and for commodities open interest also) is increasing when prices are moving in the trend direction.
- Related financial instruments may be useful in providing clues as to when trends are likely to start or finish. More will be said on them in the next chapter.

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CHAPTER 16

Contrarian Strategies

Very loosely, my definition of *contrarian* encompasses techniques that are "not trend following," and in this respect, they should not be confused with more specific techniques based on sentiment indicators. Although contrarian techniques based on herd behavior and mass psychology have been developed, they lie outside the scope of this chapter. For our purposes, the contrarian approach is a position that is taken without regard to market classification, in the belief that prices will move to profit the position. The usual basis for such a belief is that prices differ (in some sense) from their "correct" level to which they are expected to return. Semantics apart, the main objective is to describe useful techniques rather than worry about their categorizations.

In the previous chapter, techniques for exploiting trends were described. These were based on the premise that, when established, a trend was likely to continue. Some financial instruments, particularly those influenced by slowly changing economic fundamentals, do behave in this way. Prices of other financial instruments may have their own particular cyclical characteristics, lag price movements in related financial instruments, or be unjustified by their fundamentals. These represent situations in which, in the absence of a trend, there are grounds for believing that a price movement, in one direction or another, can reasonably be expected. Despite such grounds, the problem of timing any such price movement still remains.

Historically, economists have dismissed such difficulties, preferring to complain about the problems of using "rational" investment methods in "irrational" markets, rather than accept the inadequacy of their theories to explain price movements. Fortunately, times are changing, and economists have been working on their theories and are coming up with interesting concepts to accommodate psychological influences to explain formerly "irrational" market behaviors. But the stochastic nature of such influences will always be there, and the problem of timing a price movement is likely to persist. More generally, the numerous issues in price forecasting referred to in Chapter 12 are also relevant to the problems of contrarian investing.

It is sometimes said that technical methods are trend following and fundamental methods contrarian. That is a simplification since a hybrid fundamental method might accept an entry as valid only if it were coincident with a trend toward some calculated intrinsic price. And some technical methods exist to identify overbought/oversold situations to offer contrarian signals primarily used for exits but also capable of being used for entries. One particular contrarian situation in which technical methods are used is when markets are in a wide trading range moving between clearly defined support and resistance levels.

RISK/REWARD

With trend-following techniques, part of any potential profit has to be surrendered because of the need to wait to make sure the trend is established before taking a position. Similarly, with tactical exits, such as the trail stop technique described in Chapter 15 (for example, Figure 15.5), part of any paper profit is given up by prices needing to reverse before triggering the exit. If turning points could be called precisely, then both of those lost profit elements could be harvested. There is a useful halfway situation, which some investors employ, in which investors wait for a turning point but use contrarian arguments to take action before trend-confirmation methods confirm the existence of a new trend.

The rewards therefore of using such methods are greater profits when turning points are correctly called. Unfortunately, it is usually more difficult to call a new turning point than confirm a new trend; and so the probability of a failed trade increases—that is, the risk increases.

PSYCHOLOGICAL ISSUES

Everybody has his or her own preferences when it comes to trying to make money from the markets. Some derive satisfaction from correctly anticipating turning points, while others are frustrated at losing potential profits by having to wait for trend confirmation before taking action. Others will accept that they cannot properly identify major turning points, wish to avoid sideways markets, and therefore seek conservative risk/reward trades within established trends. Ultimately, each investor needs to match his or her individual talents and risk/reward preferences to his or her style of investing.

Apart from the psychology of the individual investor, markets move to extremes of high or low prices for reasons of mass psychology explained in Chapter 3. The price model of Figure 3.1 offers some insight into this process.

An indirect measure of exuberance or despair comes from the numbers of online investors active in the market. The greater the number, the more bullish the market, except perhaps in the immediate aftermath of a crash. Other clues come from relatively low trading volumes toward the end of bear markets or relatively high trading volumes toward the end of bull markets.

TECHNICAL ANALYSIS

There are a number of hybrid intermarket techniques that could be classified as "technical," but in this section, only contrarian techniques that are indisputably technical will be discussed, although we will address hybrid techniques later.

One opportunity for contrarian trades occurs when trading ranges develop. If these are narrow, limits on potential profits may not warrant the risk of taking a position, and that is something that should always be considered before taking a position in the hope of a trading range continuing.

Stochastic oscillators are primarily intended for use in trading ranges, applied as outlined in Chapter 10. Strictly, therefore, they are not contrarian in nature, but once a trading range is established, they do offer an alternative to trend following.

Trading ranges are usually well defined by support and resistance levels, which means that a long trade can be taken as a support level is approached (with a stop below), and a short trade taken as a resistance level is approached (with a stop above). Using levels in this way is genuinely contrarian, but doing so carries a risk of loss if prices break through one of the defining levels. Sometimes, as trading ranges proceed, more and more trades are made on the assumption of their continuing, and when there is a breakout, so many stop orders are triggered that prices reverse back into the trading range. Moral: If the trading range has been around for a while, consider widening the stop or exiting in the expectation of a breakout in one direction or another, but not knowing which.

A common contrarian approach is based on momentum. Momentum indicators can be used in a variety of ways, one of which is to define thresholds above or below which the market is to be considered either overbought or oversold. The expectation is that if indicators enter such regions, there may be a price reversal. A word of warning needs to be offered: Momentum depends on the speed at which prices change, and it is possible for overbought or oversold regions to be entered simply by prices moving quickly. If price movements then continue in the same direction but at a slower rate, a momentum indicator will reverse from the overbought/oversold region to a more normal one—without a corresponding reversal in price. For this reason, the usual advice is to wait for some confirmation of a price reversal (which may be less than that for a conventional trend-following strategy) before entering a position.

The particular variety of momentum oscillator defined here (equations 10.6 and 10.7) is based on regularized exponential moving averages of fractional price changes. This nondimensionalizes the result and avoids losing information through the use of normalizing denominators. However, this does mean that thresholds to define "overbought" or "oversold" conditions need to be assessed for each individual instrument by scrutinizing a chart to find thresholds that worked in the past. If fixed thresholds are sought, and associated information loss acceptable, then there is an alternative approach, described by William Blau, that divides a clever average of price changes by a similar average of the modulus of such changes, which leads to a claim of fixed thresholds being said to define overbought and oversold levels.

If momentum is to be used for contrarian signals, it is a very good idea to scrutinize charts for the instrument in question to see how well a proposed strategy would have worked. This may involve trying out different combinations of indicator length and regularization constants and may lead to the conclusions (a) that the overbought/oversold concept does not work at all, (b) that it works for bottoms but not tops (or vice versa), or (c) that it works for both tops and bottoms. The point here is that each financial instrument should be assumed to have its own unique characteristics. It is therefore sensible to examine how a proposed price-reversal-detection strategy would have worked in the past rather than apply it mechanistically in a belief that it will work in the future.

Experiments were carried out on weekly charts of the Dow to see how well the overbought/oversold concept worked. Price increases tended to be slower and steadier than price declines, making it difficult to find good oversold signals. Price crashes produced extreme oversold levels, and recoveries tended to be slow, so the overbought concept also failed for crashes. Strong but steady price declines did produce useful oversold signals. Scrutinizing charts to examine the relative efficacies of indicators with different parameters resulted in a momentum length of 13 and regularization of 3. For these parameters, a threshold for an oversold level seems to be around –0.014. Three charts are given, Figures 16.1 through 16.3, to illustrate the concept, all of which also have patterns to indicate prices are either moving, or about to move up from a bottom.

In Figure 16.1, a price low occurs in mid-October 1990 with an associated flattish bottom, a clear bottom in momentum, followed by a hammer formation on the week beginning 5 November and a gap upward on the week beginning 12 November. Momentum meanwhile had risen steadily from its mid-October bottom. The hammer formation should have been evident around the Friday close and would have represented an excellent oversold entry opportunity.

In Figure 16.2 a similar situation occurred, with a flattish bottom, momentum trough and impending bull market flagged by a hammer formation, confirmed when momentum was increasing.

In Figure 16.3, the end of a severe bear market coincided with both a trough in momentum and double bottom formation. This posed an interesting dilemma for the contrarian: to enter on the basis of momentum emerging from an oversold state and a twice-tested price support level, or to wait until the double bottom confirmed before taking a position? This is a practical case in which the different types of trader psychology described earlier in this chapter would likely result in two different decisions. Once again though, it is always useful to have a pattern, or the appearance of one about to form, to help with this type of decision. Figure 16.3 has another interesting characteristic leading to our next topic: Momentum at the first trough of the double bottom is lower than that of the second trough of the double bottom, despite prices at the two troughs being the same. This leads to an interesting concept that can sometimes be used to anticipate likely tops and bottoms, which happens to be the case in the Dow for market tops.

In one sense or another, depending on the species of indicator used, momentum measures the rate of change of price. Toward the end of a trend, price movements often slow down, resulting in values of momentum that are less extreme than those found earlier in the trend.

If *successively higher* peaks in price are matched by *successively lower* peaks in momentum, a divergence is said to be present. This type of divergence is an indication that a bull trend might be in trouble.

If *successively lower* troughs in price are matched by *successively higher* troughs in momentum, a divergence is also said to be present. This type of divergence is an indication that a bear trend may be in trouble.

In the case of the Dow, the divergence concept seems to be useful for identifying market tops. In Figure 16.4, price increases approaching the 1929 crash are matched by successively lower peaks in momentum, which was one of a number of signals to suggest the 1920s bull trend was in trouble.

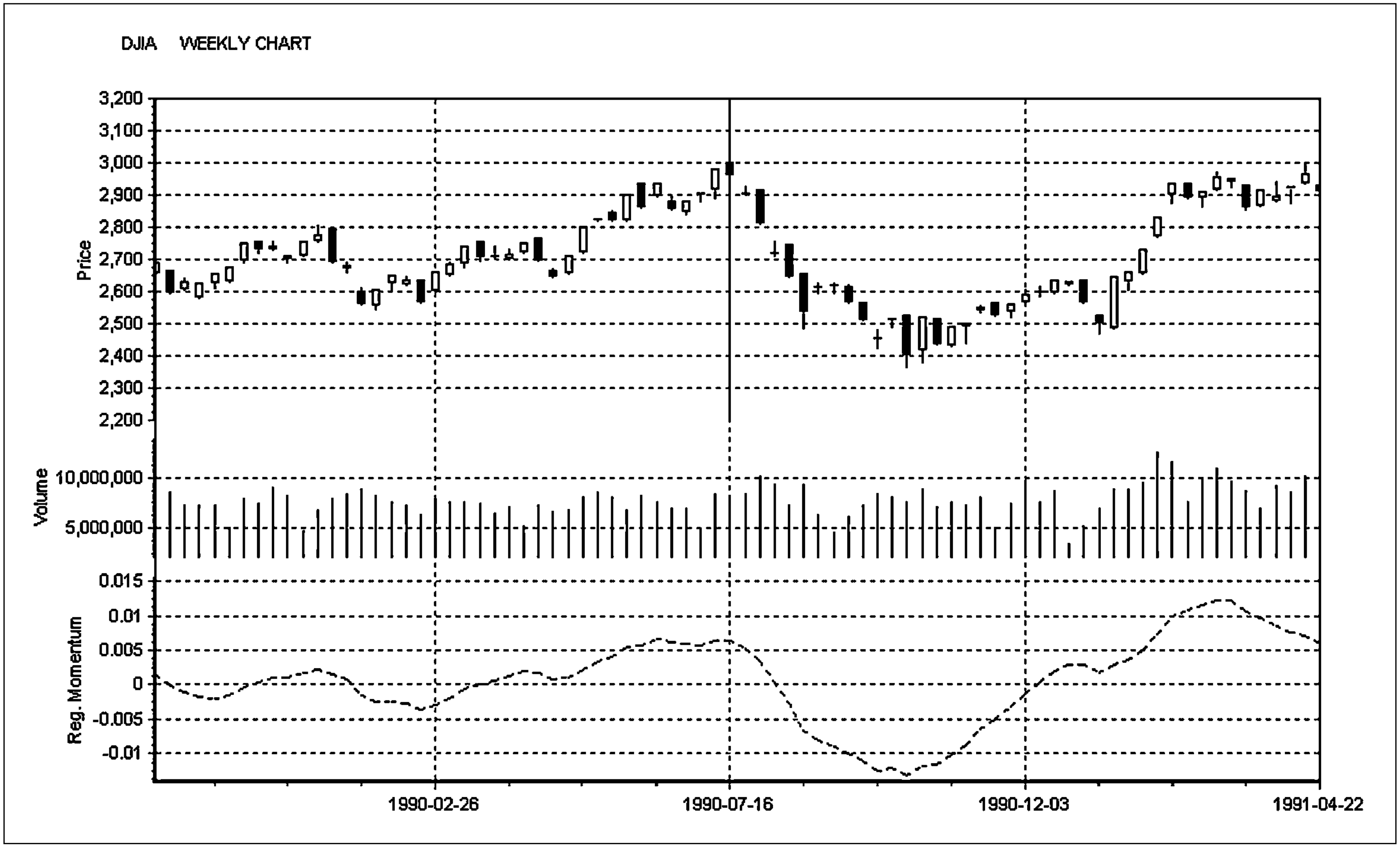

FIGURE 16.1

Regularized momentum (in this case with a length of 13 and regularization of 3) can offer a way of anticipating oversold conditions, such as the one shown here in the early autumn of 1990, where it descends to around –0.014 before ascending into the subsequent bull market, which is also flagged by a one-bar hammer formation and gap opening.

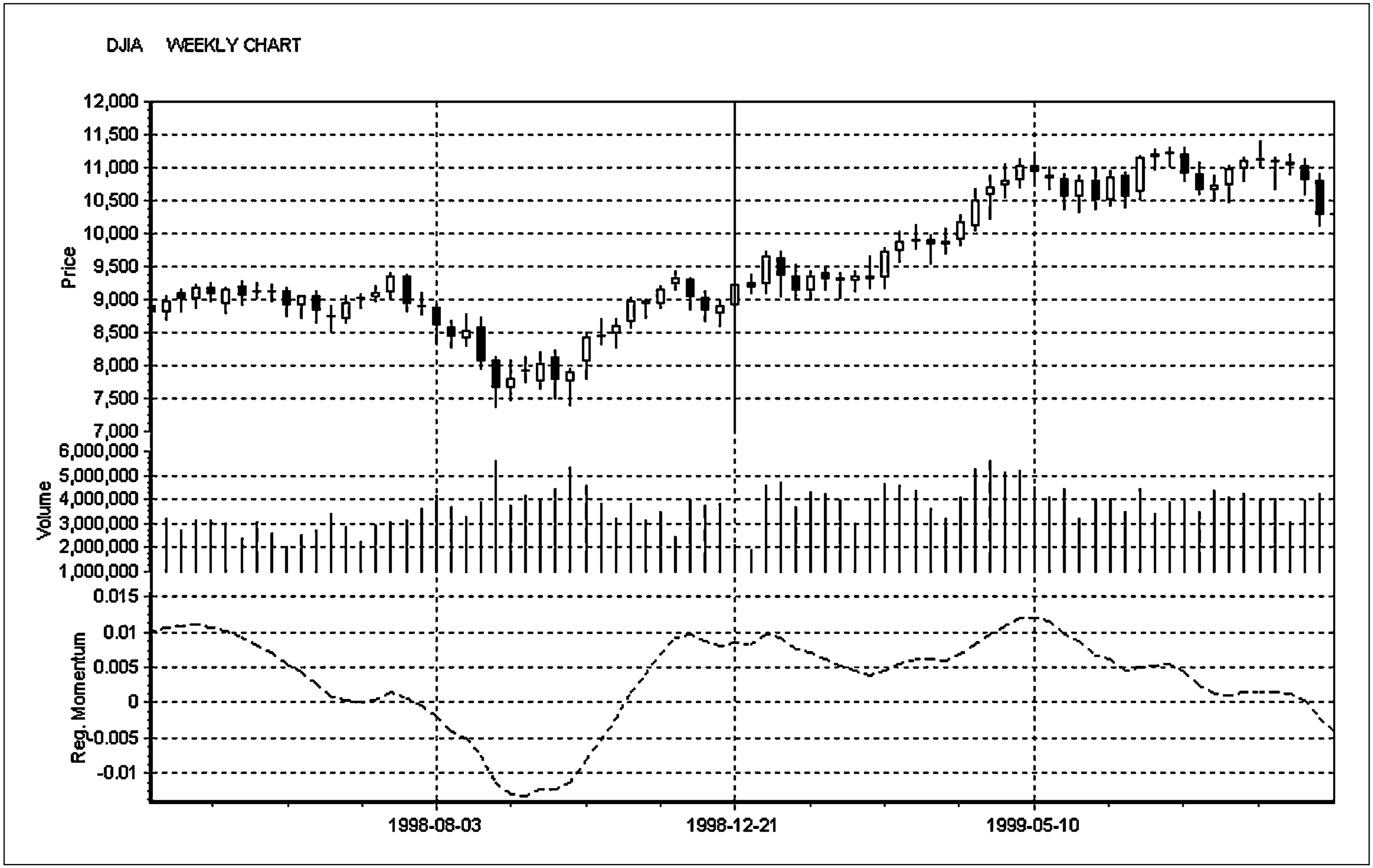

FIGURE 16.2

In the early autumn of 1998, the regularized momentum line (length 13, regularization 3) descends to around −0.014 and then rises into the bull trend. The extreme level, followed by the rise, was a signal that prices would improve. Note also the one-bar hammer formation just before the rise, and in the closely correlated S&P 500, the price increase was forecast (shown in Figure 12.2).

