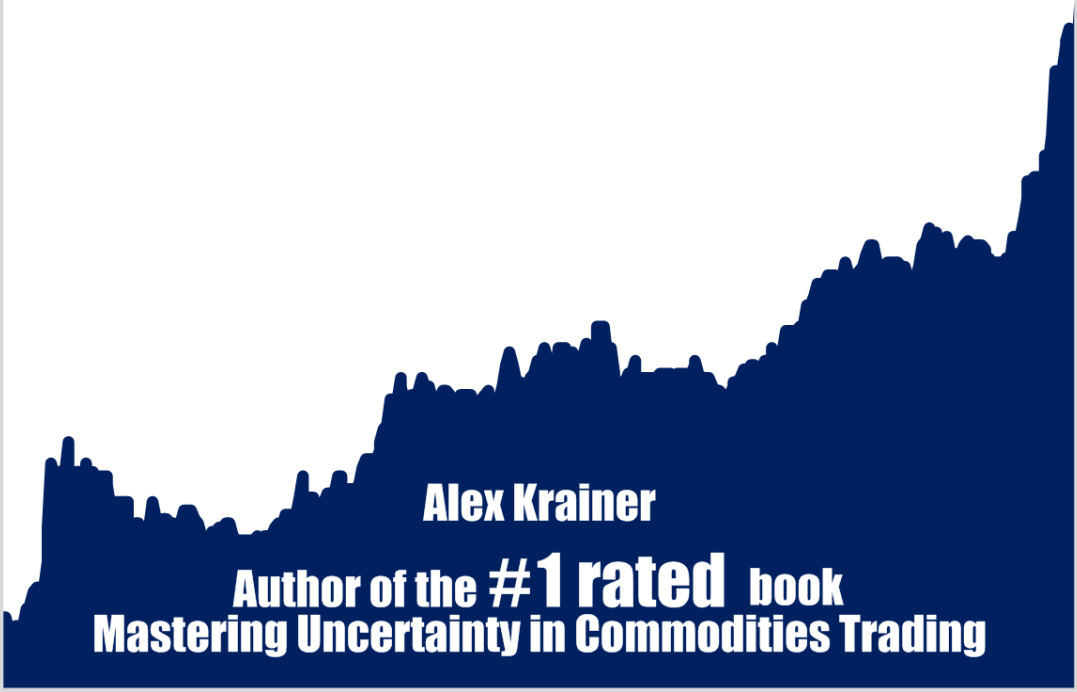
Alex Krainer's Trend Following Bible



Alex Krainer

Author of the #1 rated book
Mastering Uncertainty in Commodities Trading

Alex Krainer's
Trend Following Bible

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Cover page represents a performance histogram of 12 I-System trend following strategies on COMEX Copper from January 2019 through February 2021

ALEX KRAINER

KRAINER ANALYTICS,
MONACO

For Laura, Niko and Alex

There are three avenues of opportunity: events, trends and conditions

Sun Tzu, The Art of War

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Preface

Over the last two decades, tens of millions of individual investors around the world set up brokerage accounts to manage their own portfolios. This trend accelerated in 2019 as trading commissions plummeted toward zero. The Covid19 pandemic and lockdowns of 2020 gave it a further boost and saw trading volumes by retail investors more than double. However, a majority of these investors took up the challenge with flawed trading strategies, or with no strategy at all.

According to the brokers, most of their clients tend to do *message board* trading: quick transactions, in-and-out of the most popular stocks of the day. Many investors resort to trading as a form of entertainment and some of the brokerages deliberately exploited this inclination by modelling their services to resemble trading games. Unfortunately, their clients' performance has also tended to resemble casino gambling. Brokers' own statistics show that most of their clients lose money. Here are a few examples:

- ETX Capital: 75.6% lose money
- IG Group: 74% lose money
- Saxo Bank: 71% lose money
- Ava Trade: 79% lose money
- Plus 500: 76% lose money
- FxPro: 80.6% lose money

Among traders who rely on quantitative strategies, the results have been even worse: close to 80% of them lose money. And among active day-traders, as many as 95% lose.

Clearly, investors need a more disciplined, strategic approach to managing their portfolios. Trend following could be the best strategy to fit the bill. After more than 25 years as a market analyst, researcher, trader and hedge fund manager, I have few certainties about investing apart from these two: (1) that market trends are the most powerful drivers of investment performance and (2) that trend following is by far the most profitable strategy of long-term investing. This book seeks to explain market trends and trend following, to put the challenge of investing in its proper context, and to offer a clear understanding of the key challenges facing investors. It also covers the basic tools and methods of trend following, structuring the curriculum in its proper theoretical and practical framework.

As an investment strategy, trend following is not as entertaining as online gaming or casino gambling. On the contrary, trend following requires knowledge, judgment, patience, sound risk management and above all, discipline. It is a serious investment strategy for serious investors set on steadily growing their portfolios over the long term.

Regarding footnotes, sources and gender issues…

In writing this text I have taken pains to make it as readable and as un-technical as I knew how. To that end I've dispensed with the annoying use of endnotes. I fail to understand the benefit of forcing the 2-step process on the reader who wants to look up a source of a claim: first flip back to end-notes which are grouped by chapters and when you find it – thank you for your patience – then flip farther back to the bibliography where second and subsequent citations of the source work are abbreviated beyond recognition, as though the scarce resource is ink and paper, and not the reader's patience. In this book sources are listed in the footnotes, so no flipping between three different locations in the book to ascertain a source.

For the gender and social justice sensitive reader, please be warned that I've also dispensed with the politically correct use of "he or she." When writing in the third person, I've mostly used "he." This is not out of disrespect to women, quite to the contrary: while trading and investment speculation are not exclusively male-dominated domains, men *do* tend to be the protagonists of virtually all rogue trader scandals through history. On the other hand, women have occupied several spots in the ranks of the world's best speculators, including at least two fellow trend-followers: Leda Braga and the late Liz Cheval.

In Monaco, March 2021.

Introduction

Trends have been with us since the dawn of civilization. More than 2,000 years ago Sun Tzu wrote in "The Art of War" that there are three great avenues of opportunity: events, *trends* and conditions. In the 18th century Japan, trader Munehisa Honma took advantage of market trends to build up a large fortune speculating on the Dojima rice market in Osaka during the Tokugawa Shogunate. Honma was credited with the invention of candlestick price charting and in 1755 wrote the book "The Fountain of Gold," perhaps the first ever treatise on trading and market psychology. He described the ebb and flow of markets in trend moves: Yang bull markets and Yin bear markets.

In modern times, trend following was adopted by Commodity Trading Advisors (CTAs) and started to gain popularity during the 1970s and 1980s. For more than three decades, trend following proved to be the most successful strategy of active investment management. Many CTAs far outperformed their hedge fund peers and some of them sustained superior results for as many as three or four decades. In spite of this however, most investors regard trend following as an oddity, not entirely fit for the ranks of serious market professionals. The reason for this has nothing to do with performance but is in part simply cultural. Namely, most of today's market professionals were educated in the Cartesian tradition which validates rigorous scientific method as a way to acquire knowledge. Value is placed on understanding linear cause-and-effect relationships that allow us to make predictions about stuff. This mindset has an obvious appeal in investment speculation: we expect to predict and profit from market events by understanding how the conditions we observe would cause those events. That mindset also gives us comfort in the feeling of competence and control.

Trend following is a cultural misfit in this intellectual tradition. To begin with, it is based on a field of study called technical analysis where knowledge accrues through judgment heuristics and experience rather than empirical science. Trend following also blurs the relationship between intellectual work and its expected results. The linear thinking investor judges a transaction according to an explicit understanding of how and why that transaction should generate a profit. The trend follower simply implements a set of predefined rules, accepting that any given transaction may produce a loss. A trend follower expects profits, not from any particular transaction, but from a long sequence of trades extending far into the future.

Thus, while the conventional approaches to investing stem from an understanding of a particular situation, trend following is based on the *belief* that a certain predefined speculative behavior will deliver positive results over time, regardless of the economic situation, industry, market, or geography in which we trade. This reliance on belief is why I chose to use the word *bible* in this book's title. As with any speculative endeavor, our beliefs ultimately determine the way we invest, and our actions (plus luck) compound over time to shape our fortune. In this sense, false beliefs can lead to poor results and correct beliefs and action will lead to greater prosperity. The intent of this book is to convey such beliefs to its readers, together with a valid framework of knowledge to help them navigate markets profitably, with confidence and peace of mind.

Chapter 1: Discovering Trends

If we are to understand the workings of the economic systems we must examine the meaning and significance of uncertainty; and to this end some inquiry into the nature and function of knowledge itself is necessary

Frank Knight, "Risk, Uncertainty and Profit"

I am a trend follower, both by practice and by conviction. But the path of discovery that led me to that conviction was perhaps atypical. I can only roughly pinpoint the time when it dawned on me that markets moved in trends: it was at some point in the late 1990s during the closing stages of the dot-com boom.

At that time, I worked as an oil market analyst for Greenoil S.A.M., a private oil trading company in Monaco. I came to that job handicapped by a university education, which I had taken so seriously that I actually graduated at the top of my class. The subject I was most interested in was economics, where I was taught that in free markets, prices were determined through an efficient interaction between the forces of supply and demand and that price fluctuations in large, organized markets were essentially random.

In Greenoil's business, the exposure to oil price was the greatest source of risk, but the firm's management pretty much muddled through with an ad-hoc approach which consisted of the firm's owner deciding in his own discretion whether, when and how to hedge our exposure. This *gunslinger* approach was adequate enough during the 1970s and 1980s while the

profit margins on oil transactions were wide enough to cushion occasional trading losses. But over the years, the oil market became more and more transparent, the margins thinner and thinner, and eventually the *gunslinger* approach became a problem. We needed a better, more systematic method of managing risk.