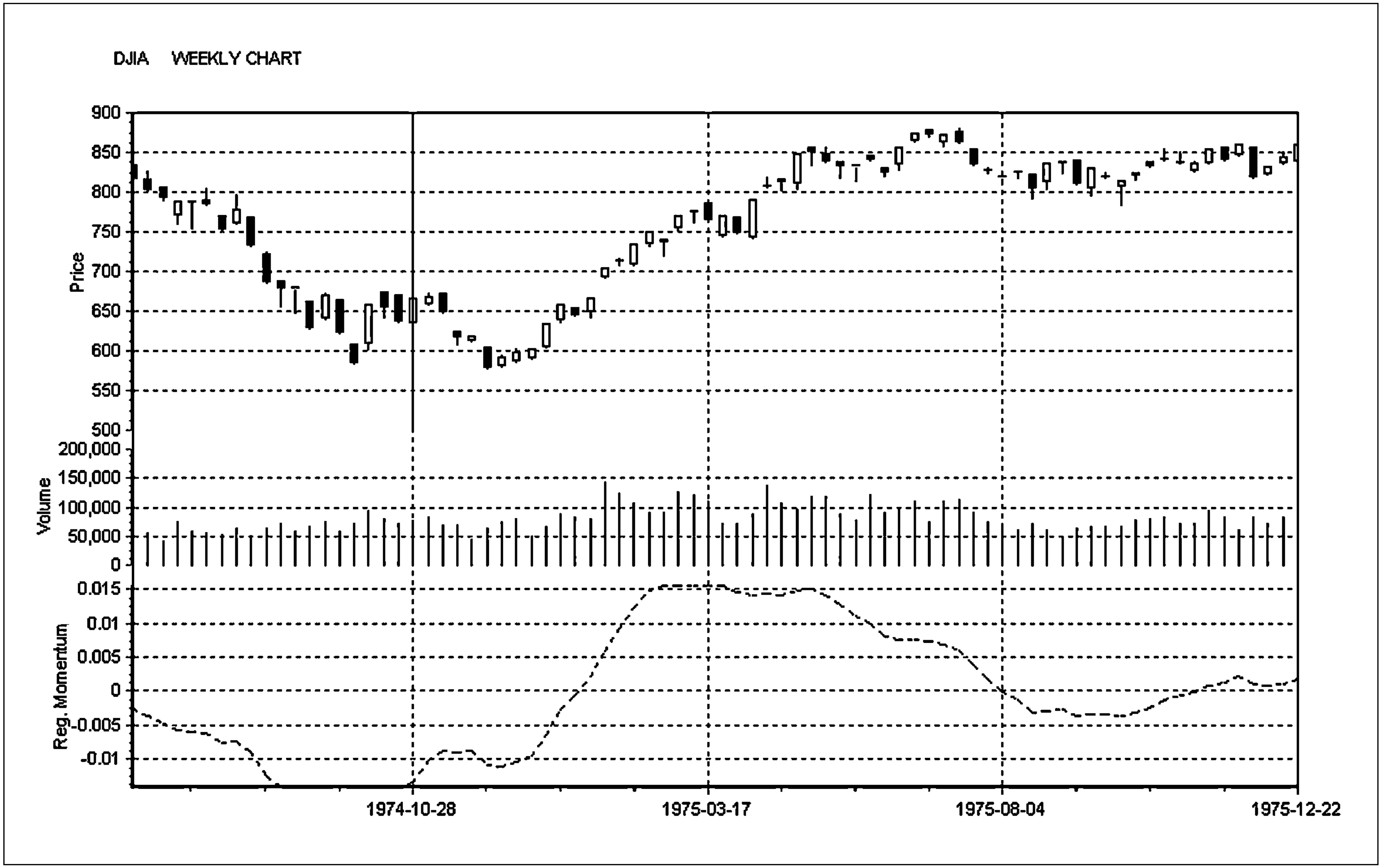

FIGURE 16.3

This 1974 bottom is flagged by regularized momentum (length 13, regularization 3) falling to extreme levels and then climbing again. The cursor is positioned at the center of a double bottom formation, posing an interesting question of whether to go long immediately after its second trough or to wait for the double bottom to confirm.

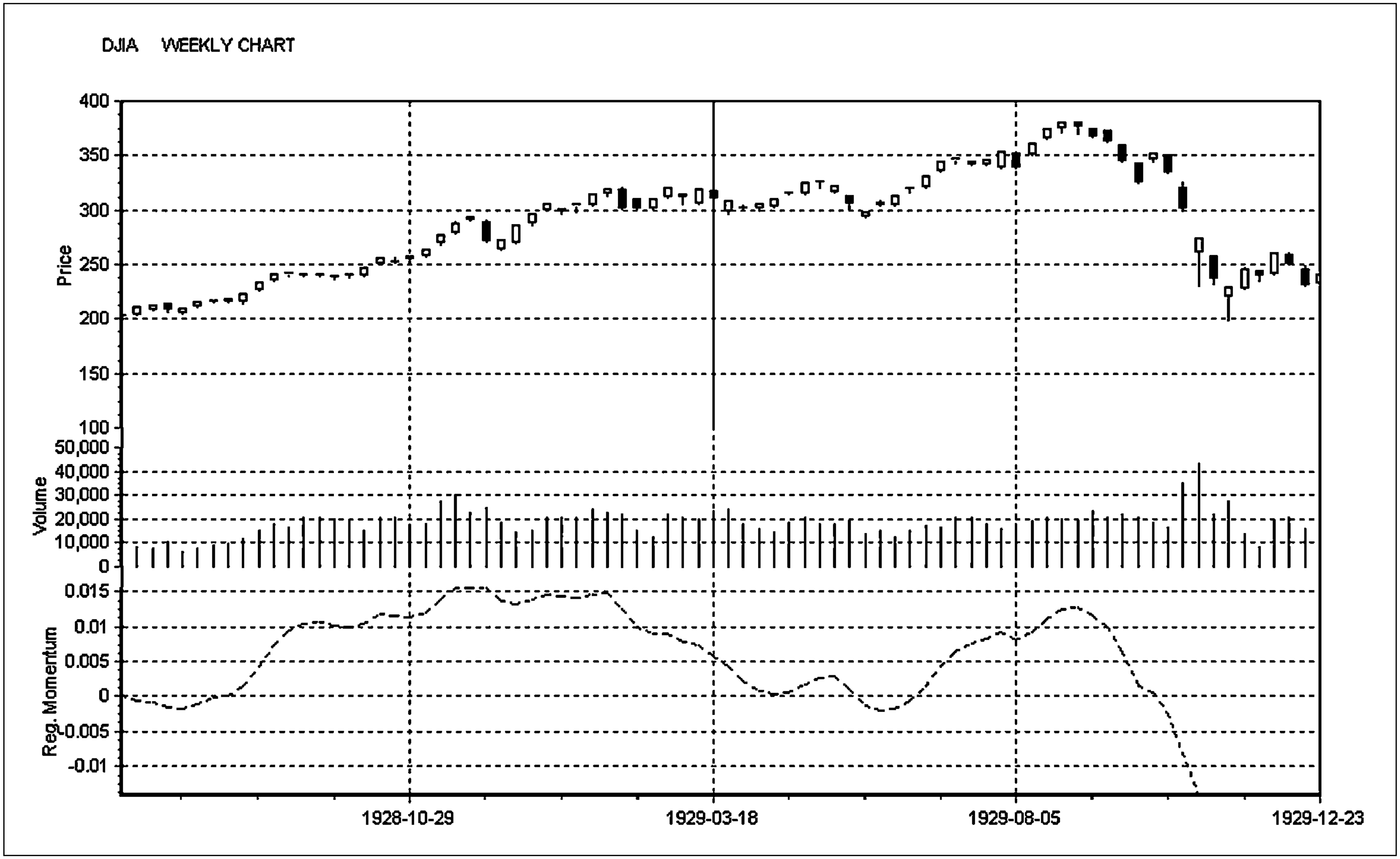

FIGURE 16.4

In the Dow, the oversold concept seems to be of lesser use than that of divergence. In this bull market, a divergence occurs when successive peaks in momentum (length 13, regularization 3) fall, and successive peaks in price rise. The peak in momentum at the time of the 1929 crash is well below that of January 1929, despite October 1929 prices being higher. This was a divergence and signaled that the trend was in trouble.

One interesting aspect of this graph is that the first momentum peak coincides with the start of the "failed" triple top shown in Figure 11.3, which should have signaled an alert for a successful short trade based on the 1929 October divergence. Also, the "failed" triple top did not itself correspond to any divergence between price and momentum at the time that it started, which cannot have helped its chances of immediate success.

A similar situation to Figure 16.4 is shown in Figure 16.5 in which price peaks leading up to the 1987 crash are matched by successively lower momentum peaks, once again suggesting the trend was in trouble.

To summarize these points about momentum:

- Some trial and error can be expected to find lengths and regularizations for any momentum indicators that offer consistent overbought/oversold or divergence signals.
- Without regularization, momentum is likely to be either too wiggly or too lagged.
- Some combination of overbought, oversold, or divergence concepts can usually be found to work, but it may not necessarily do so all of the time.
- In any situation that may be a top or bottom, look for simple patterns that have formed, or complex patterns that seem to be in the process of forming, to help with decisions.
- Most important of all: Appreciate that reversals in momentum may not be accompanied by reversals in price. Wait, therefore, for some confirmation of a price reversal before taking a position.

For some instruments, some of the time, forecasts may be reliable and provide a basis for either entering or exiting a position. Figures 12.1 and 12.2 provide examples of forecasts that could have been relied on to take contrarian trades. It needs to be pointed out that forecasts may be of variable quality, and, in particular, the issue of their reliabilities may be glossed over either by their supplier or the supplier of the software that produces them.

Open interest is a useful indicator in commodities. Based on the way it changes with price, it is possible to produce indicators that generally peak before a market top. They are not specifically covered here as these tend to be noisy and give signals too early, but they do provide an indication of when a market is vulnerable to a price reversal. In general, any reversal in price near a suspected market top or bottom that is also accompanied by a decline in open interest should be taken as a sign of a possible price reversal and added to the weight of evidence suggesting a reversal.

Finally in this section, patterns, often of the one-bar variety, are very useful for providing the additional confidence (and possibly confirmation

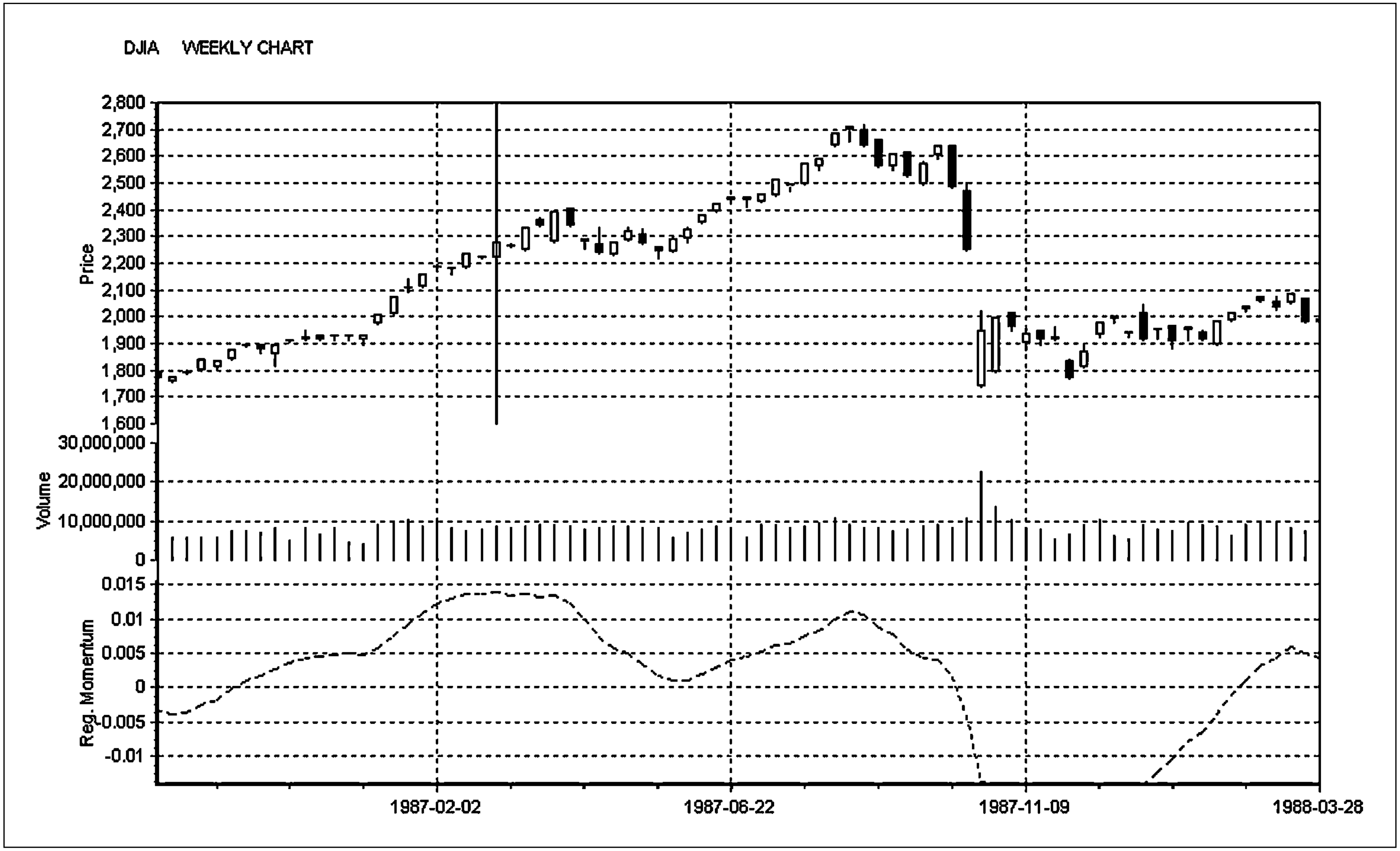

FIGURE 16.5

The cursor is positioned around March 1987, where there is a peak in momentum (length 13, regularization 3). The momentum peak before the 1987 crash is lower than that of March 1987, despite October prices being significantly higher. Once again this is a divergence between price and momentum, which in this case flagged the 1987 crash.

of a price reversal) needed to take a contrarian position suggested by other signals. Most of the figures used here to illustrate contrarian techniques involve patterns since they usually produce the earliest confirmations of price reversals needed for contrarian trades.

FUNDAMENTAL ANALYSIS

Part 2 of this book addressed some of the issues involved in fundamental analysis that offer a basis for contrarian investing, but after many chapters of technical analysis, the basics are unlikely to be at the forefront of readers' minds.

To recap, fundamental analysis involves elements of accounting and assessments of companies' prospects. Both involve subjective judgments. Checklists of criteria for which judgments are needed are useful, and some, distilled mainly from works by Benjamin Graham and Jim Slater, are presented in Chapter 6.

From Williams's formula, share prices depend on perceptions of future dividends, interest rates, and dividend growth. Graham advocates searching for value. The accounting ratios in Appendix 6.1 are intended to assist in computations for that kind of search. The fire sale conditions of the 1930s, when value investing techniques were heavily and successfully used, may never be repeated, and, if exceptional value is found, reasons for it need to be closely examined in case there is anything untoward that is not showing up on a balance sheet. Slater describes a practical concept (price/earnings growth ratio, the PEG) for finding a short list of potential growth companies, but he offers a warning that it does not work all the time, as well as useful criteria to accompany it to help improve the chances of finding a growth company. Opportunities therefore arise when price differs from intrinsic value. For the online investor, judgments in fields they are familiar with are likely to prove more fruitful than those they are not familiar with.

Note that share prices tend to depend on perceptions of future values. If growth prospects were to diminish, or some disaster were to afflict a company, then a rapid effect on share price could be expected. The opposite applies when good news comes. Perceptions are prone to errors, and so mismatches between perceptions and realities create opportunities for investors to make contrarian entries or exits—particularly when they have specific domain knowledge concerning the stocks in question.

Remember also the three classic situations in which fundamental analysis is useful:

- Undervalued or overvalued assets
- Cyclical stocks
- Growth stocks

Historically, some rich and well-known investors have tended to use fundamental methods in a contrarian sense, so it may be worth rereading Part 2 at some stage.

RELATIVE STRENGTH

The term *relative strength* is used to describe a number of different calculations based on price, and its usage here needs to be clearly defined to avoid confusion. In present usage, a relative strength line is calculated by dividing the closing prices of one financial instrument by that of another with which a comparison is sought. Usually, this will involve dividing closing prices for a stock by that for an index (such as the S&P 500), but it could involve comparisons between companies or comparisons between indexes. The idea of relative strength sits awkwardly somewhere between fundamental and technical analysis, and it is one of the hybrid techniques referred to earlier. But, irrespective of its categorization, it offers a potent tool to introduce additional information into technical decision-making processes normally based on data from a single financial instrument.

Comparisons between stocks and indexes, or stocks and stocks, are useful when there is a relevant historical track record of how well a stock has performed relative to an index or another stock. A necessary condition for using such a track record is a belief that the historical data should be representative of current operating conditions so that inferences are not distorted by changes between past and present conditions.

There are two common useful ways in which the concept of relative strength can be used to support decisions. The first is by defining an equivalent of "overbought" and "oversold" thresholds, and the second, by looking for turning points in a relative strength line that precede those for the instrument being examined.

The premise behind "oversold" and "overbought" relative strength thresholds is that the value of a stock cannot get too far out of line with whatever it is being compared against, and it is therefore subject to pressure to regress to "normal" values if it strays too far. The logic needs to be checked to see if it is appropriate before "oversold" and "overbought" relative strength thresholds are used. It should also be borne in mind that whatever the stock is being compared with might also be moving and that the relative strength turning point could be a manifestation of financial instruments moving in the same direction but at different rates. As with momentum, price confirmation of a reversal in relative strength is prudent before acting on signals derived from it.

The premise behind the use of early turning points in relative strength lines is that some instruments will "lead" others, producing a situation in which the relative strength line can turn earlier than the instrument being traded. This needs to be checked for consistency, and where that consistency is found, it can be helpful in confirming price reversals. One method that some people use is to put equal length moving averages on both the price chart and relative strength line, and look for situations in which price and relative strengths are on opposite sides of their respective moving averages—particularly at extreme values of relative strength.

It is often worth comparing competing stocks for relative strength. Figure 16.6 does this for General Motors (GM) with respect to Toyota. A historic high is reached in the late spring/early summer of 2002, the relative strength line turns, followed by a price reversal a few bars later. Similarly, in Figure 16.7, where GM is compared with the S&P 500 index, (at least) a five-year high is reached at a point where relative strength has just begun to turn downward. Although obscured by the cursor, the actual top was also a Doji pattern, giving further reason to suspect it to be a top at the time it was formed. One caution is offered when computing relative strengths of stocks against other stocks: The resulting relative strength lines are likely to be noisier than those computed relative to indexes. This reflects the additional noise in stocks compared with indexes, which reduce noise by the averaging process used to create them. This is why the relative strength line of Figure 16.6 is much noisier than that of Figure 16.7 and more difficult to infer a conclusion from.

Figures 16.8 and 16.9 show the Nasdaq composite and its strength relative to the S&P 500 index. Figure 16.8 shows the Nasdaq at a historic high, which is (almost) sustained for a few bars, before reversing. The relative strength line turned downward for two bars before prices dropped significantly, and the top was accompanied by two hanging man patterns, to give a further clue to what was about to happen. Around $2^1/_2$ years later, the Nasdaq composite's relative strength was at (at least) a five-year low, with the low in the relative strength line coming one bar before the low in the Nasdaq—one bar to the left of the cursor in Figure 16.9. The low in the Nasdaq also coincided with a bar that formed a bullish engulfing pattern. Taken together, this combination of circumstances pointed toward a likely reversal.

MULTIDIMENSIONAL RELATIVE STRENGTH

There are some services offered over the Internet that extend the broad idea of relative strength to the strength of a financial instrument relative to a basket of other instruments. The methods used draw on ideas from multidimensional data analysis, and my next paragraph is going to get a little complicated and introduce some mathematical terms that may

FIGURE 16.6

The concept of relative strength can be used to compare one security with another. In this instance the price of General Motors (upper scale) is being compared with Toyota Motors to produce a relative strength line (lower scale). The cursor indicates a market top in GM, which comes after a near-historic high in this relative strength. A turning point in relevant relative strength, which precedes price turning points around historic highs or lows, offers an alert that tops or bottoms may be present.

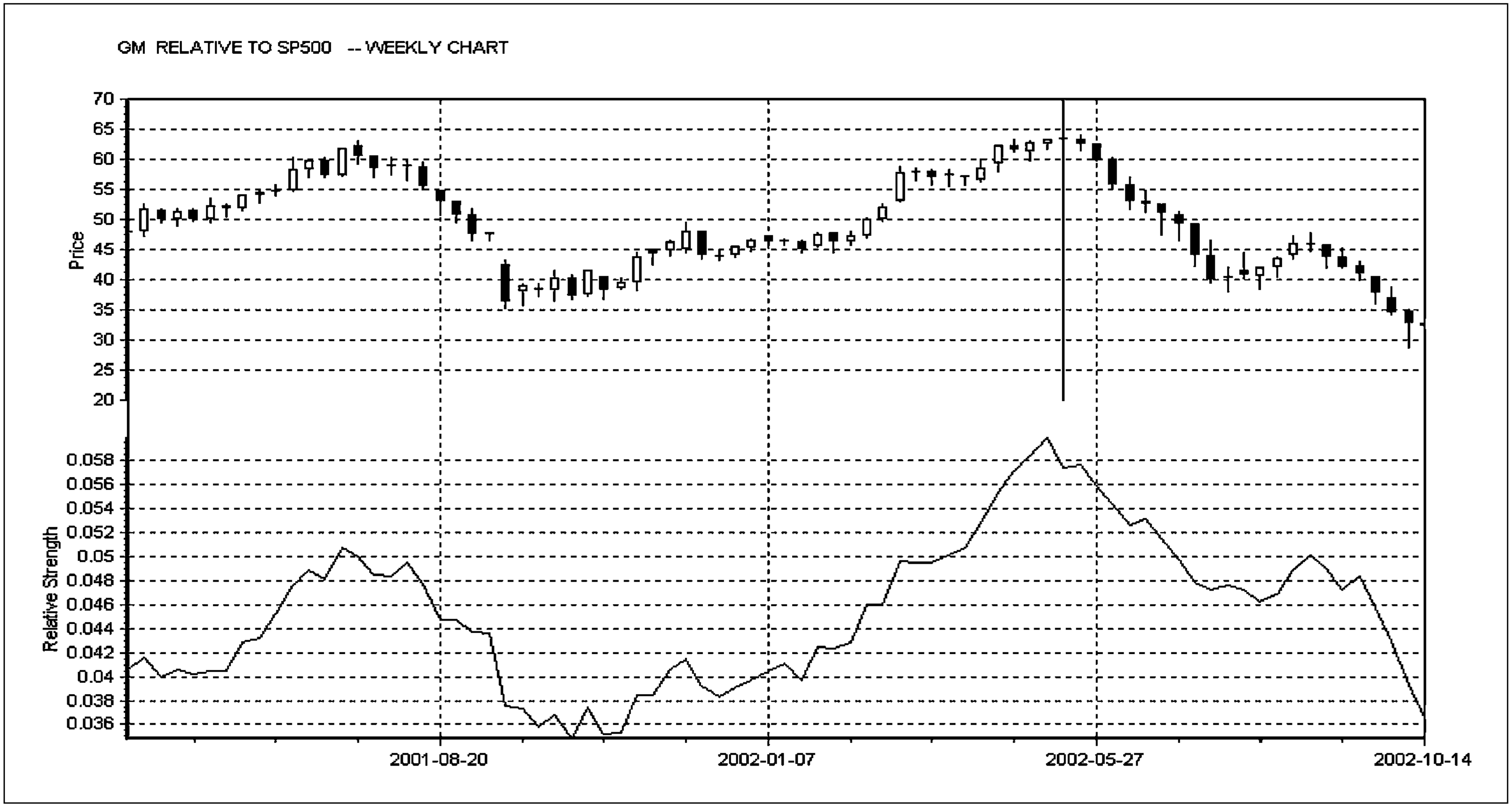

FIGURE 16.7

Relative strength is frequently calculated relative to a relevant index—in this case the S&P 500. This graph compares the same top in GM stock as Figure 16.6. The price top is shown by the cursor, once again comes at a near-historic level relative to the S&P 500, and again the turning point in the stock is preceded by one in the relative strength index.

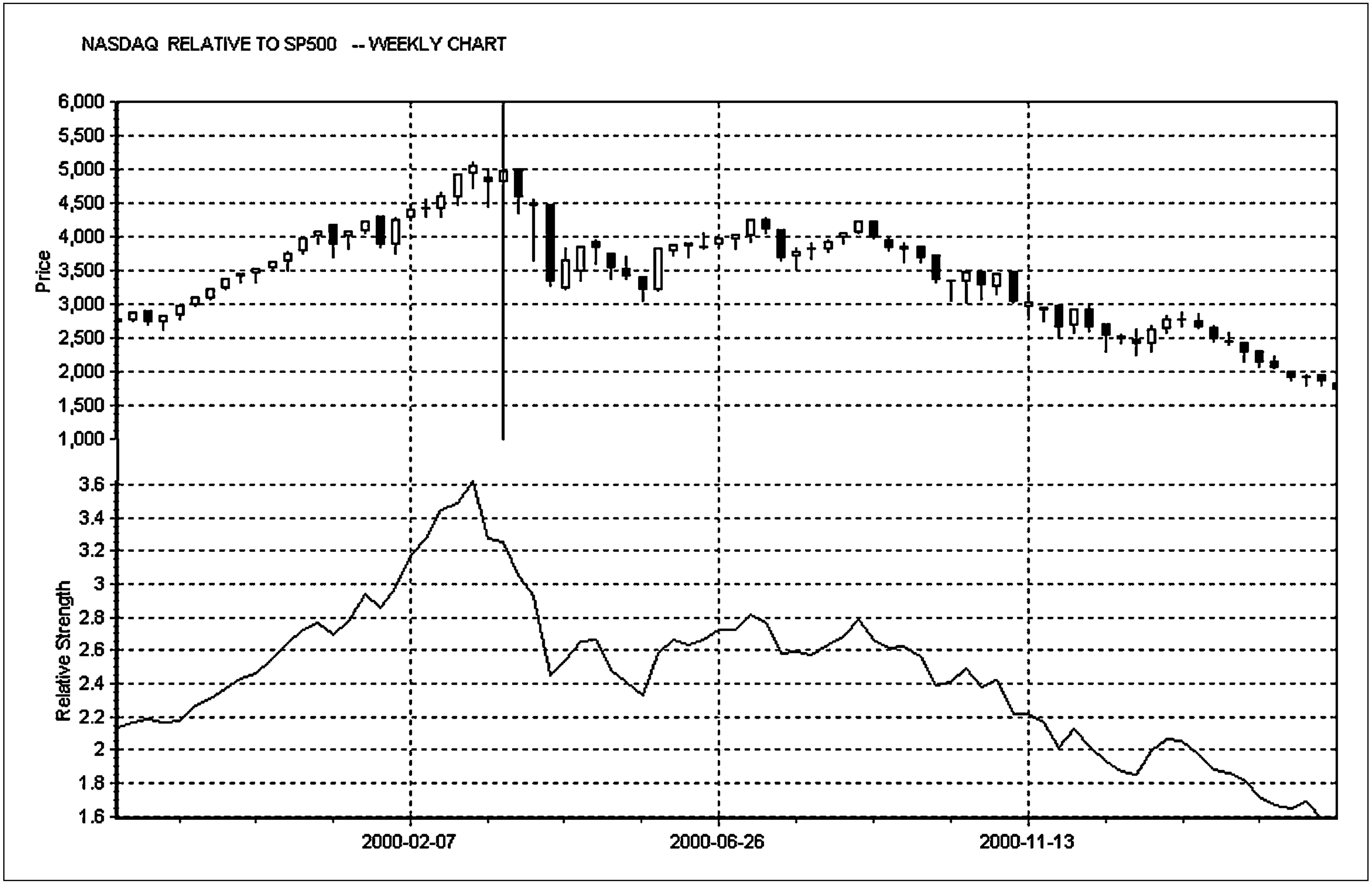

FIGURE 16.8

This figure shows the Nasdaq composite (upper chart) against its strength relative to the S&P 500. The cursor is positioned just after a historic high in both the composite and relative strength line. Note that the relative strength line is already falling sharply at the cursor's position, giving an indication of problems to come. Hanging man formations are also evident at this top.

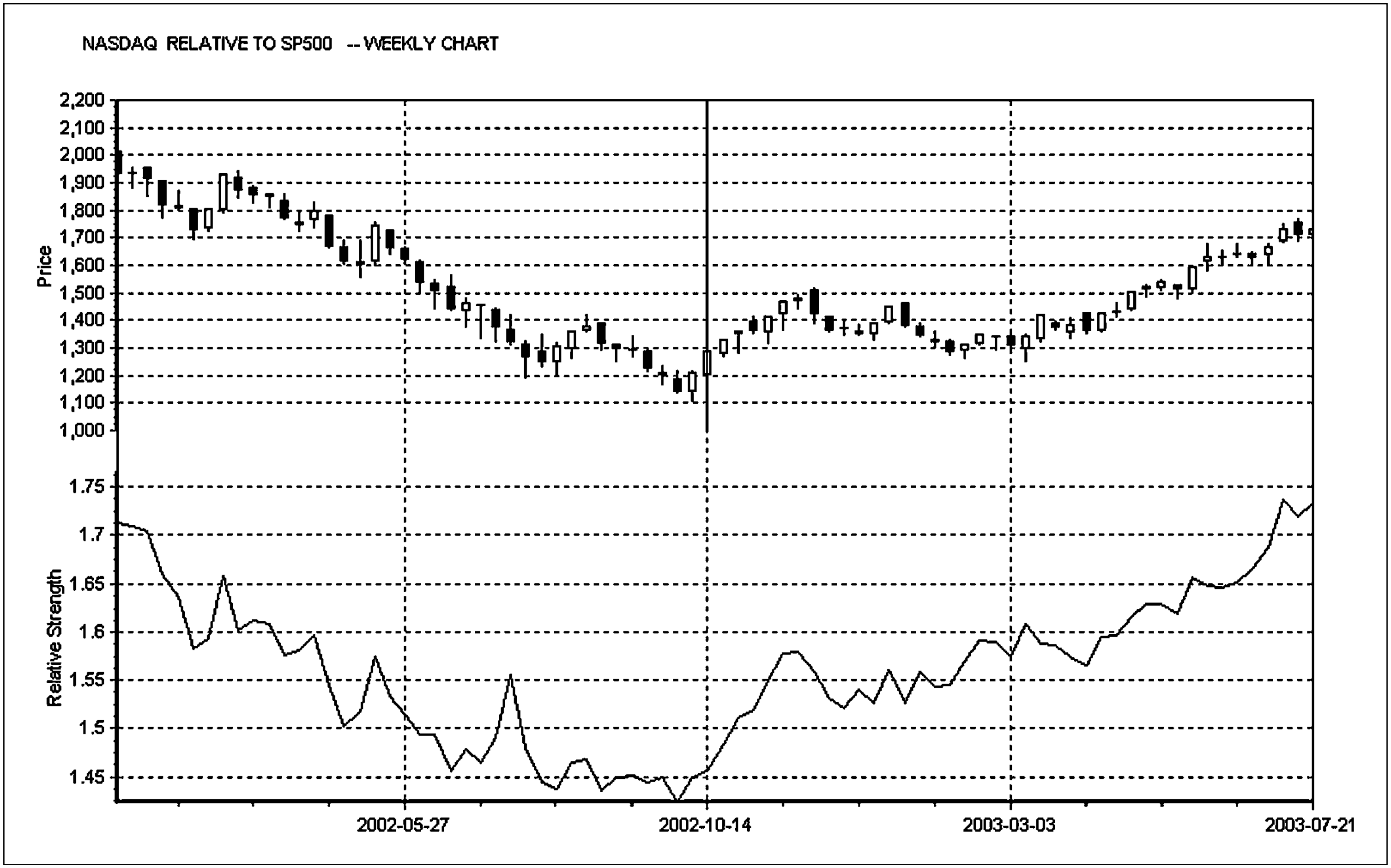

FIGURE 16.9

This figure, like Figure 16.8, also shows the Nasdaq composite and its strength relative to the S&P 500. The cursor is positioned on the bar after the (at least) five-year low in relative strength, when it is starting to increase again. The bar containing the five-year low is also a bullish engulfing pattern. The "oversold" values of relative strength would have suggested an upturn was imminent and the bullish engulfing pattern offered further support for the idea that the index was about to reverse.

be unfamiliar. If the reader gets lost, the paragraph after it aims to describe what the process delivers and key questions for the investor about its likely accuracy.

A basis for assessing multidimensional relative strength is via *principle components analysis* (PCA), which is described in C. M. Bishop's *Neural Networks for Pattern Recognition*. This starts with a *covariance matrix* of (usually preprocessed) representative values of the financial instruments, individual elements of which are given by equation 4.3. The covariance matrix is then examined for latent roots, known as *eigenvectors* (described in *Numerical Recipes*, by Press et al.), which can be interpreted as rotating the high dimensional space composed of the representative values of the different financial instruments. Each latent root (eigenvector) has an associated number, known as an *eigenvalue*. This provides a measure of the variance of the original data represented in the rotated space after its associated eigenvector has rotated that data. That measure enables the latent roots corresponding to the larger eigenvalues to be recognized as significant and data associated with latent roots corresponding to the smaller eigenvectors to be dismissed as noise. Thus, the dimension of the original space can now be reduced to the extent that latent roots can be dismissed as noise. The final part of this process is to take the representative values (derived from prices of the basket of instruments), use the significant latent roots to transform them into a noise-free, lower-dimensional rotated space, and a transposed version of those roots to get back to the space from which the covariance matrix was computed. The result is to filter the representative values of the basket of financial instruments by removing noise. Finally, if preprocessing of prices was originally done (which usually would be to remove scale effects), then its reversal, known as *postprocessing*, has to be done to get back to the price space for the basket of instruments.

The result of all this is to produce a filtered price value for each instrument, based on the assumption that the covariance matrix derived from past values is representative of the current situation. The method assumes that the covariance matrix will endure and that prices come under pressure to move toward their filtered values. For the investor, key questions are the reliability of the covariance matrix to endure and the impact of the assumption that financial instruments are linearly related, which is implicit in the use of a covariance matrix.

There are a number of variations on this technique that usually involve different ways of preprocessing. Sometimes a correlation matrix is used, but this can be shown to be equivalent to a covariance matrix with appropriate preprocessing of variables.

SUMMARY

- The big issue in contrarian strategies is whether to wait, to confirm prices have reversed, or act early, with a greater risk of failure, in the hope of securing a greater profit.
- Whatever technique an investor uses needs to be matched to his or her talents and risk/reward preferences.
- Trading ranges of sufficient width can offer opportunities for contrarian trades based on their support and resistance levels.
- Momentum, used in conjunction with confirmation of any price reversal, can be used for contrarian trades. The summary of momentum given earlier in this chapter is intended to form part of this summary.
- One-bar reversal patterns are the *minimum* confirmation needed for a price reversal.
- Forecasts, when reliable, and open interest (in commodities) can provide a basis for a contrarian decision.
- Overvalued or undervalued assets, cyclical, or mispriced growth stocks are situations in which fundamental analysis can help to highlight a potential contrarian investment. An element of mispricing is always useful if it is intended to hold a long position for the longer term, and an idea of price relative to intrinsic value is useful in assessing the chances of a price move continuing.
- Relative strength can be used in two ways: The first is by defining an equivalent of overbought and oversold thresholds, relying on concepts of momentum, and the second is by looking for turning points in a relative strength line that precede those for the instrument being examined, so as to flag a reversal. Like momentum, signals from relative strength should be accompanied by confirmation of a price reversal.
- Multidimensional variants of the relative strength concept exist to indicate when prices are under pressure to return to "normal" levels relative to the basket of financial instruments with which they are being compared. Their usefulness depends on the linearity and consistency of relationships that exist between prices for instruments in the basket. Once again, confirmation of a price reversal should be sought before acting on the results of such models.

CHAPTER 17

Trading Systems and Risk Assessments

A large proportion of new futures accounts are wiped out in their first year. Some of the reasons for this—for example, holding on to positions rather than using sensible stop orders—have already been discussed. However, another reason is a failure to appreciate the amount of capital needed to take positions when the risks in a given investment strategy have been neither appreciated nor correctly assessed. (An interesting introduction to risk, considered in a wider context than that of the markets, is given by Dan Borg. See bibliography.) Successful investors tend to look at risks before, not after, potential profit, and, irrespective of potential profit, they may walk away from an opportunity if its risks are not to their liking. In this and the following chapter, various ways of assessing and reducing risk will be discussed. This chapter will focus on risk assessment and reduction for a specific financial instrument, and Chapter 18 will focus on achieving further reductions in overall risk through portfolio diversification.

EQUITY CURVES AND DRAWDOWNS

An *equity curve* defines the amount of equity in an account, as a function of time. Equity curves are conveniently expressed visually as graphs of equity against time. The *maximum drawdown* is defined as the largest decline between a peak in the equity curve and any subsequent low point, which may form a trough. There may be intermediate drawdowns between different peaks and subsequent troughs, but the largest is the one of most interest since it creates a historical expectation for the capital needed to finance a likely run of losses. The maximum drawdown of a portfolio is therefore a vital statistic needed to work out the capital required to sustain investing with a chosen strategy. When using protective stop orders, the highest drawdowns tend to come from sequences of losses, which is why runs of whipsaw trades in sideways markets need to be avoided. Our focus in this chapter is to look at ways of assessing drawdowns for individual financial instruments and also at ways of finding the best compromise between maximizing returns and minimizing drawdowns. In the next chapter, the more general question of portfolio equity curves and portfolio drawdowns, which are the key to capital requirements, will be considered in greater detail, but an initial introduction is given here to provide a context for the remainder of this chapter.

CAPITAL REQUIREMENTS

The capital needed to run a trading account must be sufficient for both margin calls and drawdowns. This is why the need to estimate drawdown is so important—because without such an estimate, it becomes impossible to assess financial risk and capital requirements. Regrettably drawdowns often come early in an investor's career, frequently due to inexperience, and their impact then tends to be all the greater as the size of positions taken may subsequently need to be reduced to avoid the risk of wipeout, which diminishes potential profits and makes it all the harder to claw back the losses. Any "borrowing" in order to invest, often not obvious with "investments" such as spread bets (if legal) or margined accounts, will not only boost potential profits but also dramatically reduce any margin of safety against wipeout. Investors need to consider carefully just what the effects of adverse price movements will do to their equity before borrowing to invest. Often, new investors receive advice to avoid margined accounts until they fully appreciate their associated risks. Regrettably, the comment about new futures accounts mentioned at the start of this chapter suggests that such advice is all too frequently ignored. Another possible difficulty with futures accounts is that margin requirements to support a position taken by an individual may be three times or so greater than the minimum margin requirements published by an exchange that are applicable to blue-chip organizations, but this does at least have the effect of encouraging individuals to trade conservatively.

As a rough guide to capital requirements, positions taken might require capital based on a multiple of maximum drawdown, providing that multiple is high enough to accommodate margin calls. For relatively conservative trading in the futures markets, multiples of between three and five times the maximum anticipated drawdown are commonly used.

THE CHANGING NATURE OF MARKETS

As we have seen earlier in this book, markets have a way of changing from one type of character to another, often just after the majority of investors have settled on their strategies to exploit the initial market character. In terms of assessing risk, some simulation of an investment strategy needs to be carried out, but the problem of markets changing their characters often invalidates inferences drawn from those simulations. At various points earlier in the book, the advice was given either to exit or hold a fixed position in a sideways market. Those are markets that commonly cause difficulties, with the second biggest problem being sudden declines. Whatever investment strategy is simulated, when inferences are drawn, investors need to be mindful of the fact that future results are likely to be worse than those of the simulation.