The key challenge is uncertainty

It so happened that I was the most math- and computer-literate person in the company so in 1997 the boss asked me to work out a more systematic way to manage price risk. The idea was to have a method of hedging our exposure when the price of oil went against us, but to maintain open exposure through favorable price moves. The essence of the problem I was tasked with was *uncertainty:* the single toughest challenge in trading, hedging and investment management. I was entirely unprepared for this and had literally no idea how to even begin formulating a solution. My boss provided me with a subscription to price charting software and a bunch of tedious books about market analysis and risk management. Perhaps the most readable of these books was John J. Murphy's "Technical Analysis of the Financial Markets."

As I delved into Murphy's book, I was in disbelief at what I was reading: I could hardly believe that anyone would take the stuff seriously. It seemed like witchcraft with no scientific foundation or empirical rigor. But as months went on and I spent more time playing with my charting software, I was astonished to discover that many of the phenomena I had encountered in Murphy's technical analysis book kept popping up again and again in security price charts. It was things like double tops, double bottoms, heads-and-shoulders, flags, pennants, *speedlines* and many other price patterns that eventually led me to have an open mind about technical analysis. Gradually, I began to incorporate it in my market reports.

Getting immersed in quantitative research

However, my work on the risk management solution began to stall during those months. I felt I was reaching the limits of my math proficiency, so I persuaded my boss to provide me a budget to hire a team of more capable mathematicians and computer programmers to work with. A few months later, in early 1998 I had the good fortune to add my high school friend, Gorazd Medić to our team. At the time Gorazd was in Paris, working on his PhD in applied mathematics, which was a perfect match for my requirements.

For nearly two years, we worked and explored the problem matter, subjecting our price data to just about every known model of time series

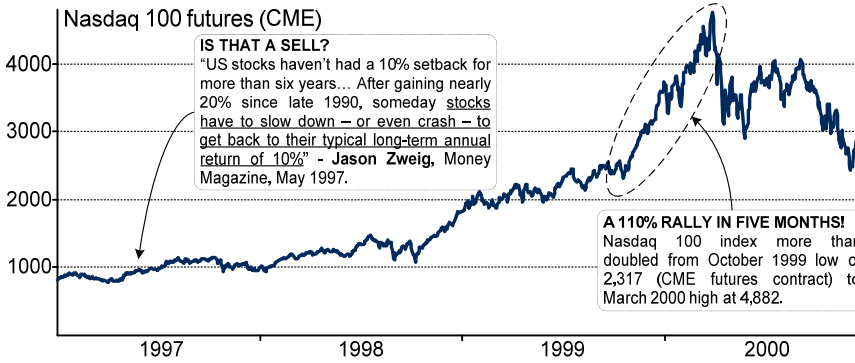
analysis, including spectrum analyses, auto-correlations, Box-Jenkins method, ARIMA,[1] and fractal analyses. In spite of our earnest effort to come up with a compelling model, I felt frustrated that nothing seemed like a particularly exciting breakthrough.

At that time, two large-scale events were unfolding simultaneously in the global markets and both of them would strongly incline our thinking toward the idea that markets moved in trends: they were the dot-com boom and the 1997-1999 oil price crash.

The dot-com bubble

The 1990s saw one of the most spectacular bull markets in history. The technology stock index, Nasdaq 100 rose from 322 in 1990 to 5,132 in March of 2000, generating a compound annual return of over 32%! As it unfolded, the Nasdaq bubble attracted a great deal of interest and much animated discussion even among the general public. Already by December of 1996, the view among many experienced analysts was that the stock markets fell into a frenzy of *irrational exuberance*[2] and that stock prices were dangerously overinflated. In spite of those views, stocks continued rolling higher and the exuberance kept getting more and more irrational for another 39 months. By the summer of 1999, the Nasdaq had advanced nearly ten-fold. Then, during the last five months of its bull market, it rallied by another 110%!

Exhibit 1.1: Irrational exuberance - the 'dot-com' bubble



Already in 1996, many believed the U.S. technology stocks to be overpriced. But the bull market trend continued through March 2000.

[1] ARIMA: Autoregressive Integrated Moving Average

[2] The term "irrational exuberance" was first used by then Federal Reserve chairman Alan Greenspan in a speech on 5 December 1996.

My boss would frequently rail against the investing frenzy that had gripped almost everyone. In those days you couldn't go out for a meal or a drink with friends without the discussion inevitably turning to the skyrocketing internet stocks like AOL, eBay, Amazon, Yahoo, and others. Everyone, including me, was setting up trading accounts with the new online brokers and everyone seemed to be making money hand over fist.

Meanwhile, one of the problems with my risk management project at work was having access to quality literature. In those days, good scientific materials had only begun to be posted online and we still largely depended on books we got on loan from university libraries. Then one day in April 1998 I read about a new online bookshop called Amazon. I gave it a try and ordered a few books. In about two weeks' time my books arrived, shipped from the United States. A few days later I wanted to order another few books and I was amazed to discover that Amazon had kept my shipping address and payment information. Ordering more books could not have been easier. I was so impressed that I resolved to invest substantially all of my savings in Amazon shares. The very day I bought them, their price appreciated by over 15% and from there they rallied a full 1,400% before peaking in March of 2000. I was certainly not about to complain about the irrational exuberance behind that market move. Clearly, whatever anyone thought about Amazon's and other stocks' valuations, the prices trended higher and the capital gains on those investments were real.

The 1997-1999 oil price crash

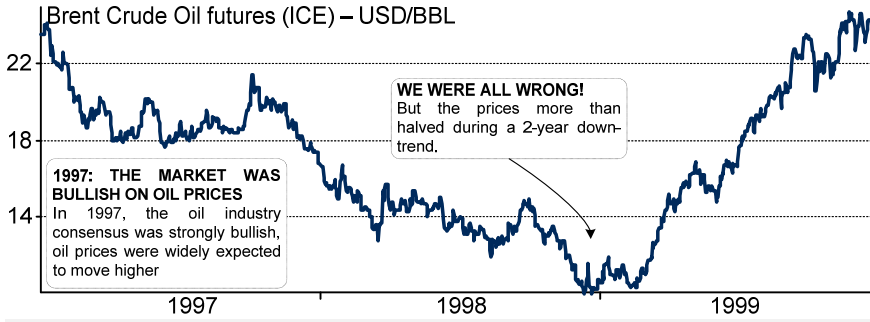
But as stock markets roared higher, oil prices were slowly drifting lower, defying much of what we thought we knew about the oil market.

Oil trading was my employer's home turf and analyzing the oil market was my day job. I was surrounded by experienced traders and I thought that all that know-how and experience counted for something. I also expected that the available economic data gave us a factual account about the markets: that "bullish" information would lead to a rise in oil prices and "bearish" information would lead to their decline. Thus, an increase in demand for oil should cause oil prices to rise. So would shortfalls or interruptions to its supply. Conversely, falling demand or increasing production should cause prices to fall. But that's not quite the way things happened in the real world.

During the late 1990s, global economic growth was in full swing and the demand for oil was rising. Meanwhile, since capital favored investments in telecommunications and information technologies, the funding for oil production and refining tightened globally. The consensus

view among oil traders was that demand would progressively outstrip supply and push oil prices significantly higher in the future. Contrary to those expectations, oil prices more than halved from around $24/barrel in 1997 to below $10/barrel in 1999.

Exhibit 1.2: Crude oil prices halved from 1997 amid a bullish consensus



From $24/bbl at the start of 1997, crude oil crashed to below $10/bbl at the end of 1998. By then the new 'consensus' was so bearish, many analysts were talking about $5/bbl oil. What happened in 1999 again surprised most participants.

The undeniable conclusion, again, was that the market was trending, regardless of what we thought that we understood about it. This trend was also accompanied by much railing and complaining about the prices that were too low, oversold, manipulated and irrational. But railing and handwringing about the markets being wrong and irrational made as much sense as king Canute trying to stop a tide by flogging the waves. The prices were there, in front of us, and they shaped the objective reality. We simply had no choice but to contend with. The markets give no rewards for being smart, experienced or sophisticated: if your actions clash against the reality as presented, you suffer the consequences. Indeed, in 1998 we witnessed a spectacular example of this clash between the markets and the most sophisticated of its participants.

LTCM: when genius failed

In 1994, Wall Street's legendary bonds trader John Meriwether set up a hedge fund named Long Term Capital Management (LTCM). To manage the fund, Meriwether assembled a formidable brain trust led by two nobel prize[3] winning economists, Robert Merton and Myron Scholes. Their core investment approach was also based on probabilistic quantitative modeling. Essentially, LTCM's models scanned the investment universe for pairs of securities whose prices tended to move together. When their prices

[3] Microsoft word says I should capitalize "nobel prize." I am not sure if I should.

diverged from one another by so many standard deviations, LTCM would buy the *relatively* cheaper security, sell short the relatively more expensive one, and make a profit as their prices reverted to their historical relationship. Things went very well for LTCM until they suddenly didn't. In August 1998 after Russia announced that it would default on her debt, LTCM found itself stuck with a highly leveraged position in Russian bonds which had plummeted in value. As a result, LTCM experienced a spectacular losing streak that led to the fund's ultimate demise. In only a few months' time, LTCM lost $4.5 billion of their investors' assets and had to be bailed out by a group of 13 large Wall Street banks. In the aftermath of this failure, Merton and Scholes both gave a number of interviews about the episode in which they pretty much blamed the markets for the collapse of their fund. In failing to conform to their models, the markets had behaved irrationally. Much of the investor community apparently believed them: in 1999 Myron Scholes formed Platinum Grove Asset Management and by 2008 raised $4.8 billion dollars. But even then, the clash of the titans between Mr. Scholes and the markets would end badly for the nobel laureate. His fund lost 29% in the first half of October 2008, adding to a year-to-date loss of 38% or more, forcing the fund to halt investor redemptions and leading to the ultimate demise of the fund. [4]

* * *

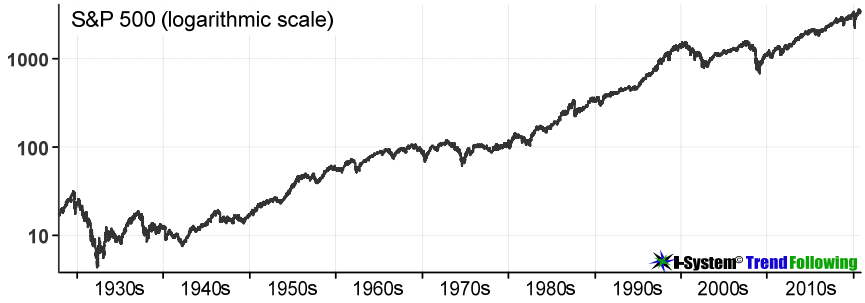
Large-scale price events: risk and opportunity

The lesson we had to learn was that the markets represent our objective reality and there was no point denying this or complaining about it. Markets do frequently defy our notions of what is rationally justifiable and what is not, particularly during periodic large-scale price events. Whether you participate in the markets as a trader, hedger or investment manager, it is exactly such events, like the 1990s oil price crash or the 1998 Russian financial crisis that had sunk the LTCM fund, that represent your greatest source of risk. However, if you navigate them skillfully, then they should also be regarded as your greatest source of opportunity.

Almost invariably, large-scale price events unfold over time as trends, and as I came to appreciate over the years, trends are by far the most potent drivers of investment performance. We see trends in the markets all the time. Think of market indices like the S&P 500 or Nasdaq, or of stock shares of companies like Amazon, Apple, Alphabet, Tesla, Microsoft and many others over the recent years.

[4] Saijel Kishan (Bloomberg News): "Nobel Laureate's Fund Halts Withdrawals: Value Drops 29% in First Half of October" – Washington Post, Sunday, November 9, 2008.

Exhibit 1.3: Spot the trend!

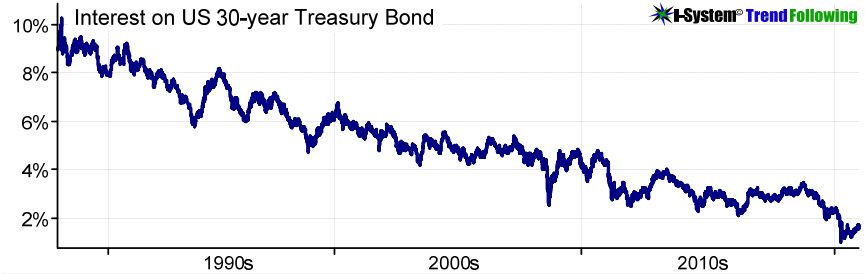


For over 90 years, the S&P 500 index has trended frequently and strongly.

In fact, most market participants already understand and expect to encounter price trends and they intuitively seek to invest in assets that could appreciate multi-fold and change their lives. Even when they invest in things like real-estate, art, wines and collectible items, they do so on the premise that the prices of these assets will rise significantly over time.

The problem, of course, is that we can never predict these events. Nobody knows how much some stock, a Bitcoin or an ounce of gold might be worth five or ten years from today. These outcomes are unknowable as they are shrouded in uncertainty. That was the problem that would become the focal challenge of my career more than twenty years ago.

Exhibit 1.4: Along a straight line – the 30+ year decline in interest rates



Some trends can span very long periods of time. The 30+ year decline in USD interest rates has formed the bedrock of our 'normal' – the environment that's shaped most students', analysts', and practitioners' ideas about the economy, markets and investing.

Embracing the idea that markets moved in trends and that trend following was a proper, legitimate investing strategy was a breakthrough that gave us a conceptual framework and a direction in which to pursue our risk management solution. Ultimately, we built a trend following model and

named it I-System. Although we were greatly enthusiastic about the model's 1999 prototype and all the possibilities we envisioned for the development of our business, my boss was not impressed. He didn't think that some "stupid computer program" should tell him how to trade the markets. He was more dismissive still about my idea to expand our firm's activities toward hedge funds management. In the summer of 2003 I was given a choice: I could stay at the firm and do as I was told or I could leave and pursue my ambitions elsewhere.

By this time I had learned much about the CTAs (Commodity Trading Advisors) who had successfully used trend following strategies in a broad range of financial and commodity markets since the 1970s. Many of these funds delivered consistently superb returns for their investors year after year and became impressive businesses in their own right. I decided to resign from Greenoil and try for the greener pastures in the hedge fund industry. Over the ensuing years I continued working on the I-System and using it to trade and manage money. These activities would define the next twenty years of my career. To my satisfaction, I-System performed very much to my satisfaction, enabling me to generate a superb performance track record managing several hedge funds and trading accounts.

Those results were also a definite confirmation that trend following was the correct choice of strategy. My earliest *baptism of fire* as a hedge fund manager came with the 2008 financial crisis and the market crash it unleashed. I passed that test with flying colors: I was among a small minority of managers who had a positive result that year. I generated 27% return (after fees) in 2008. This was not because I understood the financial crisis and correctly predicted the market crash but because I used a set of trend following strategies to navigate through the storm. I didn't need to know the future; I didn't need to know about the economic fundamentals of the stock market, bonds, oil, gold, coffee, Japanese Yen or any other market I was trading. But by adhering to a set of trend following strategies I was able to trade them all, and to do so profitably.

Part 1

UNCERTAINTY

Chapter 2: The Information Universe

The most fundamental determining fact in connection with organization is the meeting of uncertainty. The responsible decisions in organized economic life are price decisions; others can be reduced to routine.

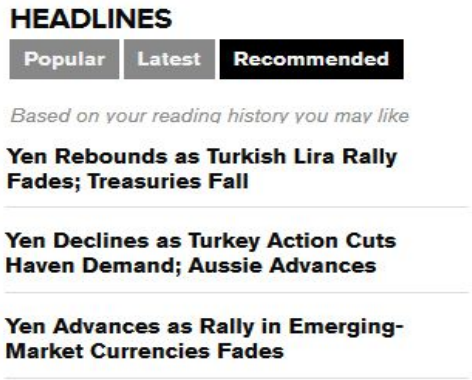
Frank Knight, "Risk, Uncertainty and Profit"

Without a doubt, uncertainty is the greatest challenge facing investors: we simply have no way of knowing what may happen tomorrow, let alone a month or a year from today. In spite of that, most investors spend considerable time seeking to understand the markets, the economic environment, correct asset valuations and trying to predict what might happen in the future. The natural thing to do before making any kind of forward-looking decision is to get the best available information about the

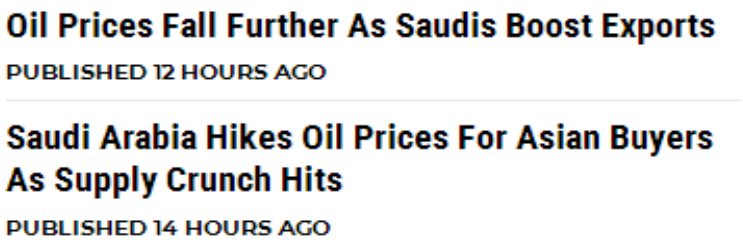
subject matter at hand. Market participants' universal need for accurate, up-to-date information gave rise to a huge industry broadcasting a constant flow of information through all the suitable media, from newspapers to wireless hand-held devices.

The commentariat and the illusion of knowledge

This massive information broadcasting industry projects a largely self-serving façade of omniscience. Virtually every data point, every price tick in the markets is linked to some event that is known to have caused the change. Every single day we hear dozens of stories linking cause and effect as if there are never any uncertainties about these things: "oil prices rally on surprise draw in reserves,… European stock markets dump on Brexit talks breakdown,… futures rally as Pfizer pharmaceutical corporation announces Covid 19 vaccine is ready for distribution,... etc. Such stories appear plausible and the industry has certainly proven effective at packaging them up for their audiences. But if you read between the lines and try to discern patterns in this unending flow of news stories, your confidence in the veracity of their content will quickly be shaken. Consider the following example:



These three headlines appeared on my Bloomberg news page literally one below the other, at the same time: Yen Rebounds, Yen Declines, Yen Advances… all clearly explained by well understood causal factors. You can spot similar examples virtually every single day. In a way, this is understandable: the whole broadcasting industry couldn't attract a large audience if they just stated the facts truthfully: "the price of gold collapsed today and we have no clue why, exactly; Yen advances, we've no idea..." Or how about the following two headlines published literally two hours apart in 2014?



If you pay attention you'll come across such contradictions quite frequently. It is all part of the business of projecting the image of expertise and omniscience, which is the way this industry sells itself to the public. While there is some genuine value behind this façade, the public must learn to use the industry's services with discernment and due skepticism.

The value of information

But even if we strip the media narrative from the underlying factual information, the value of such information is still uncertain. It would only give you a clear advantage if other market participants weren't equally well informed. If everyone already knew what you know, that information would already be baked into the market prices and you wouldn't be able to profit from it. This is the idea behind the *Efficient Market Hypothesis:* in an efficient market, asset prices accurately reflect all the relevant information. Since future price fluctuations depend on *unknowable* future events, they are presumed to be unpredictable, making it difficult for anyone to derive a systematic advantage from publicly available information. Things could be different if you happen to have regular access to privileged information – if you are a high-level banker or politician.

Western world's ideology holds that our markets are transparent, that the playing field is level, and that risks and rewards are equally available to all participants. In reality, the playing field may be quite a bit more level for certain privileged participants. For example, researcher Alan Ziobrowski of Georgia State University looked into the stock-trading performance of US Senators from 1993 through 1998. He became intrigued with the subject after reading that three out of four members of the U.S. Senate had investments in companies directly affected by their legislative activity.