SOME ISSUES IN SIMULATING INVESTMENT STRATEGIES

Simulating the results of an investment strategy sounds much easier than it is. There are many potential pitfalls, and some of the most common ones are listed here:

- Which came first, the high or the low? Price data usually contain open, high, low, and close (OHLC) data. Two fixed prices at two fixed times (open and close) are known from these data, which means multiple intrabar entries and exits cannot be simulated because the information is not there to do it. It is possible to simulate single limit, MIT, or stop orders with (OHLC) data, and the effects of changing positions at open and close prices, but that is about all that can be done with it.
- Use cannot be made of information before it is generated. Moving averages and many other indicators are calculated on the basis of closing prices. A closing price is not known until a trading session ends, by which time it is too late to take a position. In simulations, the earliest time that a position based on a calculation involving closing prices can be taken is at the open of the next day. Note also that stop prices based on (OHLC) data cannot be used until the bar *after* the latest one used to calculate their value.
- A common error is a failure to appreciate that if a stop order is triggered on the open price, then a simulation should assume the order is filled at the open price. There may be a gap between the open of one bar and the close of the previous, so if the stop order was not triggered by the previous close, it follows that when it is

triggered at the following open, it will be as the result of a gap, and very probably filled at a much worse price than the level at which it was intended to be triggered.

- Any simulation should include an allowance for commission and slippage. Slippage depends on liquidity, and it will be indicated by the bid-ask spread. Commission depends on the broker and type of service being used. Common allowances used in simulations for commission and slippage are a percentage of the order value (0.5 to 2 percent) or a fixed amount for each unit being traded—for example, an assumed cost of $80 per contract for a futures trade. Note here that the results of any simulation will be heavily influenced by whatever allowance is made for commission and slippage, and the optimum trading system strategy even more heavily influenced.
- With shares, potential gains are easily calculated by multiplying the number bought by the price change. With commodities, things are slightly more complicated. Each commodity comes in a prepackaged size, called a *contract*, which fortunately need not concern us greatly unless we wish to supply or receive delivery of it. When prices change, the value of the contract will go up or down by a fixed dollar amount for each unit of price change. For example, when U.S. bonds change their price by $1, each U.S. bond contract changes its value by $1,000. Thus, what matters to a speculator in futures are the dollars a contract changes in value for each point it changes in price. Occasionally the size of futures contracts change, and so the dollars per point figure has a related change. Although such computations sound simple, they are such a common source of error that it is worthwhile trying to get an independent check on any calculations.

PAPER TRADING

Some brokers offer investors a facility to *paper-trade* a strategy over a period of time to see how well it would have worked. There is a good deal to be said for using such facilities so that errors and strategy refinements can be made on paper rather than on a real exchange where they might lose real money. This practice can also provide an independent way of making sure the accounting calculations are correct.

An Internet service has been offered whereby subscribers can define indicator-based entry and exit signals for their chosen stocks and receive a financial report on how well their strategy would have worked. While the future of that service is uncertain, it is more certain that similar services will appear to enable investors to evaluate strategies based on technical analysis, which leads to our next topic.

TRADING SYSTEMS IN GENERAL

In professional circles, for many years, computers have been used to optimize parameters for trading systems. The reason is fairly clear: that by getting a computer to generate good trading signals, a money making machine is produced. Unfortunately markets have often tended to respond in ways to frustrate machine-derived signals. For the most part, trading systems have been based on indicators. As an example of a very simple system: A buy rule could be “price above a moving average” and a sell rule, “price below a moving average.” An optimization could then be carried out to find the length of a moving average for which this rule worked best.

Martin Pring’s book *Breaking the Black Box* describes how he used commercial software to generate trading systems and the techniques he employed to choose parameters. This offers a feasible route for online investors wanting to investigate the merits of strategies that lie within the capabilities of commercial packages. Examples given in the book suggest that these are mostly confined to the use of indicators. There are good reasons for this, one of which is that patterns, divergences, forecasts, and similar methods represent a quantum leap in the complexity of the software, with implications both for the cost of producing it and the ease with which it can be used.

Before rushing out to invest in such software, however, note that I know of at least one savvy investor who, having spent time and large amounts of money investigating and developing indicator-based trading systems, gave up on them in favor of some of the more traditional techniques described earlier. I suspect he is not alone.

There are two philosophies in common use with trading systems. One is to consider every signal—which derives from a belief that the system has been objectively tested and so following its signals rigidly should deliver better results than would using a discretionary system of untested efficacy. The other philosophy says that systems based on indicator crossovers or thresholds cannot take advantage of divergences, patterns, fundamentals, or any of the other factors that should contribute to a “weight-of-evidence” decision—and should therefore be used only as a rough guide to a more opportunist strategy that takes advantage of market situations as they appear. All investors must decide for themselves how they are going to use any results of trading systems, but the fundamental need to assess drawdown remains because without it, risk cannot be assessed. At the level of the individual financial instrument, the investment strategy needs to be mindful of the effect of its maximum drawdown on portfolio maximum drawdown, so it is usual to devise strategies to avoid high drawdowns.

DEVELOPING A TRADING SYSTEM

The raw process of developing a trading system: (1) Devise a strategy to generate buy and sell signals, and (2) optimize the parameters for that strategy so as to achieve an objective; which typically is the maximum possible quotient of profit to maximum drawdown. There is a complicating factor in that in practice, any system devised has to work on data it will not have seen, rather than on that used to find the optimal parameters.

Comments made in Chapter 12 about the problems of modeling data are relevant to trading systems. There is an idea, validated many times in practice and expressed in a number of different ways, that the simplest model capable of representing the "signal" component in any data represents the best model likely to be achieved. For trading systems, this might be achieved by taking a sample of representative market data, developing a number of related models of varying complexities, optimizing their parameters on the sample of data, and then testing their performance on out-of-sample data. The idea behind this technique is that we seek to model the signal component of data, we cannot distinguish it from the "noise" component, but when the model complexity just permits the full signal component to be modeled, it will represent the best compromise between failing to represent the signal with a model that is too simple and modeling some or all of the noise, as well as the signal, through excessive complexity. A graph of trading performance on out-of-sample data against model complexity should be at a maximum level of complexity that just allows the full signal component to be modeled but limited in complexity to exclude noise. This is because the signal is deemed to be repeatable and the noise to be random and therefore to be unrepeatable, which serves to lessen the performance of overcomplicated models on novel data.

This is a standard technique of data modeling, known as *cross validation,* and it has been adapted in various ways to assist in the special problems of optimizing trading systems (see Robert Pardo's book listed in the bibliography). These problems arise from two basic causes: (a) the problems of measuring complexity and (b) making sure data samples are representative. With many such problems, a measure of complexity can be found by counting the number of free parameters, but with trading systems, there is the additional problem of accounting for additional freedom that may arise from having many rules. The problem of ensuring that the data are representative is particularly tricky. Received wisdom on data modeling is that both in-sample and out-of-sample data should be fully representative of all markets likely to be encountered. This would require more data than are usually available so various tricks have evolved to get around this problem. One of these is to see if the model architecture (with market-specific and separately optimized parameters) works well on out-of-sample data for a number of different markets. Another is to take a number of "windows" of in-sample data and smaller "windows" of out-of-sample data, walk these windows forward through the data, finding populations of near-optimal parameters for each pair, and select the mode (that is, the most commonly found) of these parameters as the optimum. These tests need to be repeated to find optimal parameters for each financial instrument whenever strategies used by the models change.

There is a further issue of how long a model remains valid and a related issue of whether to use a general model or one specific to prevailing market conditions. In Chapter 8, the hope expressed for technical analysis was that heuristics could be found that worked for a while, but with an expectation that they would eventually break down. Some people take that view because markets have a particular character for a period and then change to another, a series of local models, specific to each market character, will deliver better results than a single model reflecting a global compromise. Consequently they ignore the mode of parameters found in walk-forward experiments (described in the previous paragraph), in preference to selecting those parameters they think will work best in the immediate future for whatever model they believe to be currently most effective. Using programs that can build and test strategies by pointing and clicking with a mouse, the average life of many day traders' systems is three weeks or less. There are no absolute answers to the question of the useful life of a trading system. For guidance, when a trading system forms part of a long-term investment strategy, its use should be reviewed whenever the market character changes (which might be evident from losses) or at least annually.

SPECIFIC EXAMPLE OF A SYSTEM

The first stage in devising a trading system was to create a strategy to generate buy and sell signals, which will be done with an indicator. In Chapter 10, the Trend2Noise indicator was described. To understand how to use this indicator in a trading system, the following points need to be appreciated:

- Trend is quantified relative to price noise and not in any absolute sense.
- Over the window of values on which the indicator is based, a positive value of Trend2Noise implies an uptrend, and a negative value a downtrend.

- In sideways markets, absolute values of Trend2Noise indicators should be relatively low, especially when those markets become extended. This leads to the idea that market types might be classified by using a threshold in conjunction with Trend2Noise. Plus or minus T might be used to define bull (Trend2Noise above +T), bear (Trend2Noise less than –T), and sideways (Trend2Noise between –T and +T) markets.

The last of these points shows how a simple bull-bear-sideways market classifier can be generated from a Trend2Noise indicator. The next stage is to introduce a tactical entry-exit (or combined exit-stop) mechanism to take trades consistent with the market classification. The parabolic system (described in Chapter 10) could be used for this purpose, but instead the filtered lines and associated stops (also described in Chapter 10) are chosen as this produces the type of trading system already described in Figure 15.5.

The rules for the system are therefore the following:

1. Enter long at the open of a bar following the Trend2Noise being greater than the threshold (+T) and the tactical entry system long. Place a stop order at the level indicated by the filtered line and equation 14.1. Treat it as a trail stop, updating the stop order on each bar for which (14.1) produces a *higher* value than the previous stop order.
2. Enter short at the open of a bar following the Trend2Noise being less than the threshold (–T) and the tactical entry system short. Place a stop order at the level indicated by the filter and equation 14.2. Treat it as a trail stop, updating the stop order on each bar for which (14.2) produces a *lower* value than the previous stop order.
3. Exit whenever stopped out, remembering that if stopped on open, the exit price to be assumed is the open price, not the stop price.

The drawdown was calculated on the basis of valuing a position using weekly closing prices—not the high or low prices, which should give more conservative results. Some calculate drawdown on the basis of closed-out positions, which leads to optimistic results.

An allowance of around $200 per trade was made for commission and slippage (exactly 200 percent of entry price). This is unrealistically high and diminishes calculated performance, but it is useful to highlight sets of parameters likely to generalize into good trading systems on unseen data.

A program was prepared to optimize the parameters for this system, and some initial results for U.S. bonds are presented in Figure 17.1. The in-sample (training) data were from August 1977 to December 1996, and the out-of-sample data from January 1997 until October 1999. These results are

PARAMETERS				TRAINING DATA							OUT OF SAMPLE DATA						
Trend2Noise Length	Filter Length	Stop Width	Threshold for Trend2Noise	Annual Profit/Drawdown	Annual Profit	Drawdown	# Winners	Average Profit	# Losers	Average Loss	Annual Profit/Drawdown	Annual Profit	Drawdown	# Winners	Average Profit	# Losers	Average Loss
16	19	1	0.21	0.76061	2231	−2933	11	4192	2	105	−0.35714	−2999	−8397	0	0	3	1468
16	19	1	0.21	0.76061	2231	−2933	11	4192	2	105	−0.35714	−2999	−8397	0	0	3	1468
16	16	1	0.21	0.62462	1949	−3120	9	4519	4	170	−0.20129	−1150	−5711	2	1212	1	1665
61	22	1	0	0.54178	3376	−6231	13	6063	5	1927	0.49685	2842	−5721	3	3644	1	305
61	22	1	0	0.54178	3376	−6231	13	6063	5	1927	0.49685	2842	−5721	3	3644	1	305
55	22	1	0.03	0.53096	2669	−5026	11	5607	4	1667	0.33357	1348	−4042	2	2725	0	0
55	19	1	0.03	0.52686	2956	−5611	12	5466	3	1448	−0.18803	−1707	−9080	1	4518	2	4411
58	22	1	0	0.5098	3452	−6772	14	5888	4	2404	0.61603	3524	−5721	3	4102	1	305
58	22	1	0	0.5098	3452	−6772	14	5888	4	2404	0.61603	3524	−5721	3	4102	1	305
58	22	1	0.03	0.4815	2718	−5644	12	5217	3	2223	0.07237	414	−5721	1	3739	2	328
58	22	1	0.03	0.4815	2718	−5644	12	5217	3	2223	0.07237	414	−5721	1	3739	2	328
52	34	1	0.03	0.46602	2340	−5022	9	6040	4	1802	0.55037	2651	−4817	2	3126	0	0
58	19	1	0.03	0.45885	2653	−5782	11	5691	4	1804	−0.21022	−1909	−9080	1	4518	3	3047
58	19	1	0.03	0.45885	2653	−5782	11	5691	4	1804	−0.21022	−1909	−9080	1	4518	3	3047
55	52	1	0	0.45633	2419	−5300	10	5146	2	1437	0.47476	3054	−6432	2	5106	0	0
52	22	1	0	0.43849	3266	−7449	13	6165	6	2155	−0.11707	−950	−8111	2	3616	2	2670
55	34	1	0.03	0.4367	2193	−5022	10	4937	3	1685	0.23045	1110	−4817	2	2392	0	0
55	34	1	0.03	0.4367	2193	−5022	10	4937	3	1685	0.23045	1110	−4817	2	2392	0	0
52	28	1	0.03	0.41889	2472	−5901	9	6744	6	1887	0.69963	3027	−4327	2	3653	0	0
55	19	1	0.06	0.40849	2027	−4962	9	4684	0	0	−0.18803	−1707	−9080	1	4518	2	4411

FIGURE 17.1

Results of optimizing trading parameters for U.S. bonds.

interesting because they show that the best-performing set of parameters in the training period made losses on subsequent out-of-sample data (calculated with the same penalizing assumption of $200 per contract for commission and slippage). Overall, the average of the top 20 sets of parameters would have made a modest profit during the out-of-sample period.

The concerns expressed earlier about overfitting the training data with an overcomplex model were investigated by constraining the Filter and Trend2Noise lengths to share the same value, which reduces the ability of the trading system to model the data and hence its complexity. If the original model were overcomplicated, then this restriction should have produced better out-of-sample performance. Results of this experiment are presented in Figure 17.2, which shows that both in-sample and out-of-sample performance decline significantly with this modification, with only 4 of the top 20 sets of parameters showing any kind of profit in unseen data. The conclusions are that the original model was either inadequately representing the data or optimal and that further parameters and rules should be experimented with to determine the system's optimal level of complexity.

Some ideas on parameter selection are offered in Pardo's and Pring's books, but a great deal of uncertainty is likely to continue to shroud the question of future performance. A former partner of mine was very good at eyeballing trading system parameters that were going to work. His technique involved looking at charts of how a system with a candidate set of parameters traded a market and coming to a judgment about which sets of parameters were flukes and which were likely to generalize into good trading systems. To an extent, this can also be inferred from performance-ranked lists of parameters, where flukes have few or no similar parameters exhibiting similar levels of performance. It comes down to a question of experience and judgment; and, in respect of trading systems, it is always a good idea to see how the system has traded with a set of parameters so that you have an idea of what to expect, can see if you are comfortable with the way the parameters trade, and, you hope, have fewer surprises in the future. So, despite the variability of the out-of-sample performance data in Figure 17.1, my experience is that it is possible to look at the way a system trades and improve the odds of choosing a good set of parameters for subsequent trading.

Parameter selection for trading systems designed for use in specific market types is relatively unexplored in the literature—but there must be a body of knowledge on this subject so one day it will percolate through to enlighten investors.

The purpose of this section was to provide an example of the principles described earlier and an appreciation of the unreliability of the performance of training data to act as an automatic guide for that of out-of-sample data.

PARAMETERS			TRAINING DATA								OUT OF SAMPLE DATA						
Trend2Noise Length	Filter Length	Stop Width	Threshold for Trend2Noise	Annual Profit/Drawdown	Annual Profit	Drawdown	# Winners	Average Profit	# Losers	Average Loss	Annual Profit/Drawdown	Annual Profit	Drawdown	# Winners	Average Profit	# Losers	Average Loss
41	41	1	0.03	0.44811	2237	−4991	8	6209	3	1347	0.26772	1416	−5289	1	3461	0	0
41	41	1	0.03	0.44811	2237	−4991	8	6209	3	1347	0.26772	1416	−5289	1	3461	0	0
42	42	1	0.03	0.44726	2235	−4998	8	6172	3	1149	0.09331	507	−5438	1	2343	0	0
42	42	1	0.03	0.44726	2235	−4998	8	6172	3	1149	0.09331	507	−5438	1	2343	0	0
56	56	1	0	0.39156	2600	−6639	7	9067	4	1954	−0.03106	−209	−6715	1	1066	0	0
56	56	1	0	0.39156	2600	−6639	7	9067	4	1954	−0.03106	−209	−6715	1	1066	0	0
57	57	1	0	0.38603	2650	−6866	7	8928	4	1779	−0.11915	−813	−6823	0	0	1	10
57	57	1	0	0.38603	2650	−6866	7	8928	4	1779	−0.11915	−813	−6823	0	0	1	10
55	55	1	0	0.3647	2420	−6636	8	7320	4	1267	−0.01118	−72	−6472	1	1309	0	0
55	55	1	0.03	0.33863	1954	−5771	6	7877	4	961	−0.01118	−72	−6472	1	1309	0	0
55	55	1	0.03	0.33863	1954	−5771	6	7877	4	961	−0.01118	−72	−6472	1	1309	0	0
57	57	1	0.03	0.3338	2128	−6376	6	8442	3	1719	−0.11915	−813	−6823	0	0	1	10
57	57	1	0.03	0.3338	2128	−6376	6	8442	3	1719	−0.11915	−813	−6823	0	0	1	10
56	56	1	0.03	0.32846	2151	−6549	6	8500	3	1683	−0.03106	−209	−6715	1	1066	0	0
54	54	2	0	0.32507	2727	−8388	7	8664	1	2628	−0.39466	−3548	−8989	0	0	2	2057
23	23	1	0.18	0.31807	1070	−3366	3	7795	1	3.07297	−0.23406	−971	−4151	0	0	2	398
37	37	1	0.06	0.31754	1743	−5488	7	5658	2	664	−0.236	−1206	−5112	0	0	1	1456
37	37	1	0.06	0.31754	1743	−5488	7	5658	2	664	−0.236	−1206	−5112	0	0	1	1456
59	59	1	0.03	0.31209	2077	−6656	7	6872	2	2061	−0.13654	−970	−7102	0	0	1	290
59	59	1	0.03	0.31209	2077	−6656	7	6872	2	2061	−0.13654	−970	−7102	0	0	1	290

FIGURE 17.2

Results of optimizing trading parameters for U.S. bonds with a shared indicator length.

It was not to produce an "optimal" trading system for the various shades of opinion on this subject to dispute. Clearly the system developed for this example is not optimal. However, it should serve to highlight the fact that despite the difficulties of estimating drawdowns, unsimulated and untested investment strategies have unknown drawdowns, which are likely to be much worse than those arising from the best sets of parameters found from this type of simulation.