In an eight-year collaborative effort with researchers from three other universities, Ziobrowski found that US Senators outperformed the equity markets on average by 12 percentage points per year. That was even better than corporate insiders who only beat the markets by 5%, not to mention the Senators' typical constituents who on average underperformed by 1.4% or more. As we'll see further on, being able to systematically beat the markets is difficult and unlikely for any group of investors. Doing so by a whopping 12 percentage points is beyond the reach of even the best professional investment managers. Ziobrowski found that the Senators "*had an uncanny ability to pick the right things on the right days.*"

Like elite politicians, elite bankers also enjoy certain privileges not shared by the rest of the world. Thus, large banks like Goldman Sachs and J.P. Morgan frequently report nearly perfect scores on their speculative trading, having positive performance nearly every single trading day. For example in 2010, Goldman Sachs revealed that out of 252 trading days they only lost money on 11 days. Morgan Stanley had similar results. From 2013 through 2016, J.P. Morgan reported a total of two losing days. Its average daily profits from trading were $72 million in 2013, $67 million in 2014, $70 million in 2015 and $80 million in 2016.[5] This kind of performance is unattainable for most of the "ordinary" participants who must tackle uncertainty without privileged information or market access.

We all get news on CNBC, Reuters, Bloomberg, and a myriad of other services that all provide essentially the same information. It is then up to investors to make out what the markets are up to and decide how to manage their investments. But there are deeper reasons why information in itself cannot provide us any systematic advantage. First, we don't act on information per se, but on the way we interpret it. Second, much of the information we receive isn't accurate and some of it may be outright false.

Market facts vs. market narratives

The information we receive usually shapes up some kind of a *narrative* about what's going on in the market. During the two decades of my career in commodities trading I have observed time and again the narrative followed the price action, not the other way around. In other words, markets lead; narratives follow. By *markets*, I mean price trends, and by *narrative,* a shared interpretation of how external economic, social or political events affect the markets.

Market information or, in trader speak, *fundamentals,* shape our understanding of the economic environment, but what we do with any bit

[5] Taggart, Adam: "Banks are Evil: It's time to get painfully honest about this." PeakProsperity.com, 17 March 2017.

of information depends on our judgment about its relevance and credibility. This is never a straightforward process, so at any one time we can entertain more than one possible interpretation of market conditions. In this way, objective information lends itself to subjective interpretations, which are often shaped by the evolution of events in the markets.

The perfect example again, is that late 1990s oil price collapse. As we saw in the previous chapter, most analysts at the time believed oil prices would rise along with the growing demand and overheating economy. But because the opposite took place, market participants' need to reconcile the supposedly bullish fundamentals with collapsing oil prices gave rise to stories and rumors about massive stocks of unsold oil and vast tank farms around the world, full to the brim. As prices approached $10/barrel, the bearish narrative became so entrenched that many traders thought that oil could halve again to $5/barrel. But many of these stories turned out to be unverified rumors which were given credence only because they could explain the reality we were witnessing. At the very bottom of that trend, the narrative was almost universally bearish, but in 1999 oil prices reversed course. They tripled to $35/barrel over the following 20 months even as the world economy slipped into a recession and demand for oil contracted.

Again, the market sought to reconcile these contradictions with a new narrative to fit the events. Now we heard about falling production of oil fields around the world, rising production costs, a shortage of refining capacity and growing demand for oil from emerging economies. One of the biggest stories affecting the market was the peak oil hypothesis. Not that this hypothesis was just then formulated catching everyone by surprise: it was originally advanced by Marion King Hubbert in 1956 and subsequently popularized in the 1970s. It reemerged in 2005 and 2006 because market participants needed to explain the oil prices, which continued to break new all-time record highs. We'll make a small detour here to look at the peak oil hypothesis as it might prove relevant to the future of trend following.

Peak oil and Saudi oil wealth

Peak oil refers to the point in time when worldwide oil production passes its maximum point, followed by an irreversible decline. According to various interpretations, we probably passed this point between 2005 and 2009.[6] Given the massive relevance of this hypothesis to my employer's business, I made a concerted effort to get to the bottom of the issue. I

[6] In its 2010 International Energy Outlook, the U.S. Energy Information Administration (EIA) proclaimed that oil production from conventional sources probably peaked in 2006.

expected to unearth the truth of the matter. Instead, I encountered widely diverging views and dissonant information produced by different agencies and research outfits.

In particular, there was a stark contrast between the views espoused by proponents of the peak oil hypothesis and the conventional view of the market held by the industry.[7] Peak oil researchers believed that we were entering a period of terminal decline in oil production and that oil prices would rise much, much higher in the future. The conventional view held that crude oil was very plentiful around the world and that new deposit discoveries and improved drilling technologies would keep us abundantly supplied at stable prices for decades to come.

The happy talk about plentiful oil usually invoked Saudi Arabia's vast reserves and inexhaustible production capacity. For years, the kingdom was believed to have some 260 billion barrels of proven oil reserves together with another 200 billion of probable reserves. It had not occurred to me to question these figures until I started to scratch a bit below the surface. The magic of Saudi oil reserves was that they kept constant (or even increased) in spite of the extraction of close to 3 billion barrels each year. After decades of extraction, you'd think that reserves would decline accordingly. But no: by 2014, Saudi Aramco claimed that they had 790 billion barrels of *oil resources* and expected this figure to hit 900 billion barrels by 2025.[8] This bonanza did not come about from discoveries of giant new deposits[9] or from magical new technologies but mainly from the changing definitions of what constitutes crude oil and from a subtle shift in terminology.

While most of the press uses the terms *reserves* and *resources* interchangeably, it is very important to distinguish between the two. Resources comprise oil from *contingent* and *prospective* sources which include quantities that are *potentially recoverable* from as of yet *undiscovered*[10] accumulations. Thus, oil *resources* are by definition wide open to exaggeration and wishful thinking. What we have traditionally understood as *reserves* usually represents only a small fraction of resources that can be feasibly developed.

[7] By industry, I mean the oil corporations, their bankers, consultants and analysts.

[8] Reuters: "Saudi Aramco's Oil Resources to Grow to 900 bn Barrels by 2025." 19 November 2014.

[9] The last great Saudi oil field was discovered in 1967. To date, only smaller deposits have been found.

[10] "Recoverable" doesn't necessarily mean "economically recoverable," which would imply that the value of extracted oil should cover the costs of exploration, drilling, extraction, transportation and a certain return on invested capital.

If we revert to the traditional *Proven Reserves Method*,[11] Saudi reserves are not nearly as abundant as the headline numbers would suggest. The last audit of Saudi reserves complying with this methodology was done in 1979 and showed that Saudi Arabia had 110 billion barrels of *proven* reserves, another 67 billion barrels of *probable* reserves and 69 billion barrels of *possible* reserves. Oil reserves are classified as proven if there is 90% confidence of them being recoverable with existing technology and under current economic and political conditions; they are probable if there's a 50% confidence of them being recoverable; for possible reserves, there has to be at least 10% confidence of recoverability under existing circumstances. Given that well over 115 billion barrels have already been extracted since 1979,[12] Saudi Arabia could be dangerously close to running dry.

The work of peak oil researchers like Matthew Simmons, Collin Campbell and Michael Ruppert corroborated this scenario as did the leak of 2007 confidential U.S. Embassy cables from Riyadh published by The Guardian.[13] The same diplomatic cables also revealed a weakness in Saudi Arabia's ability to increase production. For example, Mr. Sadad al-Husseini, Aramco's Executive Vice President for Exploration (from 1992 to 2004), announced in 2007 that the company planned to increase production to 12.5 million barrels per day by 2009. To attain that goal, Aramco made a massive $50 billion investment in expanding production. In the 1990s, Aramco operated 15 drilling rigs; by 2015 this number was not quintupled to 80. In spite of all that, Aramco had great difficulty arriving at their 12.5 mb/d objective. The limitations to Saudi Arabia's oil production capabilities received further corroboration in a 2012 report by

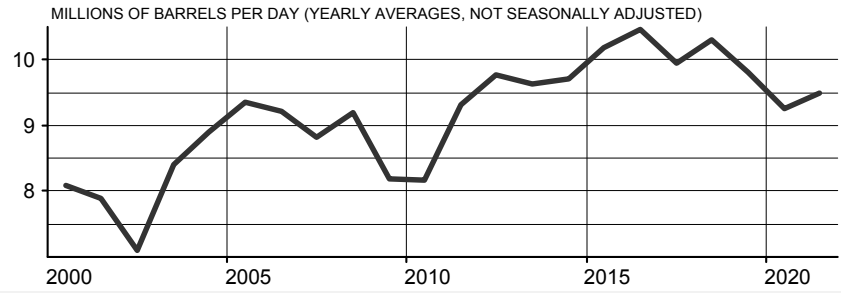
[11] This methodology was required by the U.S. Securities and Exchange Commission, but was last performed on Saudi Aramco's reserves in 1979. After the control of Saudi Aramco passed from American management to the Saudi Petroleum Ministry no further surveys using this methodology have been conducted.

[12] According to the U.S. Energy Information Administration, Saudi Arabia extracted 99.76 billion barrels from 1980 through 2014. Since then, Saudi production has run at least 3.6 billion barrels per year, bringing total production from 1980 through 2019 close to 120 billion barrels.

[13] In 2010 The Guardian published confidential U.S. Embassy cables from Riyadh released by Wikileaks. One of the cables from 2007 recapitulated U.S. Consul General's meeting with Mr. Sadad al-Husseini, Aramco's Executive Vice President for Exploration from 1992 to 2004. According to this cable, Mr. Husseini asserted that at that time, Saudi Arabia had 64 billion barrels of remaining oil reserves and that these reserves would last 14 years (i.e. until 2021), after which Saudi output would enter a period of steady decline that no amount of effort would be able to stop. A different report by Citigroup in 2012 further confirmed the dire situation with Saudi oil reserves concluding that failing to discover major new oil fields, the kingdom was liable to cease exporting oil altogether by 2030.

Citigroup,[14] which concluded that if it failed to discover major new oil fields, the kingdom could cease to export oil altogether by 2030.

Exhibit 2.1: Crude oil production for Saudi Arabia



Production of 10 million barrels per day equals about 3.6 billion barrels per year.

Over the years, the Saudis took pains to reassure the world of their undiminished production capabilities, particularly in 2014 and 2015 when Aramco's perceived 'muscle' was instrumental in collapsing the oil price by more than 70%. But this show of strength may have been the kingdom's last hurrah; in 2019, while seeking to raise funds in international credit markets Aramco published a bonds prospectus in which it disclosed that their largest oil field, Ghawar was producing 3.8 million barrels per day. Up until that time, nearly every oil analyst in the world 'knew' that Ghawar was producing 5.8 mb/d.[15] Below is the Bloomberg headline from April 2019:

Markets

The Biggest Saudi Oil Field Is Fading Faster Than Anyone Guessed

By Javier Blas
2 April 2019, 13:34 CEST *Updated on 3 April 2019, 10:17 CEST*

- Ghawar can pump 3.8 million barrels a day, less than expected
- Bond prospectus give details of the kingdom's largest fields

Two million barrels per day vanished without any explanation. This should have been a shocker for the global markets. Given that Ghawar

[14] Godsen, Emily: "Saudis 'may run out of oil to export by 2030'" – The Telegraph, 5 Sep. 2012.
[15] Blas, Javier: "The Biggest Saudi Oil Field Is Fading Faster Than Anyone Guessed" – Bloomberg, 02 April 2019 - https://www.bloomberg.com/news/articles/2019-04-02/saudi-aramco-reveals-sharp-output-drop-at-super-giant-oil-field

accounted for about half of Saudi Arabia's production, supplying more than 5% of global oil demand, this was a rather staggering revelation. But it generated no *narrative* traction: the media downplayed it, the markets shrugged it and the oil price barely moved.

Quality and sources of market information

The mixing up of oil *reserves* and oil *resources* by news reporters, as we just saw, is a symptom of a much more significant challenge for market analysts: the pervasiveness of shoddy reporting. Once you start reading news reports with a critical eye, you encounter this problem all too often.

The oil price collapse in 2014 and 2015 was accompanied by daily reporting that almost invariably bolstered the prevailing bearish narrative. However, many of these reports would not get a passing grade even in high school. Here's an example: in April 2015 Bloomberg published a story by one Grant Smith, titled "Saudi Arabia Adds Half a Bakken to Oil Market in One Month."[16] The headline already makes a great impression and already predisposes the reader to expect a strong bearish case for the oil market. And the article itself delivers the goods in crisp facts and figures. Grant Smith writes that "Saudi Arabia boosted crude production to the highest in three decades in March," adding 658,800 barrels per day to an average of 10,294 million barrels per day. Those were some very precise figures obtained from a very non-transparent oil producing nation. The article went on to cite more amazingly detailed figures, rounded to the nearest 100 barrels. It cited four such figures and all four ended with the figure 800 (658,800; 346,800; 811,800; 318,800).

Well, paint me excessively suspicious, but I did find that odd because in spite of such surprising precision, the article also presented a glaring contradiction. See if you can spot it: in the opening paragraphs, Smith wrote: "The kingdom boosted daily crude output by 658,800 barrels in March to an average of 10.294 million…" In the very same article, a few paragraphs later he said: "Saudi output rose by 346,800 barrels a day in March to 10.01 million a day…" For headline readers, the story's implications were clear and unambiguous: the Saudis were flexing their oil producing muscles, the oil glut would keep getting bigger, and the price had nowhere to go but down. This narrative clearly contributed to market participants' collective perception of the bearish reality in the oil market. But for a more rigorous analyst, such reports posed more questions than answers. Who sourced the figures and how? How could that major and respected news organization publish such a massive discrepancy about a

[16] Smith, Grant: "Saudi Arabia Adds Half a Bakken to Crude Market in a Month." – Bloomberg, 16 April 2015.

subject of such huge importance? Or is the whole point of the exercise simply producing splashy headlines, then backing them up with whatever junk lies at hand or can be contrived without raising suspdicions among the readers?

The hidden bias

All too often, narratives tend to be skewed by an invisible bias which determines which "facts" are included in a story and what significance they are given. During the 2014/15 oil price collapse, the need to explain facts on the ground created the bias that led the majority of analysts to pick facts with bearish implications to contrive a compelling explanation of the price collapse. Bullish "facts," like the declining oil output simply got ignored for the occasion. Reading over many market reports I've identified at least three constituencies producing energy analyses with their inherent biases looking at energy markets:

1. **Energy industry and their investment bankers**. Their reports tended to be upbeat-to-exuberant: there's plenty of oil, production is going through the roof, fracking technologies are improving by the day and production will keep growing to infinity.
2. **Government agencies**. Their reports were usually cautiously upbeat, both about the available oil reserves and the ability of new technologies to develop new projects and resources feasibly.
3. **Academic institutions**, particularly UK-based ones. Their reports tended to be positively alarmist and frequently evoked global climate change, the need to move away from fossil fuels and shift to alternative energy sources.

Each of these groups produce professional and credible-looking reports with neatly tabulated figures and compelling-looking charts, but they often lead to rather different conclusions. Between the lines, it is not difficult to discern the root of each group's bias. Oil industry and their bankers want to attract investment capital. This obviously includes Saudi Aramco and the worldwide army of analysts on their payroll. Government agencies want to favor dominant industries and avoid stirring alarm among their constituents. And academic institutions – ever devoted to pursuing unvarnished truth – at times put out reports that reach pre-formulated conclusions requested by groups that fund their research.

There was no reason to believe that the information on other industries was any better. Take the example of South Africa's gold reserves. For decades, South Africa had been one of the world's largest producers of

gold. According to a revision in 2001, their reserves were pegged at 36,000 tons of the precious metal, about 40% of the world's total. However, United States Geological Survey subsequently estimated that South Africa only had 6,000 tons worth of feasibly extractable gold reserves left. Later research by Chris Hartnady of the University of Cape Town showed that the country's true reserves were perhaps as low as 3,000 tons. The discrepancy between 36,000 and 3,000 tons again puts the whole way we obtain such information in doubt.

Again, precise figures published in professional-looking research reports project the appearance of factual truth, yet I can't help but wonder how those figures came about. In his book, "The Lexus and the Olive Tree," Thomas Friedman explained how he filed temperature reports for Beirut when he worked there as a correspondent for the New York Times. "I estimated what the temperature was, often by ad hoc polling," writes Friedman. "Gathering the weather report basically involved my shouting down the hall or across the room: 'Hey, Ahmed, how does it feel out there today?' And Ahmed or Sonia or Daoud would shout back, 'Ya'ani, it feels hot.' … So I would write, 'High 90 degrees.'"[17] Friedman's reports were then included in UPI worldwide report from Beirut and duly published in newspapers like the New York Times or the Washington Post. They appeared as facts, black-on-white, yet as Tom Friedman confesses, they were merely his own lazy guesstimates.

It seemed reasonable to conclude that much of what we thought we understood about markets could be based on data sourced with similar rigor. Once cited in glossy reports they gained the validity of hard facts. More likely, they were low-resolution approximations or something even worse. As law professor Michael Carrier noted, "It doesn't matter if the figures are correct. For even if they are completely disproved, the mere articulation of numbers promises a precision that's difficult to dislodge from audience's consciousness."[18]

[17] Friedman, Thomas. "The Lexus and the Olive Tree." New York, Anchor Books, 2000.
[18] Carrier, Michael: "Copyright's Blind Spot: the Innovation Asymmetry" – Disruptive Competition Project, 18 Dec. 2013.

Is it even true?

> *The arithmetic of government statistics (jobs, growth and inflation) is distorted and dishonest almost beyond measure.*
>
> *Paul Singer*

> *When things become serious, you have to lie*
>
> *Jean-Claude Juncker*[19]

As if shoddy research, questionable surveying and the frequent bias baked into the so called market fundamentals weren't bad enough, it is also clear that much of this information is produced by agencies that have a direct or indirect financial stake in the industries they report on. This makes it hard to dismiss the suspicion that much of the data could have been deliberately distorted or outright fabricated. Paying a small bit of attention to the news and press releases substantiates this suspicion rather abundantly. Here are a few examples: in October 2012, the U.S. Census Bureau reported an unusually sharp fall in the unemployment rate, from 8.1% in August to 7.8% in September of that year. This was a very unexpected bit of good news as it implied that the economy, which was technically in recession at the time, had miraculously powered forward at the fastest rate in nearly thirty years.

[19] At the time he made this statement in 2011, Jean-Claude Juncker was the Prime Minister of Luxembourg and the chairman of eurozone finance ministers. As such, he was the Euro currency union's key spokesmen.

As it happened, this information was favorable to President Obama who, at the time, was concluding the re-election campaign for his second term in office. Not only would the information ultimately prove false, but it turned out that the Census Bureau, which published it, was fully aware of this. It transpired that some of the Census Bureau's surveyors fabricated the data by making up household survey results with fictitious people and jobs. The deception apparently escalated at the time of President Obama's re-election campaign.[20]

In another example, during the aftermath of the 2008 financial crisis the Federal Reserve Board was seen repeatedly fudging the figures on U.S. household net worth.[21] In the second quarter of 2009, household real estate wealth was reported to be $18.3 trillion. Later, the figure was revised down by a whopping $2.1 trillion. Closer scrutiny of the Federal Reserve Board's reports revealed that such revisions happened in every quarter during the crisis period. The repeated pattern of reporting more positive figures first then revising them downward indicated that these weren't innocent errors but intentional distortions. This enabled the Fed to report encouraging headline figures and thus curb pessimism during a severe recession. Subsequent downward revision would help the next set of quarterly numbers look better.

For example, between the second and third quarters of 2009, household net worth staged a jump of $2.7 trillion, most of which – $2.3 trillion – was due to the previous downward revision of the second quarter's figures. Without the downward revision, the $2.7 trillion improvement would look much less rosy at only $400 billion. Indeed, this pattern appeared less like honest errors and more like the Federal Reserve Board's crisis-management gimmicks. Borrowing from the same playbook, the U.S. Bureau of Labor Statistics similarly engaged in the practice of reporting optimistic unemployment numbers first, then revising them later. Between April and October 2010, the BLS low-balled the unemployment figures on 22 out of 23 consecutive weeks[22] only to revise them upward later, when they no longer had the news headline impact. According to the New York Times, the total revisions of unemployment figures in 2009 showed that 1.36 million more jobs were lost during the year than originally reported.