DELIVERABLE: RETURNS DATA

Having chosen and simulated potential investment strategies for candidate financial instruments, the next requirement is to examine the question of how to put them together in a portfolio. The raw data needed to address this issue are known as *returns data*, which are the percentage change in values between one time period and the next. If a weekly system is used, then returns data would be based on weekly valuations of positions or the profit or loss made between the exit price and the closing price of the previous week. In the event of a system being out of the market, the returns data are zero for that period.

SUMMARY

- Graphs of equity in an account, plotted against time, are called *equity curves*.
- Equity curves can be plotted for the returns from trading a single financial instrument or a portfolio.
- *Drawdown* is the largest decline in the equity curve between a peak and subsequent low point.
- A heuristic for capital requirements in the futures markets is to use three to five times the maximum expected drawdown.
- Markets change, and changes can impact on the results of simulations of investment strategies.
- Simulating an investment strategy is harder than it looks. Using broker-provided services for results of paper trading can help both to check on your planned strategies and on your accounting calculations.
- Most trading simulation is based on indicators and generally avoids more realistic weight-of-evidence approaches.
- Getting the complexity of a trading system right is nontrivial. If it is too simple, it fails to model useful data. If it is too complex, it models unrepeatable noise and performs poorly on unseen data.

- A trading system produced from in-sample data should be tested on out-of-sample data.
- Eyeballing trading parameters that work is not easy, but once the parameters are chosen, they should always be accompanied by an examination of how they trade a market.
- Despite the difficulties of assessing how a trading system will perform on unseen data, it is generally worthwhile to do some simulations with a view to assessing potential drawdowns and profits, and especially to identify ways of trading to reduce drawdowns.
- Failure to do any simulations may result in high drawdowns and wipeout of capital.
- Ultimately, simulations should aim to deliver percentage changes in the values of equity between different time periods that can be used for subsequent portfolio calculations.

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CHAPTER 18

Portfolio Diversification

This book has covered many topics on which professional investors hold strong and varying opinions—with the result that some views expressed will be disputed by some professional investors. If there is one subject that just about all of them agree on, it is the need for diversification. So this chapter aims to outline some of the arguments in favor of it as well as suggesting other ways of reducing risk.

Acknowledging the need for portfolio diversification is a tacit admission that much of the time, investment decisions will be wrong. If they were right all of the time, the investor could put all available capital into the highest-yielding instrument and secure the highest possible return. Unfortunately many investment decisions do not work out as planned, so nearly all investors aim simply to minimize their exposure to risk. Diversification is a major element in the control of risk and something that each and every investor needs to be fully aware of.

Diversification reduces risk, and so the degree to which it needs to be used depends on an investor's risk preferences, which are often related to age. For a young person, opportunities will usually exist to recover from a financial disaster, and so relatively high risks may be acceptable. For the more elderly investor, there is usually more to lose and fewer opportunities to recover from financial disasters, so acceptable levels of risk are usually lower. One adage developed to reflect this situation was to advise that the percentage of wealth to be held in stocks should be equal to 100 less an investor's age—with the rest being held in less risky but lower-yielding investments, such as bonds. Whether this is good practice or not is an issue that has been argued about for a long time. The arguments usually center on the relative risks and returns between stocks and bonds rather than the basic need for more elderly investors to be more cautious in their exposure to risk.

Various investment strategies can be devised to make multiple investments to hedge against both specific and general risks. In this chapter some specific risks will be identified and possible techniques for dealing with them outlined.

Earlier in this book, the conventional advice to "invest in what you know" was mentioned. In this chapter the implications of investing too large a proportion of a portfolio in "what you know" will also be examined, and the need for uncorrelated investments will be highlighted. From the portfolio perspective, if investors wish to invest in "what they know," they will need to find out what to invest in to offset risk and then to learn about those investments.

A PORTFOLIO CASE STUDY

A number of points about capital requirements, equity curves, and considerations for building a portfolio are best illustrated by a case study—thus our use of a case study here to provide a context in which to discuss diversifying portfolios. In addition, the discussion on drawdowns from Chapter 17 needs to be brought to a conclusion.

In Chapter 17, drawdowns were discussed in the context of a single financial instrument. Trading parameters were optimized to find the maximum quotient of profit and maximum drawdown, so as to find low-drawdown trading strategies for a portfolio of positions. One way (not recommended) of putting a portfolio together is to weight it in inverse proportion to the maximum drawdowns from the known trading records of its individual components. Before I knew about the better techniques of modern portfolio theory, I participated in the development of such a portfolio for an employer, who traded it during 1995 and 1996. The portfolio was composed of futures contracts, mostly interest rates and currencies, but with some metals and agriculturals to add diversity. The trading system used was originally developed for U.S. bonds, worked reasonably well on currencies and interest rates, less well on the other futures contracts, and hardly at all on stock indexes. At the time, before their convergence toward a common European currency, there was enough variation in European economies to construct a diversified portfolio that included a large element of European bonds. The overall portfolio would have been improved if multiple trading systems, optimized for a wider range of instruments, had been employed—but we had only one that worked and had to do the best we could with it.

Broadly, the system was designed to produce 20 to 30 percent returns on capital employed equivalent to five times the maximum portfolio drawdown. For many people this may appear to be very conservative, but the enterprise was a proving trial to gain experience from which a decision could be taken either to invest more heavily or look for other investment and/or trading techniques.

The growth in equity of the system cannot now be duplicated exactly, but an approximation to it is presented as a price chart in Figure 18.1. In both 1995 and 1996, significant drawdowns were recorded, which were just within the system's historical limits. The trial was ended in September 1996, when the drawdown was almost at its historical maximum of 20 percent, but unfortunately just before the major rebound in the last three months of that year (shown by the right-most three bars on the chart), which, had the trial continued, would have turned a 20 percent loss into a 20 percent profit.

One of the reasons I have presented the approximate equity growth as a price chart is that we used technical methods to help assess where the portfolio equity was likely to head, and such methods are increasingly being used for these decisions. It is interesting to note that in the case of Figure 18.1, one argument was that several moving averages had turned downward, suggesting a downturn, and another, that a Bollinger band had just been touched, suggesting a rebound. (Bollinger bands are not covered in this book, but information about them may be found at www.bollingerbands.com.) The technical decision was fiercely argued and (wrongly in the light of what subsequently happened) went with the moving average argument.

Hindsight is a wonderful thing, but I have to admit that in September 1996, my confidence in the system was at a low ebb, more as a consequence of the extended period over which the drawdown had developed than its absolute amount, and I accept my share of the blame for not speaking out more forcibly against the decision to end the trial. This was, in part, a case in which a gradual decline in equity over many months had led us (wrongly as it turned out) to doubt the validity of the numerous careful calculations on which the trading system and its associated portfolio had been built. Technical signals, like so many other market signals, can be contradictory, and the right one is not going to be correctly chosen all of the time—but when applying them to equity curves, the totality of the calculations behind those curves needs to be considered and not just a technical signal from the equity curve in isolation from the many other signals generating the trades from which it is built.

To recap, this was an inappropriately optimized portfolio, for a trading system developed for U.S. bonds that had been adapted to trade a number of other futures contracts. This therefore raises the question of what

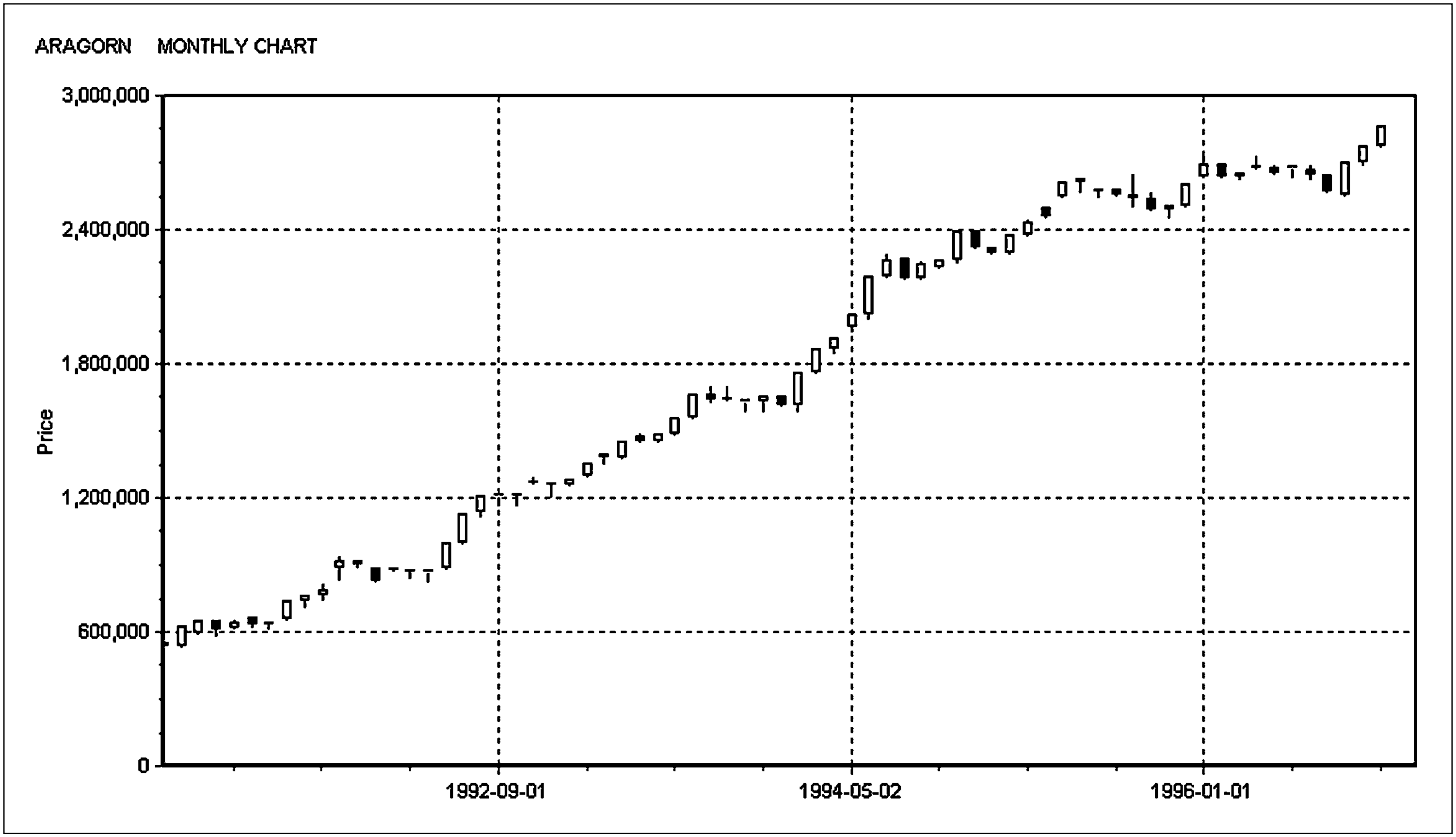

FIGURE 18.1

The figure shows the approximate growth in portfolio equity, expressed as candlesticks on a price chart, from a portfolio of futures investments of currencies, interest rates, agriculturals, and precious metals. In general, the growth in equity is fairly smooth.

would have happened had the other futures contracts been dropped and U.S. bonds traded exclusively? An equity growth price chart reflecting this strategy is shown in Figure 18.2, which is much less smooth than that of Figure 18.1. A separate calculation shows the maximum drawdown to be three times greater than that of the (suboptimally) diversified portfolio. This would have resulted in either a threefold increase in the capital required for the same risk (of drawdown) and return or a threefold reduction in return for the same risk.

What these two examples demonstrate is the benefit to be had when the (overall-profitable) elements of a diversified portfolio make and lose money at different times, so as to reduce maximum portfolio drawdown. Typically, gains from diversity are most dramatic when increasing it in a portfolio with just a few instruments, and trail off after thirty or so.

For an online investor to take advantage of diversification, some thought needs to be given to the implications of the time needed for its management. If trading/investment decisions need to be made daily, for a large number of instruments, involving positions that are going to be held for only a short period, the time needed to manage the portfolio—that is, do the necessary research, make good decisions, issue the orders, and carry out other administrative tasks—can rapidly spiral out of control. One of the worst situations for online investors is that of having to sacrifice diversity because they underestimate the time needed to manage a portfolio based on a strategy involving daily decisions. It is less time consuming to run a well-diversified portfolio based on weekly decisions, involving positions that are going to be held for a longer period. At the risk of belaboring the point, for many working people, a well-diversified weekly managed portfolio is going to offer greater rewards than a daily managed system whose diversity is limited by their available time.

INDEXES AND RELATED INSTRUMENTS

One way of improving portfolio diversity is to invest in an index or fund composed of a basket of stocks. This spreads the risk across a pool of stocks and is often the option of choice when time, expertise, and/or investment capital are in short supply. That then raises the separate question of how to find a good fund. The answer is beyond our scope, but we can make the following general observations.

There are many such funds available for investors, and so the discussion will be limited to three general types. Stock indexes that routinely replace weaker stocks with stronger are exercising a “survival-of-the-fittest” policy. This policy turns them into a form of trading system, and they tend to outperform the average of stocks on exchanges where their components

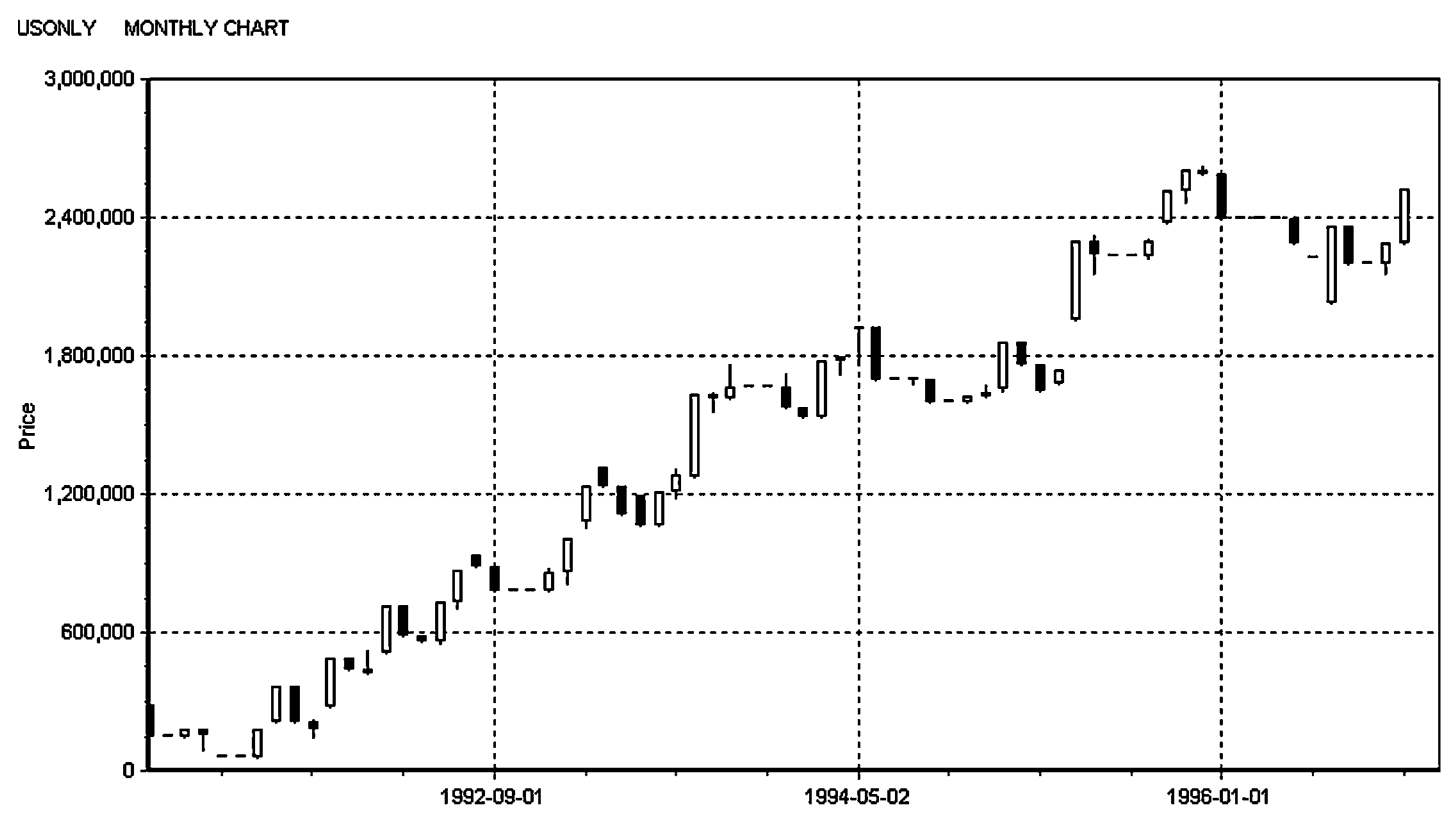

FIGURE 18.2

If an investment strategy similar to the one that produced the data for Figure 18.1 is now applied to one of its best-performing elements (U.S. bonds) to achieve the same return, the result is the much less smooth growth in equity shown here. Separate calculations show that the maximum drawdown is three times greater than that of the portfolio whose equity growth is approximately represented by Figure 18.1.

can be found. Several low-cost *index tracker funds* are available to investors wanting to exploit them.

Actively managed mutual funds offer a way of achieving diversity, as do *exchange traded funds*. Exchange traded funds are less well known than mutual funds, but typically they consist of a basket of stocks from a specific industrial sector. They offer the investor exposure to the fortunes of the sector in general, rather than to a company in particular. Unlike mutual funds, they can be traded intraday like normal stocks, which many investors prefer. A limited portfolio of exchange traded funds implicitly offers greater diversity than the same number of stocks selected from sectors represented by those exchange traded funds. Such a portfolio looks to be an interesting intermediate option between investing in a managed fund and a fully diversified portfolio of stocks. It may be the option of choice for investors with limited time but wanting to make their own decisions.

EXPLICIT INSURANCE

Derivative financial instruments exist to insure against adverse price movements. The most obvious of these are *options*, which can be bought to secure the right, but not the obligation, to buy (*call option*) or sell (*put option*) a financial instrument at a fixed price (called a *strike price*) at a future date (up to an *expiration date*). Options offer an *explicit insurance policy* against adverse price movements. However, like insurance policies, premiums charged for options depend on perceived risk, which probably means that when you most need them, they are going to be expensive. As an example of this, a former colleague used to tell of how he bought call options for a stock index (which conferred a right to buy at a strike price) just before the 1987 crash. At the time of the crash, when people were desperate to sell, not buy, the volatility in the market was so great that the call options were sold at a profit despite the fact that the stock index had crashed. Had put options been bought, they might have been exercised and the difference between a strike price and (lower) instrument price taken as a profit.

A point to appreciate about options, which makes them very much like an insurance policy, is that when you buy them, the only money you stand to lose is what you paid for them. In contrast, when options are written (just as insurance policies are underwritten), associated risks may be unlimited. Options are a subject with their own risks, terminology, literature, and domain expertise, and this briefest of introductions is intended simply to convey the message that they can be bought as a means of offering an insurance policy, for a limited period, against a financial instrument's suffering an adverse price movement.

If you believe a sharp move to be imminent and want to protect a portfolio's value from its consequences, another way of doing so is to take a position (usually short) in (typically) the S&P 500 or Nasdaq. If this is done, then unlike the purchase of options, risks may still be unlimited, but they should be reduced if liquidity is good and stop orders are in place.