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[20] Crudele, John: "Census 'faked' 2012 election jobs report." New York Post, 18 November 2013.

[21] Durden, Tyler. "Charting The Government's Chronic And Flawed Overrepresentation Of Household Net Worth: A $2.1 Trillion Downward Revision In One Quarter." ZeroHedge, 11 December 2009

[22] Durden, Tyler. "Charting Statistical Fraud at the BLS: 22 Out Of 23 Consecutive Upward Revisions in Initial Jobless Claims". ZeroHedge, 30 September 2010

The list of similar examples is long and it is hard to escape the impression that a lot of the information circulating in the markets is doctored, spun and distorted. And just as the U.S. government isn't above fabricating the figures, it is abundantly clear that most other governments aren't either, and we've seen countless cases of governments cooking their books and misreporting economic data from around the world, including advanced economies like Japan, Australia and many European nations. All governments, corporations and individuals for that matter, want to appear stronger and more credit worthy than they really are. In this sense for example, South Africa's gold reserves could be overstated because the country's ability to service its external debt might be severely impaired if it turned out that its gold reserves were in fact only 5% of the officially reported figures. This would be even more adverse to banks that have significant exposure to South Africa's debt. The country's debt is an asset on the bondholders' balance sheets, and unfavorable information could lead to a credit rating downgrade and crippling multi-billion dollar haircuts for the nation's creditors. The same is bound to be true for other countries, banks, and corporations. Contrary to the Western free markets ideology, vested interests do have their own agendas and when facts get in their way, the vested interests do their utmost to get in the way of facts.

* * *

Between the groupthink-induced narratives, conflicting biases, questionable figures and deliberate distortions in our information universe, arriving at an accurate understanding of the economy and the markets is quite out of the question. These observations ultimately shattered my illusion that market research – no matter how diligent – could help us to predict future developments or meaningfully improve our decision-making. The idea that conventional market research alone *does not* improve decision-making in investment speculation may at this point sound like an exaggeration, but the preponderance of empirical evidence strongly supports it, as we'll explore further on.

Chapter 3: Market Forecasting

Forecasting is the most complex, interactive and highly nonlinear problem that had ever been conceived of.

John von Neumann

Economists can't forecast for a toffee… They have missed every recession in the last four decades. And it isn't just growth that economists can't forecast; it's also inflation, bond yields, unemployment, stock market price targets and pretty much everything else.

James Montier

Even supposing that we have access to accurate information, our decisions are not simply knee-jerk reactions to raw information. Rather, the way we choose to act is determined by the way we *interpret* information and the meaning we attach to it. That meaning depends on our convictions about the way things work in the world. When it comes to investing money, our convictions are likely to be shaped in large part by our understanding of economics. Frank Knight explained the purpose of economics as a way "*to work out, on the basis of the general principles of conduct and the fundamental facts of the social situation, the laws which determine the prices of commodities and the direction of the social economic process.*"[23]

[23] Knight, Frank. Risk Uncertainty and Profit. New York: Hart, Schaffner & Marx, 1921 (p. 71).

Economics is a social science, but over the last century or so, economists have increasingly resorted to methods of natural sciences like physics or mathematics. The shift from fuzzy analyses of human conduct to pursuing more exact scientific methods compelled economists to adopt numerous assumptions about human nature. The effect of these assumptions was that it confined economists to work their theories within an unreal world where human conduct resembles the Brownian motion of inanimate particles. Here are some of the explicit or implicit assumptions economists adopted in order to make human conduct more suitable to exact scientific analysis:

- participants in an economic system are completely rational;
- they are entirely free to act on their inclinations in the process of production, exchange and consumption of goods and services. No constraints are placed by individuals or by the society on members of the community;
- they enjoy perfect clarity about the long-term and short-term consequences of their actions
- they are entirely motivated by economic factors;
- communities enjoy perfect competition with constant, complete and costless exchange of information between all participants;
- each member of the community acts as an individual and solely on his own behalf with complete disregard of others;
- community members do not collude amongst themselves at the expense of other members or the community as a whole;
- each member continuously produces a complete commodity which is consumed as fast as it is produced;
- each participant endeavors to maximize his or her own utility;
- members in a community do not engage in fraud …

While these assumptions may be necessary to describe an economic system in mathematical terms, I think that even termites display more individuality and variation in their behavior than do humans as cast by economists. The difference between the economists' rational individual and the real humans we all know and love was perfectly captured by the so-called *ultimatum game*. In this game, two players are given a small sum of money to divide between themselves. Player A proposes how to divide the sum and player B can either accept or reject the proposal. If the second player accepts, they split the money as agreed and each gains a share of it. If he rejects, both walk away with nothing.

Now, if ultimatum game participants were wholly rational and strictly intent on maximizing their own utility, we should expect player A to propose a split that's grossly in his favor – say, 80% or more. And since

player B is also rational, he should accept anything above zero really, because the alternative – getting nothing – hardly maximizes his utility in the situation. But common sense tells us that real people don't behave that way. Even in the experimental setting of the ultimatum game, people tend to observe rules of fairness and the most common proposal is a fifty-fifty split, while proposals where player B gets less than 20% of the money are routinely rejected. Clearly, the players' sense of fairness in dealing with each other trumps their rationality or any utility maximizing impulse.

But since expressing soft concepts like *fairness* mathematically isn't practical, economists prefer to study a termite-like humanity that does not and never did exist. As a fuzzy, social science, economics has offered sufficiently compelling narratives about the affairs of human societies to be accepted as a legitimate science. As such, it has over the centuries mobilized the creative energies of many great minds who made important contributions to our understanding of how the world works. But in its quest for exactness, it has in part become a jumble of superfluous and often misguided intellectual pursuits. To the extent that its objective is to predict future outcomes, it is unlikely to ever succeed. The following cases offer telling examples of this failure.

Economists and their forecasts

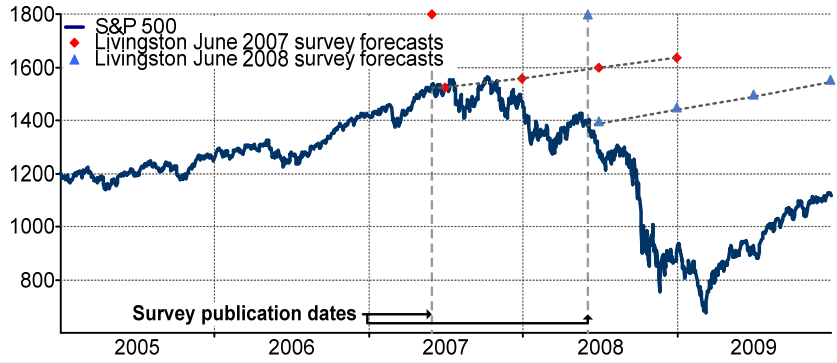
In January 2019, the Wall Street Journal surveyed about one thousand energy market experts and asked them to project the price of oil over the next four years (through 2023). Most of these experts' forecasts were clustered between $65 and $70 per barrel, only slightly higher than where the barrel was trading at that time. But by April 2020, the oil price would tank nearly 80%, an event that virtually nobody saw coming. This case speaks to the impossibility of predicting large-scale price events – the evidence of which we encounter all the time.

Twice a year since 1946, the US Federal Reserve Bank of Philadelphia publishes the Livingston Survey which summarizes the forecasts of 31 prominent economists from industry, government and leading academic and financial institutions. These panelists regularly submit predictions about significant economic indicators including Gross Domestic Product, the unemployment rate, interest rates and the S&P 500 stock market index. Only three months before the onset of the year 2000 recession, these forecasters saw no signs of the imminent economic downturn and stock market collapse. Their forecasts of the unemployment rate, GDP growth and the level of S&P 500 index were widely off mark.

Livingston Survey of 31 prominent forecasters, conducted in 2000 by the Federal Reserve Bank of Philadelphia				
Forecast for:	2001		2002	
	Forecast	**Actual**	**Forecast**	**Actual**
Unemployment	4.3%	4.8%	4.5%	5.8%
GDP growth	3.1%	0.8%	3.4%	1.9%
S&P 500 at year end	1490	1145	1639.5	899
Source: Federal Reserve Bank of Philadelphia				

The next, 2007-2009 recession and the 2008 market crash caught them equally unawares. The survey released in June 2007, five months before the onset of the recession, stated that *"the panelists think that real GDP will grow 3.0% annually over the next 10 years."* They also projected that the S&P 500 index, which traded just above 1500 at the time, would rise to 1600 by June 2008 and 1635 by the end of 2008. In fact, by June 2008, the S&P 500 dropped to around 1400. In light of these events, the Livingstoneans duly revised their next batch of forecasts, only this time they got it even wronger: the S&P 500 lost another 700 points, collapsing nearly 50% below the level predicted by these prominent economists.

Exhibit 3.1: Stock markets always rise in a straight line – Livingston Survey forecasts for the S&P 500 index

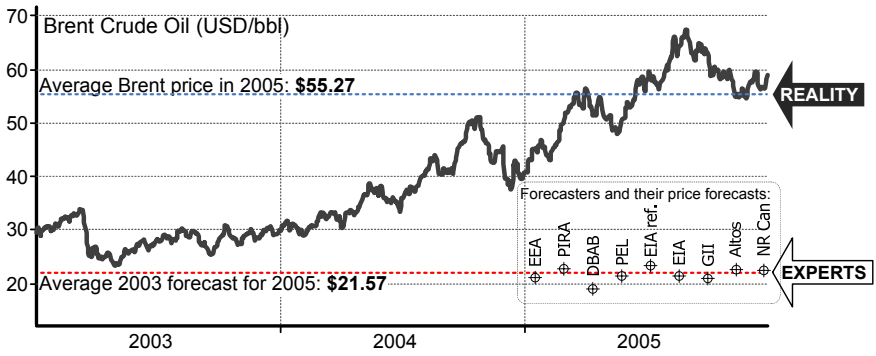


The Livingston Survey, published in December and June of each year, makes economic forecasts for the end of the current quarter and future periods, in half-year time lapses. The forecasts are based on surveys of 31 leading economists from industry, academia and financial institutions. The above chart interposes the S&P 500 level forecasts from June 2007 and June 2008 surveys, plotted against the actual values of the index.

In addition to commissioning surveys, the U.S. Federal Reserve itself retains several hundred economists[24] who gather economic data and feed it into elaborate economic models that seek to describe how the economy works through complex mathematical algorithms. These impressive troops of learned economists and sophisticated models they built have equally failed at predicting on important occasions. As hedge fund manager Paul Singer expressed it ever so impolitely in his October 2013 letter to investors, "… the Fed's models and predictions were catastrophically wrong about the financial system, financial institutions and risks in the period leading up to and during the [2008] financial crisis."

The seeming impossibility of successful prediction of economic growth, employment or stock markets is consistent with economists' inability to forecast future commodity price levels as well. The oil market, the world's largest and most closely studied commodity market, offers another example of the failure of forecasting. Every year, the U.S. Energy Information Administration (EIA), the statistical and analytical agency within the U.S. Department of Energy, publishes an exhaustive report titled International Energy Outlook which, among other things, provides long-term oil price forecasts. The forecasts are generated by the EIA as well as a group of the industry's leading research institutions.

Exhibit 3.2: Commodity prices don't ever change much – EIA 2003 oil forecast for 2005



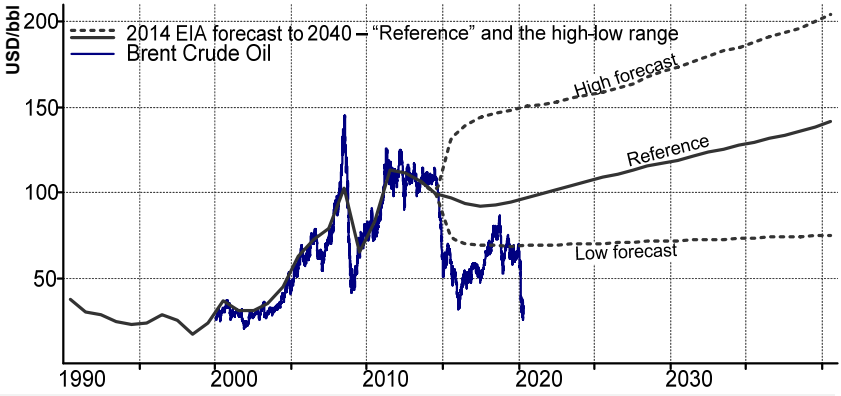
Forecasts of the average 2005 oil price submitted in 2003 to Energy Information Administration by eight leading research institutions. In 2005, the oil price rose more than 150% above these institutions' average forecast.

[24] According to some reports in 2012, the total number was about 730: 189 worked for the Federal Reserve Board, another 171 at different regional banks; adding in statisticians and support staff – generally also economists, the total arrives at 730. (Source: "How the Federal Reserve Bought the Economics Profession" by Ryan Grim, Huffington Post, 23 October 2009.)

In 2003, as oil was still trading between $20 and $30 per barrel, all the forecasts submitted to the EIA[25] for 2005 were clustered between $19 and $24 per barrel. Indifferent to these authoritative predictions, crude oil continued rising with the year's average vaulting to over $55 per barrel – 2.5 times higher than the average expert forecast. Realizing perhaps the futility of generating exact price forecasts, the EIA changed the way it presented its oil price forecast. In more recent years, the EIA tried predicting the future of oil prices in a broadening band between the high and low world price. As it extends into the future, this high-low band widens covering as much as $80 per barrel and more.

With such a very broad brush, EIA would be much more likely to hit the right answer. Sadly, this approach underscored the limitations of forecasting even more starkly: while its 2014 forecast projected the low oil price falling no lower than about $70 per barrel, within two years – by January 2016 the actual price dipped below $30 and remained below $70 through 2020!

Exhibit 3.3: Perhaps if we tried with a really broad brush? EIA forecasts of North Sea Brent prices, 2014 – 2040



EIA forecast range published in EIA's International Energy Outlook 2014, plotted against the actual Brent Crude Oil price.

EIA's forecasts, based on the best information in the industry and on inputs from the most highly reputed petroleum analysis institutes in the

[25] The forecasts were produced by Altos, DBAB (Deutsche Bank Alex Brown), EEA (Energy and Environmental Analysis), EIA (Energy Information Administration), IEA (International Energy Agency), GII (Global Insight, formed in Oct. 2003 through the merger of Data Resources Inc. and Wharton Econometric Forecasting Associates), NRCan (Natural Resources Canada), PEL (Petroleum Economics), and PIRA. Source: Energy Information Administration "*International Energy Outlook 2003*."

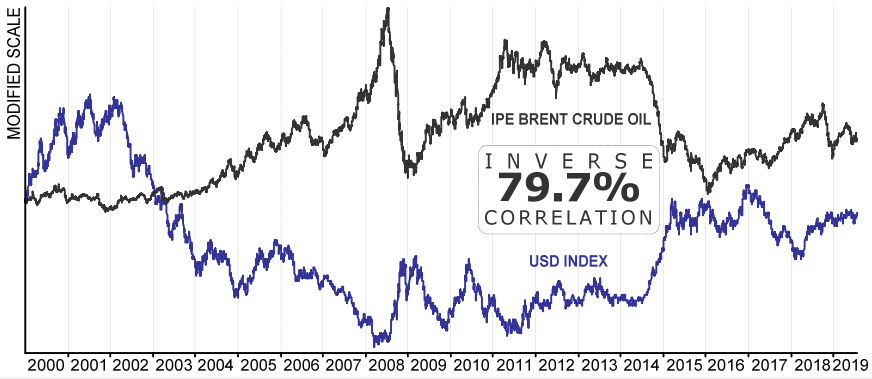
world, has proven badly wrong almost from the day it was published and it's been mostly wrong for over seven years!

The unit of account conundrum

Security prices and forecasts are always expressed in some unit of account – US dollar, yen, euro, etc. The currency unit is usually assumed to be a solid foundation on which to measure the relative worth of output, consumption and investment. But every currency is itself subject to fluctuations that can and do affect the nominal prices of financial securities and commodities. Even if the supply and demand of a given commodity were fixed in perfect equilibrium, its price would likely still fluctuate because of the changes in the currency's relative value.

The oil market offers a good illustration again. Oil prices are almost universally expressed in US dollars per barrel. While it would be difficult to measure the US dollar's impact on oil prices, we can easily measure their correlation. Over the past 20 years, there's been an almost 80% inverse correlation between the US Dollar Index and the price of crude oil: as the dollar weakened, oil prices have tended to go up and as it strengthened, oil prices tended to fall. The relationship is quite apparent when we plot the two time series together:

Exhibit 3.4: US dollar and the price of oil – the strongest relationship



For over 20 years, US dollar's relative strength has been the strongest influence on the price of oil, far eclipsing any supply and demand fundamentals

Thus, the relative strength of the US dollar has been the single greatest influence on oil prices, far eclipsing all other elements determining the supply and demand economics. In spite of that, this clearly discernible 'elephant in the room' barely ever gets a mention among the learned market analysts. That could be because acknowledging the relationship between oil price and the dollar would greatly complicate their jobs and

put their expertise in doubt. To try and forecast future price fluctuations, oil analysts would have to take into account the state of the US economy relative to other nations, inflation, Federal Reserve's monetary policy, government's fiscal policies, etc. The sheer complexity of interrelatedness among all these factors easily overwhelms anyone's ability to digest them.

The very real groupthink problem

To make things a bit more complicated still, forecasts are also subject to psychological (or reputational) issues among the forecasters. In January 2019, Reuters asked over one thousand energy market professionals to predict future oil prices. These experts thought that the barrel would average between $65 and $70 through 2023. Just like the EIA's forecasts in 2003, the projected values clustered in a relatively narrow range, only marginally higher or lower than the current prices at the time. This indicates a certain groupthink that appears to prevail among the most prominent market analysts.

From their point of view, there's a valid reason for this. Namely, forecasts affect their publishers' reputations. The farther analysts stray from the crowd, the greater the risk: if they get it wrong, and not just by a little bit, they could jeopardize their reputation or even become the object of ridicule. Thus, even if in 2003 some bold analyst correctly estimated that oil prices would more than double through 2005, their firm would be unlikely to publish such a forecast. From an institution's point of view, it's much safer to be wrong along with everyone else.

Almost (but not quite) as good as tossing a coin

Market forecasting is indeed so daunting that we shouldn't be surprised that it basically doesn't work – we even have a bit of empirical evidence for that thanks to a rather admirable study conducted by the Manassas, Virginia based CXO Advisory Group. From 2005 through 2012 CXO tracked over 6,500 forecasts for the U.S. stock market provided by 68 experts including such names as Marc Faber, Jeremy Grantham, Laszlo Birinyi, John Mauldin and Charles Biderman.[26] Their report found that for all graded forecasts, only 46.9% were accurate – *almost* as good as tossing a coin! This study confirms what we might have expected: that even the world's most learned market analysts with decades of experience, many of them armed to the teeth with all the information resources and computing horsepower money can buy, still can't average better than fifty-fifty.

[26] "Guru Grades" CXO Advisory – www.cxoadvisory.com/gurus/ (last accessed 18 April 2015).

The brick wall of complexity

Forecasting is based on either implicit, or explicitly formulated economic models. To be workable, such models must reduce the complexity of the real, actual economic relationships and adopt numerous assumptions about the state of the world, such as economic growth rates, population growth, consumer demand, government deficits, inflation rate, geopolitics, wars, revolutions, natural disasters, etc. If any one assumption proves wrong, the model in question will be off the mark. A relatively new field of mathematics called Theory of Computation provides an illuminating perspective in this regard. This theory concerns itself with so-called effectively computable algorithms and studies complex, non-equilibrium systems as if they were computers carrying out algorithms.