The point needs to be made that any explicit reaction to an impending threat will need a means of identifying such threats, and in practice, such means are not going to be right all the time. The result is that options are likely to be bought, or positions likely to be taken in stock indexes, at times when they are not needed, and associated costs will have to be carried. There is another way to proceed, which is to set up a portfolio of positions so that its overall equity is insensitive to general movements in the market. This leads on to our next topic.

IMPLICIT INSURANCE

Historically, investors have for the most part bought shares and tried to get out of the markets prior to any declines. However, futures contracts offered the chance to make money whether the markets went up or down, and increasingly, short selling in various forms has been and continues to be used by smaller investors. For stocks, some brokers now offer a way of doing this through *contracts for differences* (CFDs), which enables a bet to be placed on the future direction of a stock's price, but without access to dividends or any other benefits of stock ownership. Effectively, this means that the equivalent of short or long trades in stocks can be made at will.

With a facility to take long or short positions in place—if a strategy can be devised that is equally successful in identifying and exploiting both long and short trades, and a diversified portfolio constructed of positions that are half long and half short—then in the event of a market crash, what is lost on the long trades should be gained by the short. Such a portfolio is said to be *market neutral*. Better still, if stop orders are in place and the market crashes, stop orders for long positions have a reasonable chance of being filled and the short positions can ride the crash to profit the investor. Note that in strong bull markets good short trades may be hard to find, and in strong bear markets, a parallel problem will occur in finding good long trades. Unlike some views expressed in a well-known quote of Lord Keynes, I see no merit in being the last person left owning shares at the bottom of a bear market, and I believe that any moral qualms about placing "bets," rather than owning shares, should be set aside since the broker's risk will either be carried, or ultimately managed, by buying or selling the shares on which the bets are placed. For what it is worth, in my view, if one wishes to do some good by investing, the capital needed has to be preserved and expanded, and it should not be be squandered on situations in which the capacity to do future good is compromised.

This principle of half-long, half-short portfolios can be applied to instruments other than stocks. Currencies are sold relative to the U.S. dollar, which means that when the dollar moves in value, all currencies move up or down in price. Suppose now that a relationship is found such that currency A always moves up in value when currency B always moves down, and vice versa. If price movements in A and B are thought likely, a long position might be taken in currency A or an (opposite) short position in currency B, to profit from those expected movements. On the other hand, if half the available capital were used to support a long position in currency A and the other half a short position in currency B, then the combination of the two positions would offer an insurance against any movement in the value of the dollar—since the loss in one position would be compensated for by the gain in the other. If the dollar did not move, then the same profit would accrue from the two opposite positions, that could accrue from a single position taken in either A or B.

This kind of strategy may fall outside the remit of conventional portfolio diversification, and it represents a diversification of position to insure against the risk of the overall markets moving to the detriment of an all-long or all-short portfolio. Curiously, when used with stop orders, it results in a situation in which the more the overall markets move in either direction, the greater the potential for gain.

Unlike explicit insurance, implicit insurance usually involves the construction of a portfolio so as to guard against a general threat to that portfolio rather than a specific threat to an instrument within it. Also, unlike explicit insurance, it is free, it should be a consideration in designing a portfolio, and it is not specifically taken into account by the risk metrics that we will look at later in modern portfolio theory.

BUILDING A PORTFOLIO

Typically a "short list" of some 50 or so instruments might be followed from which 10 to 15 are selected to form part of a portfolio. Knowing what instruments to track can be problematic. The most obvious stocks to follow are those in areas you know, but they may not offer enough diversity for a portfolio. A tactic being increasingly used is to use a reporting service (for example, broker-supplied trading patterns) to find stocks or other instruments with interesting price activities and then include them for a while on a short list to see how they perform. The final choice of what to include in an investor's portfolio and short list is subjective, but the broad principles are to achieve qualitative diversity by looking for economic independence between the different instruments of the portfolio and a level of safety and reward consistent with an investor's risk preferences.

Advice for designing conventional (all-long) portfolios is offered by both Benjamin Graham and Jim Slater, and their various books are well worth reading for the additional background information they contain.

Graham's writings tend to anticipate portfolios of stocks and bonds, which exploit the observation that money tends to flow from one to the other whenever economic certainty changes. If conditions become uncertain, then money tends to flow to the greater security of bonds, whereas when the economic outlook improves, money flows toward the greater opportunities for reward offered by stocks. When interest rates fall, both stocks and bonds may rise in price, but when interest rates rise, both may fall in price. Despite a tendency for a correlated price response to changes in interest rates, there remains an interesting degree of diversity and safety to be found from such a portfolio.

Graham also stresses the importance of a *margin of safety* in any investment, which can be defined in various ways but represents the excess of the fair value of an enterprise over the sum of its debts. This is a very good principle to follow, particularly with traditional industries, but it can be harder to evaluate when trying to assess the fair value of a business with high intangible assets, such as a strong brand name.

Slater recommends holding a minimum of 10 to 15 stocks, with no more than 15 percent of portfolio investment going into any single stock, and selling stocks whose story has changed. He also recommends generally letting profits run and cutting losses. This could be achieved with the use of trail stops and should avoid a situation in which an investor using them is the last person left holding shares at the end of a long bear market.

These are traditional principles for constructing portfolios, but the ideas expressed earlier about implicit insurance probably offer greater protection against a sudden overall movement in the market, although it has to be pointed out that if protective stop orders are either not used or not filled, the potential for losses on short trades is unlimited. This means that when using the principles of implicit insurance, particular attention needs to be paid to the liquidity of the instruments in the portfolio to maximize the chances of stop orders being filled at or near the levels at which they are triggered.

Liquidity may be assessed by examining bid/ask spreads and daily trading volumes over a period of time.

Some investors also like to restrict their portfolios to the largest companies on the grounds that these are of a size that means they are less likely to suffer a financial collapse. A counterargument runs that large companies have less scope for exponential growth than smaller companies. There is no definitive best answer to these arguments as ultimately, the best answer depends on personal objectives and risk/reward preferences.

One way or another, a portfolio of financial instruments that investors believe they can make money from has to be assembled. It is important, and restated here for emphasis, that each component of a portfolio should reflect a situation in which the investor feels money can be made. Where that is not the case, the investor should not be inhibited from exiting a position and, if necessary, holding cash until suitable opportunities appear. After the components of a portfolio have been selected, there is then an issue of what proportion of the available capital to invest in each of its constituent parts. This is where our next topic, modern portfolio theory, can help.

MODERN PORTFOLIO THEORY

A useful definitive reference is Edwin Elton and Martin Gruber's *Modern Portfolio Theory and Investment Analysis* (listed in the bibliography), but the nature of the topic is likely to make any specialist book on the subject hard going. My aim here is to try to capture the basics so that readers can understand the background to some of the software and Web-delivered services for portfolio optimization, as well as ways these services can be used.

Earlier discussion in this chapter has loosely referred to financial instruments' making or losing money at different times. An aid to putting this idea into a mathematical framework is to look at the percentage increase or decrease in the value of each component of a portfolio between each time step. For example, if weekly time steps were used and a position taken in the S&P 500 that increased in value by 2 percent between one week and the next, its "return" would be 2 percent. Correlations of "returns" could then be examined for the investment strategy used, for each instrument in a portfolio, at each time step. The example given earlier of prices of currencies A and B always moving in opposite directions to each other represents a situation of negative correlation, in which a short position in one delivers similar returns to a long position in the other. As far as modern portfolio theory is concerned, this situation offers no diversity. But as we have seen, a long position in one coupled with a short position in the other offers protection against movement in the dollar. This is overlooked by modern portfolio theory but needs to be borne in mind by any portfolio designer.

After the instruments of a portfolio have been selected and the intended investment strategy simulated over time to find historical trading positions, a time history of returns for each instrument of the portfolio is computed. A "window" of past returns data, which are believed to be most relevant to the present situation, is then chosen, and a covariance matrix of returns constructed. (At this point it might help to review the descriptions in Chapter 4, between equations 4.1 and 4.4, where means, covariance, and correlation are explained.)

Using the notation of Chapter 4, for the N time steps in the window, the kth return of the ith instrument is denoted by x_{ik}. The mean of the returns of the returns of the ith instrument μ_i is given by

$$\mu_i = \frac{\Sigma_{k=1}^{k=N} x_{ik}}{N} \tag{18.1}$$

The covariance between instruments i and j of the portfolio is given by

$$\sigma_{ij} = \frac{\Sigma_{k=1}^{k=N} (x_{jk} - \mu_j)(x_{ik} - \mu_i)}{N-1} \tag{18.2}$$

If the ith instrument constitutes a fraction w_i of the overall portfolio, then the variance of the overall portfolio is given by

$$\text{Portfolio variance} = \sum_i \sum_j \sigma_{ij} \times w_i \times w_j \tag{18.3}$$

where i and j are summed over the instruments in the portfolio.

A pause is needed here to see where all this is heading. If intrabar returns are worked out (based on closing prices) for Figures 18.1 and 18.2, and means and variances of those returns computed, their means would be roughly identical, but the variance (that is, the degree of dispersion) of the returns shown in the more jagged equity chart of Figure 18.2 would be much greater than that of Figure 18.1. The object of diversification is to try to smooth out the peaks and troughs of an equity curve, which is directly equivalent to having a low portfolio variance. Equation 18.3 provides us with a mathematical expression for portfolio variance, which offers a way to find portfolio weightings that offer the smoothest equity curve for a given return.

The point to bear in mind is that minimizing portfolio variance for a given return is equivalent to finding the smoothest equity curve for a portfolio producing that return. Note also that (18.3) and (4.5) are directly equivalent and that modern portfolio theory is a specific application of a general decision technique that can also be used to find credibility factors for different opinions, or models, for which historical errors are available.

My own preference is to work in terms of standard deviation (that is, square root of variance) of portfolio returns, rather than their variance, as this is easier to relate to other statistical ideas on confidence limits. It is not a big issue, but I mention it because various figures that follow will use it.

For some feasible target return of r, the portfolio optimization problem can be posed as

$$\text{Minimize} \sum_i \sum_j \sigma_{ij} \times w_i \times w_j$$

subject to the constraints

$$\sum_i w_i = 1 \quad (18.4)$$

$$\sum_i w_i \times \mu_i = r \quad (18.5)$$

These formulas are saying that we seek to minimize the portfolio variance subject to the constraints that the fractions w_i invested in each of its constituent parts must sum to unity (18.4) and deliver a return of r (18.5)—always assuming that such a return is within the feasible performance limits of the investments strategies envisaged.

A portfolio optimization program (*portfolio.exe* on the accompanying CD-ROM) was written to generate vectors of **w** offering minimum risk for specified returns r. This program, like most other portfolio optimization programs, could accept other constraints, such as minimum or maximum bounds for the portfolio fractions of individual instruments, or some instruments constituting fixed fractions of the portfolio. A usable boundary of minimum-risk portfolios for a range of specified returns is known as the *efficient frontier*.

The program was checked using returns data from the earlier case study with 10,000 randomly generated portfolios satisfying the "weights must sum to unity" constraint (18.4) to see if the calculated efficient frontier provided a fair representation of a minimum-risk boundary. Results are shown in Figure 18.3.

To explain Figure 18.3 in greater detail: The bottom left of the graph reflects portfolio weightings that achieve a minimum standard deviation of returns. Typically this will consist of a portfolio with a few low-yield instruments, which have a low portfolio standard deviation of returns because they never make very much. At the top right, the investment is concentrated to the maximum possible extent on those instruments that offer the highest returns irrespective of risk. Between these two extremes lies a region where a best compromise between risk and return is usually found. If some investment is made in all instruments, then the region of returns corresponding to the cloud of points indicates the operating range, with the efficient frontier showing the limit of minimum achievable risk for any portfolio weightings.

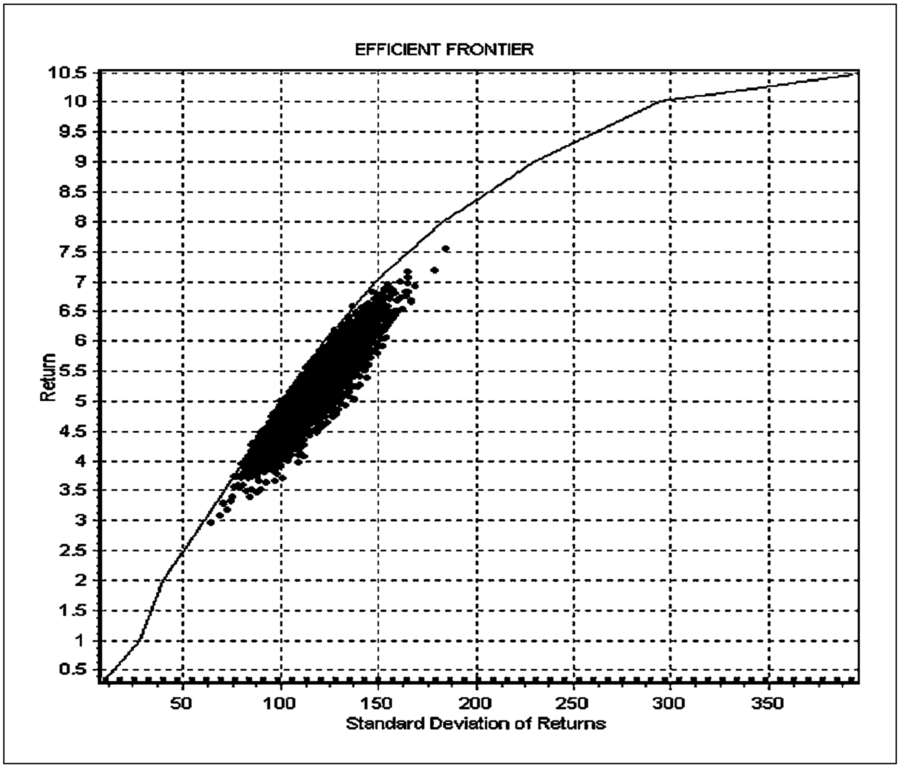

FIGURE 18.3

The *cloud* of points plotted on this graph of portfolio return against portfolio risk (as measured by the standard deviation of returns) shows the results of some 10,000 randomly weighted portfolios of 12 financial instruments. Reducing portfolio risk produces an equity curve more like the desirable one in Figure 18.1 than the undesirable one of Figure 18.2.

The line in this figure shows the calculated boundary of such points and is known as the *efficient frontier*. The reason it extends well beyond the cloud of points is that toward the bottom left, it has to discard instruments with high standard deviations of returns, and toward the top right, it has to drop instruments with low returns. If many more randomly generated portfolios were produced, these extremes would eventually be found.

The ability to see that the calculated boundary defines the performance limit of randomly generated portfolios serves to confirm the validity of the program used to find it.

To illustrate the usage of this kind of software, Figures 18.4 through 18.6 have been prepared showing the different portfolio weightings required to operate on the efficient frontier for different values of portfolio returns. The (returns) operating point of the portfolio is shown by a horizontal dotted line in the upper (a) part of each figure, and the weightings needed to reach the efficient frontier by a horizontal bar chart at the bottom (b) part of each figure. Labels such as "SF" (Swiss franc) and "CL" (crude oil) on the horizontal bar chart indicate the instrument being weighted.

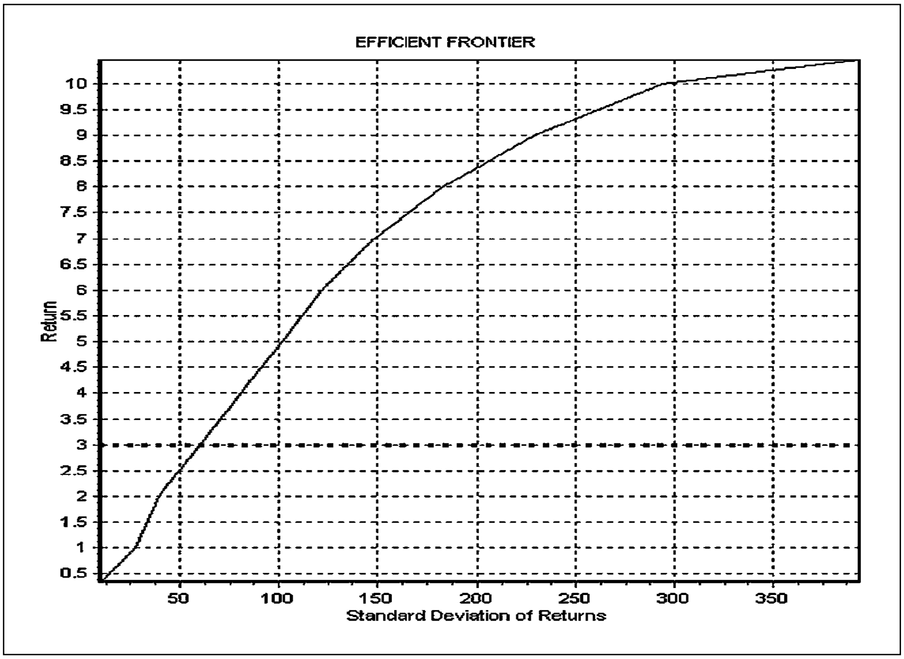

FIGURE 18.4a

This figure shows the efficient frontier, which defines the boundary of the best portfolios that deliver a specified return for minimum portfolio risk, defined by the standard deviation of returns.

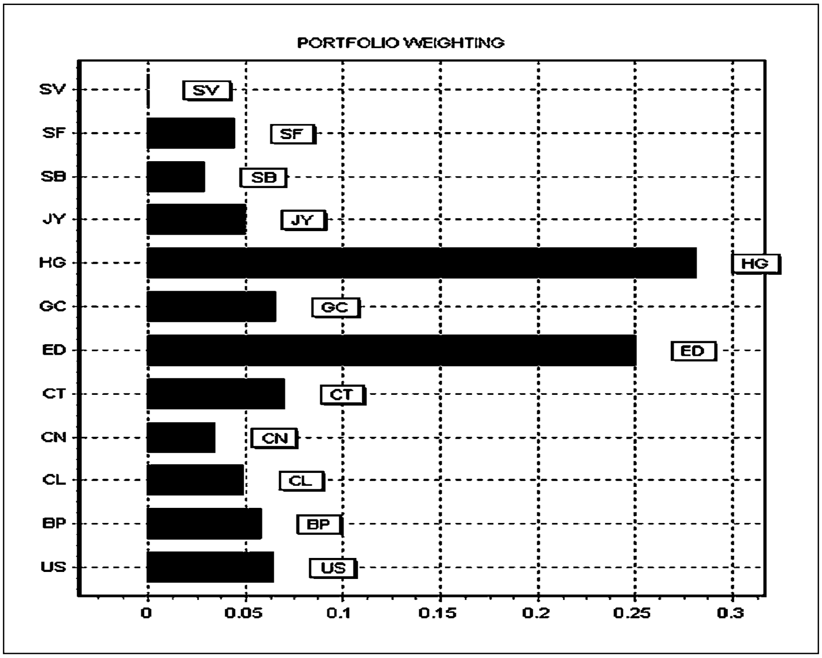

FIGURE 18.4b

For a return of 3 units, shown by the dotted horizontal line in Figure 18.4a, the horizontal bar chart shows the weightings of the different instruments of the portfolio needed to reach the efficient frontier.

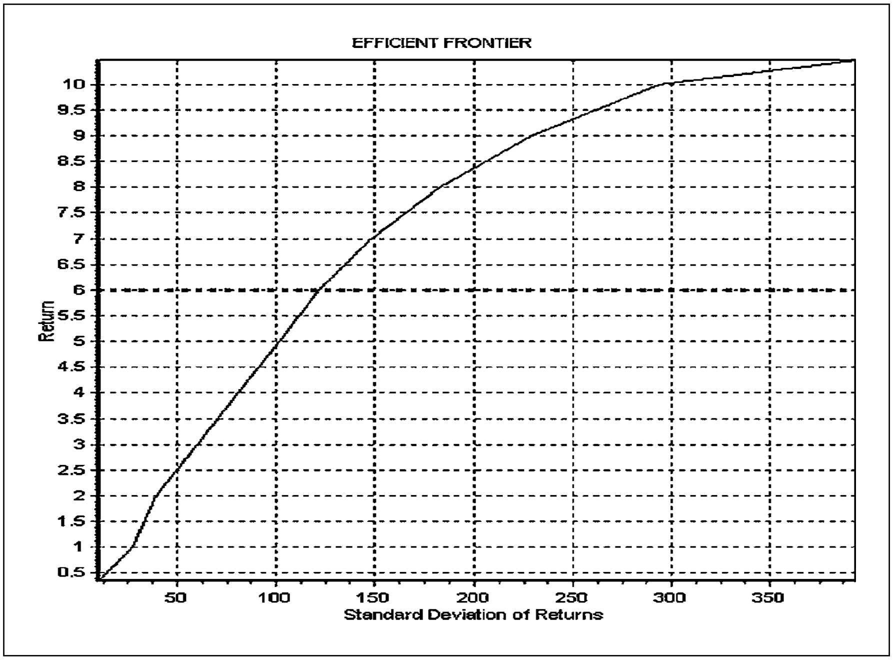

FIGURE 18.5a

This is the same efficient frontier as Figure 18.4a, but the operating point, shown by the dotted horizontal line, has now moved to up to 6 units, which requires a change in the composition of a portfolio needed to deliver minimum risk at the new operating point.

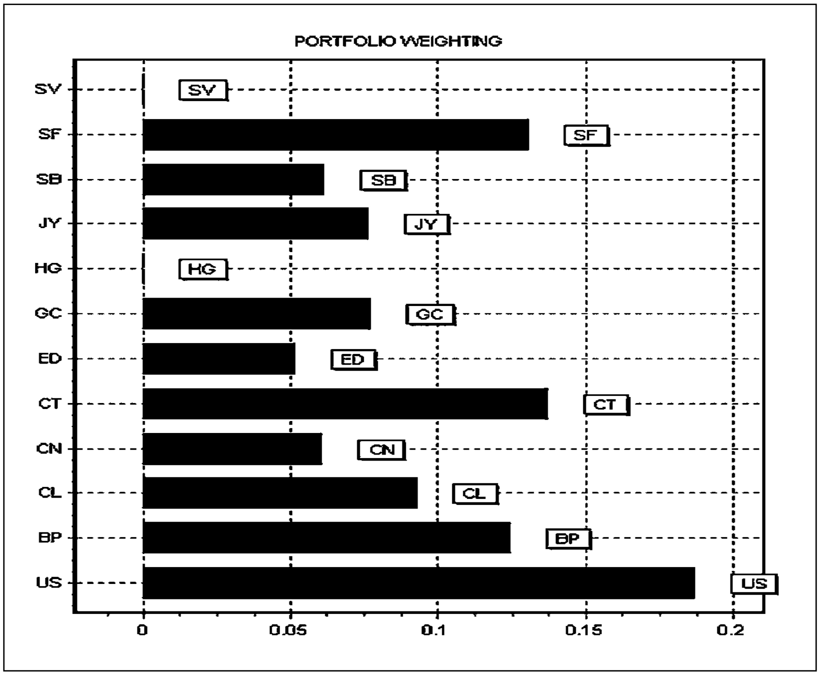

FIGURE 18.5b

This figure shows the composition of a portfolio needed to deliver a return of 6 units with minimum portfolio risk.

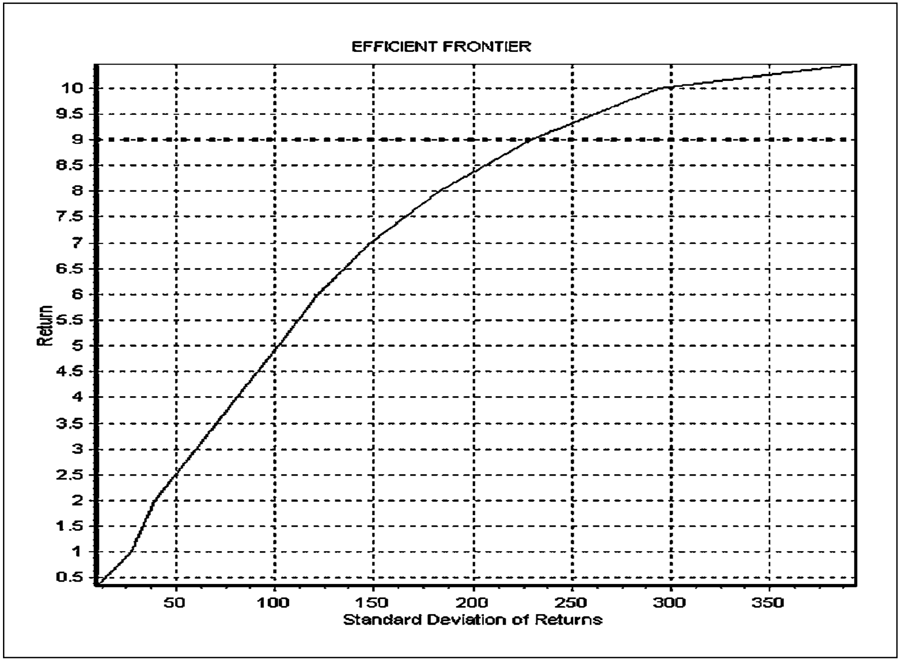

FIGURE 18.6a

Once again, this is the same efficient frontier as Figure 18.4a but with the operating point now raised to a return of 9 units. The corresponding portfolio delivering minimum risk is shown below in Figure 18.6b.

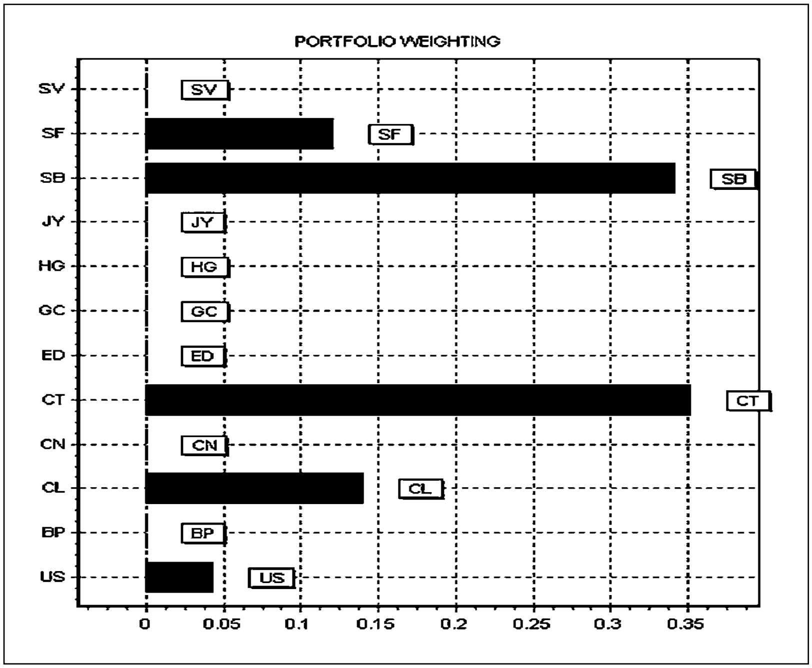

FIGURE 18.6b

The demand for high returns means that lower-yielding instruments have to drop out of the portfolio, resulting in less diversification and greater risk.

The basic point to emerge from these figures is that portfolio weightings needed to achieve an efficient frontier vary greatly with the target return being asked of the portfolio. As an example, high-grade copper (HG) forms the largest single component of the portfolio operating at a return of 3 units (Figure 18.4), but it has no part in the later portfolios of Figures 18.5 and 18.6. Asking for a target return of 9 units (Figure 18.6) reduces the portfolio to just five instruments because the other instruments cannot deliver the return demanded. The choice in this portfolio is that of high returns with high risk, or lower returns with lower risk—which is another example of a familiar story, first offered in this book in Chapter 3. For the online investor, the messages are that modern portfolio theory is not perfect, but after the composition and trading strategies for a portfolio have been decided, it offers a good way of finding out how much to invest in each instrument, and it is worthwhile using to optimize your portfolio to reduce risk.

One final point on this concerns the debate on portfolios of stocks and bonds. J. Castillo has written a lighthearted introduction to this subject, which looks at various all-bonds and combined stocks and bonds portfolios (see the bibliography). He concludes that the combined stocks and bonds portfolio carries less risk than the all-bonds. His message is that for minimum risk, it is important to see that losses and offsetting profits are made at different times, and since this tends to be the case with the mixed stocks and bonds portfolio, it represents a lower risk than one composed exclusively of bonds.

SUMMARY

- Accepting the need for portfolio diversity is a tacit admission that many investment decisions will be wrong.
- Adding diversity to a portfolio results in smoother growth in equity and smaller price peaks and troughs.
- Acceptable risk thresholds for investors are personal decisions but often depend on age with less risk usually acceptable for more elderly investors.
- The time needed to make decisions to manage an adequately diversified portfolio (10 to 15 instruments) needs to be matched to the time available and the frequency with which decisions are needed. For many working people, a portfolio based on weekly decisions will be more attractive than one based on daily attention.
- Investing in “what you know” may not offer enough diversity for a preferred risk threshold, and it may be better to “learn what you need to invest in.”

- When applying technical methods to portfolio equity curves, bear in mind that there are many constituent signals that will have contributed to such curves, and the totality of those signals usually has a greater significance than any derived from the shape of the equity curve.
- When expertise, time, or capital are in short supply, it may be best to invest in a fund.
- A portfolio of a limited number of exchange traded funds offers an intermediate diversification solution between investing in a managed fund and trying to run a larger, fully diversified portfolio of stocks.
- Options exist to facilitate the purchase of insurance against price movements that threaten a portfolio's value. Similarly, taking a position contrary to that of your portfolio might be a way to hedge against a perceived threat.
- Any reaction to a perceived threat must involve a mechanism to identify that threat, which will not be correct all of the time. This means that any kind of explicit insurance will involve carrying costs.
- It is possible to set up a portfolio of half-long, half-short positions, to offer protection (implicit insurance) to the value of a portfolio against general market movements.
- To build a portfolio, there needs to be a short list of instruments to consider and a mechanism for trawling through possible instruments to create that short list.
- A "margin of safety," that is, excess in the fair value over the total debt, should be looked for in stocks entering the portfolio with a long position.
- A portfolio should have a minimum of 10 to 15 stocks with no more than 15 percent being invested in any one. A smaller number of exchange traded funds could offer a similar level of diversity.
- Instruments entering the portfolio should have adequate liquidity.
- A decision on the minimum acceptable company size should be made.
- Any instrument entering the portfolio should be consistent with an associated trading strategy from which a profit appears likely.
- When an instrument in the portfolio no longer makes money, or could be replaced by one with substantially better prospects, the position should be exited.

- When designing a portfolio, ideas on implicit insurance should be considered to guard against overall market movements.
- Once the composition of the portfolio and trading strategies has been decided, a historical simulation can be carried out to get intrabar returns, from which the proportions of the portfolio to invest in each instrument can be calculated using modern portfolio theory.

CHAPTER 19

Management of Portfolio Decisions

This chapter will attempt to show how ideas from the diverse elements of this book can be drawn together to build and manage a portfolio. The need to condense most of the ideas in this book into a single chapter inevitably involves a summary, so its content should not be seen as exclusive but rather as a single example of an infinite number of exploitation schemes. Ultimately, each investor has to work out what is important for his or her situation and preferences and work out his or her own way of running his or her portfolio.

Many traditional investors may initially regard the decision process described in this chapter as impractical. But they should keep in mind that progress in making life easier for online investors will continue, and therefore the direction proposed looks to be a fruitful one. Services and software envisaged for this decision process are not currently integrated for the online investor, and they may not be integrated even for the institutional investor, but their elements exist in isolation, and a computer-literate online investor should be able to purchase them and achieve a degree of integration. And if this vision is not expressed, the integrated tools needed to help the average online investor are unlikely to be developed. Within a few years of writing these words, I would expect a number of fully integrated suites of software and services to be available to the online investor.

TRAWLING

The purpose of *trawling* is to monitor what is going on across a wide range of investor-selected financial instruments so that if an interesting situation arises in any of them, the investor knows about it. Just as three-letter intelligence agencies eavesdrop on electronic communications to find items of interest, so an investor can make use of screening or alerting services that scan a wide range of tradable instruments to find those for which price activity looks likely.

Apart from the trading pattern recognition service previously mentioned, other stock screening or alerting services exist, based on supplier- or user-defined indicators and fundamentals. One service even claims to identify pretakeover price activity. Industrial classification codes mentioned in Part 2 are sometimes used to screen for activity in specific industrial sectors.

The generic function these services carry out is similar to that of automated intelligence intercepts; that is, they go through an enormous amount of data looking for activity patterns satisfying a criterion of interest, which in the case of an investor's trawl will usually be conditions believed to indicate forthcoming price changes. Setting up a trawl can be as easy as using broker-supplied services. It might involve your subscribing to a service or downloading price data and running your own trawling software on it. Vendors of price data often provide screeners to use with it.

At some stage in the process of taking positions for a portfolio, some investor-decided minimum criteria will need to be satisfied. Such criteria are decided on an individual basis and best applied at this trawling stage, so that further time is not wasted on instruments that are not going to form part of a portfolio.

One such criterion should be a minimum threshold for liquidity, and every potential candidate for a watch list should be above that threshold.

If not already done by a screener, fundamental criteria can be usefully introduced at this point, where simple checks on price/earnings (P/E) ratios and bond ratings should offer a rudimentary level of safety. If a fundamentalist investment strategy is to be used, then at this stage the relevant criteria (typically based on accounting ratios) should be examined. The stock screener, or various Web sites, should be able to help in this process, the result of which should be that everything in the watch list should satisfy specified fundamental criteria.

Where the creation of a watch list is a manual process, it is vulnerable to psychological influences, notably the desire to achieve a result to justify the effort expended, the danger of following a herd, subjectivity in seeking and evaluating information, and most damaging of all, pride, particularly in the aftermath of success.

WATCH LIST

A *watch list* consists of financial instruments to be monitored for potential inclusion into a portfolio. This list might include financial instruments with which you are familiar so that your expertise can give you an edge. If you are running a portfolio of 10 to 15 instruments, your watch list may need around 50 instruments. A watch list is likely to take a while to develop and should not be rushed (to the detriment of diversity and performance) just to fill a required quota.

A crucial question than needs to be answered is whether or not the trading and/or investment strategies available to you would result in a profit if the instrument were included in the watch list. Typically, arriving at an answer means satisfying fundamental criteria (such as your assessment of any margin of safety) and being able to rapidly generate optimal parameters for one of a number of possible investment strategies that might be used for the instrument, and selecting the best. It is acknowledged that a bottleneck exists in this area at present, but it is one that looks to be capable of a solution, which should extend investor strategy options beyond simple indicators.

For an approach involving patterns, the instrument's historical trading pattern database should be checked to see where they occurred previously and what happened subsequently. Then you can come to a judgment about the likelihood of any newly confirmed pattern working.

If there is no historical evidence that a profit in a watch list candidate could have been made with available strategies, the chances are it does not belong in the watch list. If there is such evidence, then returns data may be available for portfolio calculations depending on the nature of the exploitation strategy envisaged. With trading patterns or judgmental decisions, returns data based on buy-and-hold or sell-and-hold strategies, for a period prior to the present are sometimes used to drive later portfolio calculations.

The main point is that the content of the watch list needs to have an associated exploitation strategy and a potential for profit, and ideally it should provide representative returns data for later portfolio calculations.

THE PORTFOLIO

First, if you do not think you can make money with the instruments in your portfolio or watch list, leave your capital on deposit and do not feel compelled to put it at risk.

If you are happy to rely on the ad hoc diversity that is likely to accrue anyway from having a portfolio and wish to use strategies based on "feel," then judgments about the content of a portfolio may not involve calculations.

A more scientific approach would involve returns data and the use of modern portfolio theory. At present, the selection of candidate instruments for portfolios is mostly a manual process in which performance and risk are the main considerations.

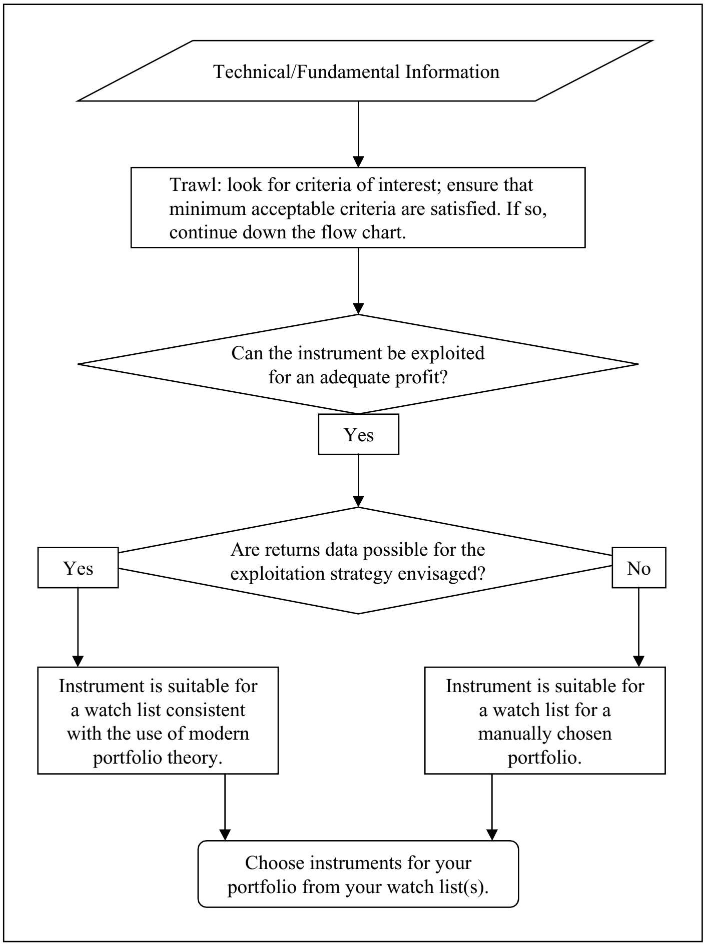

FIGURE 19.1

Overview of portfolio selection and review process.

As described in Chapter 18, considerations of implicit insurance enter portfolio design, but only the returns from a proposed exploitation strategy enter calculations of modern portfolio theory. This means that there are two independent metrics for risk: one that is subjective, arising from an acknowledgment of a possible overall market movement that may require a half-long, half-short portfolio, and another that is objective and based on the standard deviation of returns for a proposed portfolio. There are a number of interrelated questions than need to be considered:

1. What are the investor's risk/reward preferences for the portfolio?
2. Is there something in the portfolio that should be removed?
3. Is there something in the watch list that could replace something in the portfolio to move it closer to the risk/reward preferences sought?

Current manual methods involve trying portfolios with different combinations of instruments and evaluating their risk/reward characteristics. Longer term, this process is likely to be automated with a genetic algorithm delivering a "population" of optimally weighted portfolios of known performance for the investor to select from.

A flowchart describing the processes of trawling, creating a watch list, and determining options for the type of portfolio that can be created is shown in Figure 19.1.

ENTRIES

Before entering, exit options should be known and exit strategies ready. These will involve monitoring information as it comes in and knowing in advance how to use that information with the chosen exploitation strategy. Specifically, this means that procedures for monitoring and processing incoming information should be put in place before a position is taken.

Typically entries are taken at open, but some investors try to finesse entries to get better fills. Some use limit orders to try to improve their fills. Some draw histograms of prices for different days of the week and then time entries on days of the week when prices are historically relatively low or high; but for the most part, entry orders are at the market.

If stops are to be used, then a stop level should be calculated before placing the entry order, and the two orders, entry and stop, placed simultaneously. The discussion around equations 14.1 and 14.2 should help in deciding levels for stop prices.

In a pure trading strategy, entries may need to be rushed, but in an investment strategy, they should not be. More generally, the investor needs to be mindful of the psychological pressures summarized earlier in this chapter and in greater detail in Chapter 3. Actions needed prior to entry are shown in the flowcharts of Figures 19.2 and 19.3.

MONITORING THE PORTFOLIO

Once a portfolio is established, it has positions to which the investor has exposure. Once in a position, there is much less room to be choosy about when to exit than there was about when to enter since before an entry, there was always the luxury of keeping the associated cash in a risk-free investment. Most of the routine monitoring will therefore be concerned with exits.

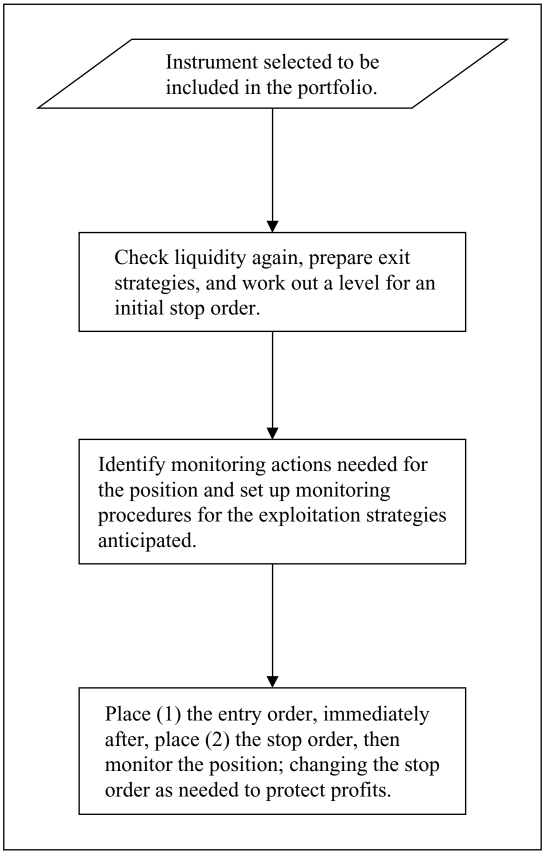

FIGURE 19.2

Actions needed prior to entries.

Depending on the services provided by the broker, stop orders may need to be reentered at regular intervals, typically weekly but at worst, daily. For much of this book a weekly decision strategy has been assumed, in which case it would be useful to find a broker who will accept *good-till-canceled* (GTC) *stop orders* for at least a week. This makes it possible for entries and trail stop levels to be decided at weekends and orders to be placed on Monday morning, leaving minimal monitoring to be done until the end of the week nears.

One possible exception to this concerns strategies involving penetration of moving averages by prices, which may require event-driven orders not available on a GTC basis. Even with weekly systems, it is a good idea to see how things stand with a portfolio on Thursday evening

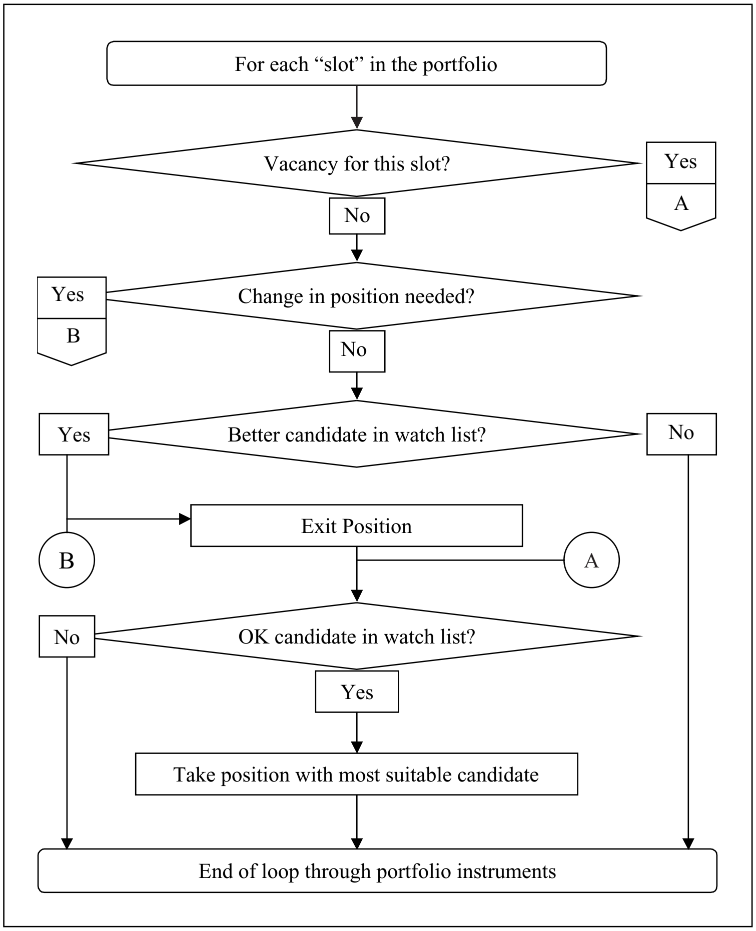

FIGURE 19.3

Portfolio selection/review process.

and also before the close on Friday, just in case some intervention over and above any normal strategy is needed. As an example, if it became clear before a close that the likely closing price would precipitate a signal, it might be better to take action before that close, than to accept the price at a possible gap opening of the next weekly session. The 1987 crash was a case in point. Figure 19.4 shows a flowchart describing this process. Despite the exception noted here, as a minimum, weekend decisions and Monday morning order placements can suffice to run a stop-protected weekly system.

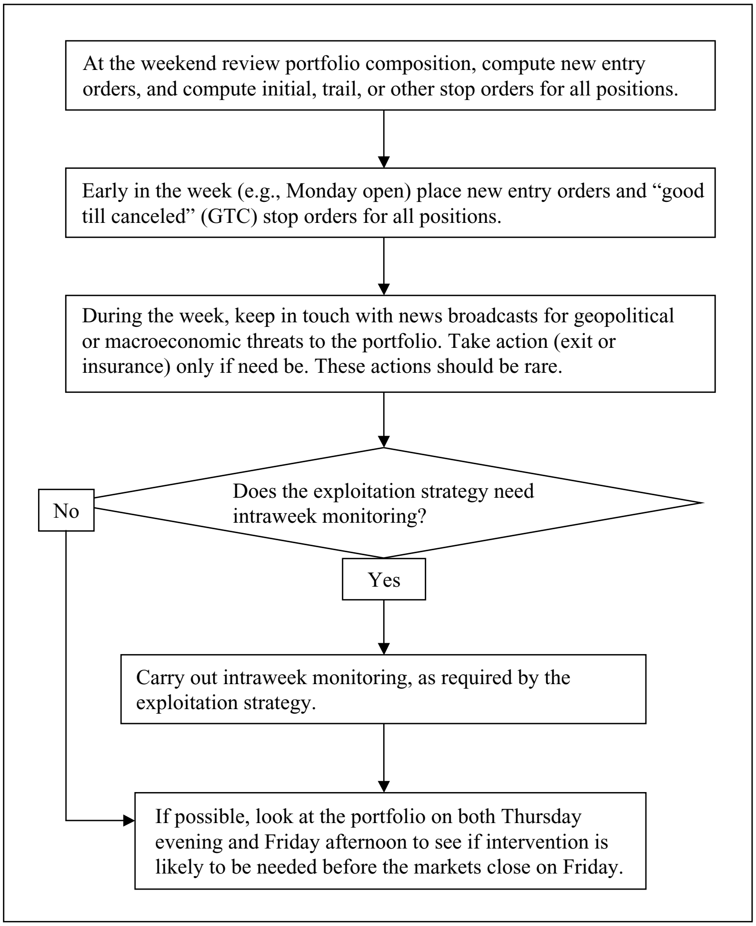

FIGURE 19.4

A typical monitoring schedule for a primarily weekly exploitation strategy.

It is not strictly necessary, but many investors using weekly systems like to do a daily check to see if their orders (GTC or not), particularly stop orders, have been triggered and/or filled.

Daily checks are necessary if a discretionary element is used in an exit strategy. As an example, if there were an exceptional move in favor of a position that was only using weekly trail stop exits, profits might be taken intraweek rather than when the trail stop was triggered. This is why the use of such exits would require a level of intraweek monitoring. But the point remains that with an essentially weekly system, any daily monitoring is to fine-tune exits or finesse entries rather than take fundamental decisions on entries or portfolio composition. For some, this combination of a heavier workload at weekends and lighter midweek monitoring will offer the best compromise between interests in the markets and the demands of a career. It also offers flexibility in respect of personal workloads, in that if (weekly determined) trail stops and GTC orders are used, then a level of safety exists in the event that daily monitoring cannot be carried out.

There will be situations in which either explicit insurance (see Chapter 18) or a need to close out the positions of an entire portfolio may occur. If there is a threat to a specific instrument in the portfolio, the best option might be to exit the position in favor of cash. If for some reason you are stuck with a position that looks to have reacted excessively to news and is already in an oversold or overbought state, then if it qualifies as a contrarian entry, it might be worth staying with it. In such circumstances, a review should be carried out as to why a timely exit did not occur, and procedures should be put in place to improve the situation for the future.

With regard to an overall threat to a portfolio, the most probable reason will be a change of sentiment in response to an overheated market. Sometimes, an overreaction to bad (global) news can result in an oversold market from which a rebound is likely, but large and sudden downward changes in price are more common than the other way around. Monitoring of fundamentals should alert the investor to the likelihood of an overheated market but not as to when a downturn will occur. Some investors simply go to cash when faced with overheated markets, others will wait for a technical signal (patterns—even of the one-bar kind, indicators, contrarian signals, and so on) before acting, and others will opt for a hybrid policy of converting their most exposed positions to cash while retaining some core elements of their portfolio in the hope of further profit. These influences mean that news needs to be monitored at three levels: (1) geopolitical, (2) macroeconomic, and (3) specific news for the instruments in the portfolio. The first two can be accomplished with normal reading and television viewing, but they could usefully include the monitoring of representative indexes such as the S&P 500. The third (specific news) level of monitoring can be achieved by setting up Internet-provided news alerts or checking on financial Web sites for instruments in the portfolio and on the watch list.

When monitoring positions, remember that there are often psychological pressures to "be consistent" or "not want to be proved wrong" that encourage investors to stick with their entry decisions long after they should be abandoned. Such pressures can make exits a character test, particularly exits on stops for which the temptation may exist to withdraw a stop order just before it is triggered rather admit to "error" in the original entry decision.

As mentioned several times in this book, professionals accept that such entry “errors” occur, and after they are apparent, they consider it a far worse “error” not to acknowledge them and do something about them than to make them in the first place.

When considering a position, there are three questions that you should ask: (1) If you did not already have your current position, would you be in it now? (2) If you exit now, taking commission and slippage into account, are you likely to be able to reenter at a more advantageous price in the future should you choose to? (3) Is there another financial instrument with greater claims to be included in your portfolio?

Monitoring of fundamentals should include price/earnings ratios and bond ratings, or some other measure of a company’s general financial health. If a stock price is dependent on growth prospects, then the price/earnings growth ratio may also need to be monitored. If a stock has a high P/E ratio on the basis of its growth prospects, then any perceived impediment to those prospects (internal or external) is likely to cause a sudden decline in its price.

Apart from the fundamental considerations mentioned earlier, if you have any favorite technical indicators, examine them for exit signals. In particular, the contrarian techniques of Chapter 16 can offer useful early warning signs. The first thing to do is to find out if overbought or oversold concepts work with the instrument in question. Then use them if they do, ignore them if they do not, and always be aware of price/momentum divergences and relative strengths.

Trading patterns also provide exit signals, but try to get additional confirmation, particularly before using simple (one-bar) patterns. A combination of contrarian signals and patterns can work well, as indicated by some of the figures in Chapter 16.

At the time of writing, some Elliott wave recognition software is just beginning to appear. Should this prove effective, then the concept of five waves in the direction of a trend followed by three correction waves could be fed into a monitoring process. I hesitated to write very much about Elliott waves because I felt them to be very dependent on specialist knowledge, but if that has been effectively built into software, then the objection disappears and they could be used relatively easily for trading strategies and the routine monitoring of exits.

Last but not least in this section, do not be afraid to use the simple techniques of support, resistance, and trendlines to aid exit decisions.

EXITS

If the stop orders, exit strategies envisaged at entry, and routine monitoring are all in place, then the exits should have been made at the right places, and no further action should be required other than to find out the price at which the relevant order was filled.

SUMMARY

Figures 19.1 to 19.4 are intended as a memory aid for the actions described in this chapter, but ultimately, each investor has to work out his or her own exploitation strategies and ways to organize and administer them effectively.

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GLOSSARY

A

Asking Price (or Ask) The price at which somebody offers to sell.

B

Bayes' Rule A technique for updating existing expectations when some new information appears.

Bidding Price (or Bid) The price at which somebody offers to buy.

Bear Market A market consisting of a sequence of lower highs and lower lows.

Bond An IOU that pays interest. Bonds have preferential claims (over shareholders) to a company's assets if it is liquidated.

Bond Rating A grading system based on letters that aims to assess a company's ability to meet its financial obligations. Bonds rated grade BBB and above are considered investment-grade bonds.

Bull Market A market consisting of a sequence of higher highs and higher lows.

C

Candlestick Chart A representation of the open, high, low, and close prices for a period in which the open and close prices are represented by a rectangle and highs and lows by a vertical line going upward to the high and downward to the low. When the close is below the open, the body of the rectangle is colored black, and when the open is above the close, white.

Close Price (or Close) The final price listed at the close of a trading session.

Cobweb Theory A simple theory of economics relating price to expectations, supply, and demand.

Common Stock Otherwise known as a *share*, a financial instrument that represents a share of a company that can be purchased, without a right to dividend other than that declared at the discretion of the directors. In the event of liquidation, shareholders' claims to assets are considered after others have been paid.

Contrarian Strategy A position taken against the sense of price movement in anticipation of a reversal.

D

Divergence A situation in which, for example, successively higher peaks in price are matched with successively lower peaks in an indicator, such as momentum.

Dow Jones Industrial Average (or Dow) An index based on 30 stocks traded on the New York Stock Exchange.

Drawdown Maximum drawdown, defined as the largest difference between a peak in an equity curve and any subsequent point on that curve.

E

Efficient Frontier A line on a graph of portfolio returns against portfolio risk showing the minimum achievable risk for a given return.

Efficient Market A trading market in which market forces act to correct any differences between the values and prices of stocks.

Equity Curve In the context of a portfolio of traded instruments, the growth (or decline) in overall equity over time as a result of the trading activities.

F

Fill The price at which an order is filled.

Fundamental Analysis An attempt to establish an intrinsic price of something. Fundamental analysis is then used (usually) to take advantage of any difference between that intrinsic price and the actual listed price.

H

High Price (or High) The highest price reached in a trading session.

I

Initial Public Offering (IPO) An initial offering of private shares for the public to purchase.

Intangible Asset A nonphysical asset such as a brand name, patent, or goodwill.

K

Kondratieff Cycle A long-term cycle in commodity prices, lasting around 54 years.

L

Liquidity The ease with which something can be traded.

Low Price (or Low) The lowest price reached in a trading session.

M

Momentum A generic term used to express the rate of change of price with time. A nondimensional version of momentum is used in this book.

O

Open Interest The number of futures contracts outstanding for a commodity. Figures quoted are either for a specific delivery date or a total for all delivery dates. Open interest decreases with increasing agreement on price.

Open Price (or Open) Price at the open of a trading session.

Option A kind of insurance policy that (effectively) pays out if prices move beyond a price known as the *strike price*.

P

Patterns (or Trading Patterns) Characteristic variations of price and time that traders have noted are associated with turning points or trend continuations.

Portfolio Diversification The reduction of risk by spreading investments over instruments that generate uncorrelated profits and losses.

Preferred Stock A share with guaranteed rights to dividends and preferential claims over those of common stockholders in the event of liquidation. Unlike bonds, there is no guarantee that the principal will be repaid. Most preferred stock can be repurchased by the issuer (known as *calling*), which the issuer is likely to do if it no longer needs to borrow or it can borrow money for less than it has to pay out in dividends.

Price Bar Chart A representation of the open, high, low, and close prices for a period in which the high and low prices are represented by extremities of a vertical line and the open and close prices are represented by short horizontal lines, drawn to the left and right, respectively, of the vertical line.

Price/Earnings Growth (PEG) Ratio The P/E ratio divided by the percentage (annual) growth rate.

Price/Earnings (P/E) Ratio The ratio of a company's share price to its earnings per share.

R

Regression A process for finding a mathematical formula to represent data points.

Regularization A process for smoothing a mathematical representation of data points.

Relative Strength The quotient of the price of an instrument and the price of something to which it is believed to be related, such as a representative index on the exchange where it trades.

Resistance A price level at which selling pressure makes a further price increase unlikely.

Retracement A name given to a price movement following a turning point as it retraces the values from which it has come.

Returns The percentage change in value of a position between one time period and the next.

S

Sideways Market A market that is neither bull nor bear.

Slippage The loss on a trade due to the spread.

Spread The difference between the asking price and the bidding price.

Stop Order (or Stop) An order to be triggered when prices decrease (sell) or increase (buy) beyond a specified level. The position is subsequently sold at the market price.

Support A price level beyond which buying pressure makes any further price decline unlikely.

T

Tangible Asset A physical asset such as a building, inventory, or plant.

Technical Analysis An attempt to analyze price, volume, open interest, and similar data to find an exploitable relationship, without necessarily any expectation that it will continue for very long.

Trail Stop A policy for using stop orders involving moving the stop closer to the market price as a paper profit is generated by a position.

Trend A progressive price movement either upward or downward.

Trendline A straight line, drawn on a chart, touching either (1) a number of well-spaced low pivots or (2) a number of well-spaced high pivots.

V

Volume The number of measurable units of a financial instrument that are bought (or sold) during a defined period.

W

Whipsaw A sequence of losing trades, usually brought about by technical entry and/or exit signals that are wrong-footed by market price movements.

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INDEX

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