The science of complexity considers all living systems, from the life of a single cell to human society and its economic systems, as non-equilibrium, or dissipative systems. These are systems that require a constant flow of mass or energy (or both) to sustain the ordered structure. In this sense we can think of economic structures as being maintained in an ordered state by the constant flows of capital, labor, goods and services. For a whole range of human endeavors, the ability to accurately predict the behavior of non-equilibrium systems like the economy, climate, earthquakes or volcanic eruptions, could be immensely valuable. Nonetheless, we are unlikely to ever achieve any consistent rate of success. This is not due only to inaccuracy of information, limitations of knowledge, or the available computing horsepower, but also due to the impossibility of modelling complex systems in sufficient detail.

This is the hypothesis of the theory of computation. According to Santa Fe Institute's physicist Stuart Kauffman, the theory shows that "*in most cases by far, there exists no shorter means to predict what an algorithm will do than to simply execute it, observing the succession of actions and states as they unfold.*" [27] Stated otherwise, an algorithm is its own shortest description. In computer science terminology, it is *incompressible*. Likewise, our economic systems and markets may well be incompressible and probably represent their own shortest descriptions. People frequently counter this idea by raising the subject of weather forecasting and point out that meteorologists have become very good at predicting weather and in particular, hurricanes. It is true that hurricane forecasts have greatly improved over the last few decades and the 24 and 48 hour forecasts of their *trajectories* tend to be fairly good. This is because the trajectory of hurricanes is determined by a number of major factors:

[27] Kaufmann, Stuart. At Home in the Universe: the Search for Laws of Self-Organization and Complexity. Oxford: Oxford University Press - 1995.

Theory of Computation and the Human Brain

Study of the human brain reveals the many difficulties scientists face in analyzing complex systems. In spite of our deep fascination and desire to understand the brain, our knowledge of this complex organ remains relatively modest. To unlock its deeper mysteries, scientists have increasingly turned to computer technology, to try and simulate its various functions and better understand its architecture and functioning. On the 2nd April 2013, U.S. President Barack Obama unveiled "the Brain Initiative," the most ambitions project yet to map the inner workings of the human brain. In Mr. Obama's words, the project's objective was to give scientists "*the tools they need to get a dynamic picture of the brain in action and better understand how we think and how we learn and how we remember*." That knowledge, said Mr. Obama, "*will be transformative*."

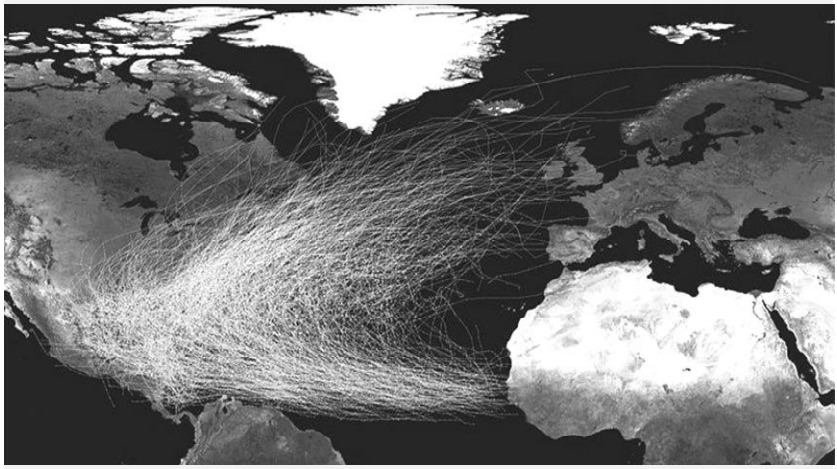
That may seem like an exciting prospect, but here's a bit of perspective: in August 2013, only a few months after this grand announcement, a team of Japanese and German scientists working at Japan's RIKEN Advanced Institute for Computational Science in Kobe proclaimed that they completed the largest-ever simulation of brain activity using a machine. The simulation was run on Japan's "K" computer built by Fujitsu. K was ranked the world's fastest supercomputer in 2011 and remained among the world's top five in 2013. It consists of 82,944 processors and has a memory capacity equivalent to that of 250,000 personal computers.

The simulation involved 1.73 billion virtual nerve cells connected by 10.4 trillion synapses. That may all sound rather impressive, except, it took K about 40 minutes to complete a simulation of one second of neuronal network activity. Furthermore, while K simulated 1.73 billion neurons, the average human brain is believed to have about 100 billion neurons. In other words, one of the world's fastest supercomputers needed 40 minutes to simulate only a single second of the activity of less than 2% of the average human brain. To be sure, this wasn't an exact replica of a chunk of the actual brain but a rather crude model in which neuronal synapses were connected randomly. By the scientists' own admission, the simulation was only meant to "test the limits of the simulation technology," developed under the project.

The really useful aspect of this simulation was to show just how very far we are from simulating anything resembling the real human brain. Supercomputers will surely keep getting more and more super, but the point in time when they will be able to accurately replicate the functioning of the human brain in real time is very far – possibly infinitely far in the future.

the earth's rotation which causes hurricanes to predictably move from east to west until they approach the large area of high atmospheric pressure usually present around the Bermudas. "The Bermuda High" causes them to swerve northwards near the Atlantic coast of the US, and from there, the Gulf current conveys them North-Eastward. The relative stability of these elements gives hurricanes a somewhat predictable trajectory as we can see in the map below:

Exhibit 3.5: A (somewhat) predictable path?



Atlantic tropical storm trajectories (1851 – 2005)
Source: Wikimedia commons <https://upload.wikimedia.org/wikipedia/commons/3/31/Atlantic_hurricane_tracks.jpg>

However, in spite of climate scientists' vast and detailed knowledge about the formation of hurricanes and in spite of advanced technologies that enable real time monitoring within the storms, our ability to predict their structure and *intensity* is not even good. We can still never be sure about which disturbances will grow into hurricanes and which ones will dissipate or pass with only minor rainstorms. The mind numbing advances in computer modelling of the storms have enhanced meteorologists' ability to work out probable outcomes, but not accurate prediction.

The 'sensitive dependence' problem

An impossible problem also lies in the complex models' sensitivity to input data. Namely, very small differences in the values of initial variables can lead to very large variations in outcomes. The seemingly insurmountable theoretical problem in modelling complex systems was discovered by MIT's theoretical meteorologist Edward Lorenz. Lorenz

developed a computer model to emulate the weather. One day in 1961, Lorenz decided to rerun the results of one particular simulation starting at its mid-point. As data inputs, he used the results for that point he had from his print-outs. The new simulation quickly started diverging from the original results and soon bore no resemblance to it. The ultimate explanation for this divergence had profound implications for science: while Lorenz's program took its calculations to six decimal places, his print-outs only showed the values to three decimal places. The minute difference between, say 1.234567 and 1.235 applied in the second simulation led to very large differences in the final results. Lorenz termed this phenomenon, "sensitive dependence on initial conditions." This implies that all complex systems likely have a similar sensitivity, which makes the problem of accuracy of measurements yet another stumbling block in science's attempt to get to the bottom of such systems. Indeed, accurate prediction will likely remain unattainable in spite of the advances in all areas of research. As the director of the National Hurricane Center, Bob Sheets put it, "*The grid*[28] *for the computer models does keep getting smaller and smaller, but we're still taking in terms of miles, while the actual weather is taking place at the level of molecules.*" [29]

Both in natural sciences and in economics, our efforts to predict how a complex system will behave are up against a brick wall of complexity. For traders and investment managers, as well as for policymakers, this has sobering implications. It is hard to escape the conclusion that the whole business of economic forecasting amounts to educated guesswork at best. At worst, it could be less than useless. In spite of this, a majority[30] of investment managers report that they rely most heavily on economic forecasts for their investment decisions. This could help explain another phenomenon that we will explore in the next chapter.

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[28] Climate scientists have advanced by modelling the Earth's atmosphere as three-dimensional grids consisting of a number of horizontal data points stacked in a number of atmospheric layers. One of the first such models was developed in the mid-1950s by the US Weather Bureau. It consisted of a single level of the atmosphere at about 5,500 meters and data points spaced 248 miles apart. In the 1990s, the National Oceanic and Atmospheric Administration developed a model that analyzed data at 18 levels of the atmosphere within three nested grids, the finest of which covered 345 square miles with data points 11.5 miles apart: 16,200 points receiving data in time steps of 15 seconds.

[29] Sheets, Bob and Jack Williams. "Hurricane Watch." New York: Vintage Books - 2001.

[30] That would be over 60% according to a 2006 global survey of asset managers and pension funds from 37 countries managing some $30 trillion in assets co-sponsored by T. Rowe Price Global Investment Services Limited and Citigroup. Questioned about what would drive their investment decisions over the next five years, the majority of respondents indicated they would most heavily rely on the "medium term outlook in the bond markets," (67%) and "global/regional economic prospects" (62%).

Chapter 4: Expertise and Performance

> *After nearly 50 years in this business I do not know of anybody who has done it successfully and consistently. I don't even know anybody who knows anybody who has done it successfully and consistently.*
>
> *Jack Bogle*[31]

During a trip to Russia in 1993, one William Browder, working as a consultant with Solomon Brothers, discovered that the whole of the Russian economy – a treasure trove containing some of the world's most abundant reserves of natural gas, oil, coal, iron ore, tin, lead, gold, silver, diamonds, timber, rare earth minerals and arable land – was being privatized at a valuation of $10 billion. This was equivalent to one sixth of Wal Mart's market cap at that time, a discount of well over 99% on the book value of the assets being sold. The government of President Boris Yeltsin imposed no restrictions on who could purchase the privatization vouchers.

Browder rushed back to Salomon Brothers in London, his employer at the time, to try to convince his bosses and colleagues that they were "giving money away for free in Russia." But his co-workers showed very little interest. None, writes Browder, "*could divorce themselves from their own narrow mind-set… for weeks I just kept presenting my idea over and over, hoping that by repetition I would eventually get through to someone. … Instead, I completely ruined my reputation inside Salomon Brothers. No one wanted anything to do with me because I was that 'crazy fuck who wouldn't shut up about Russia.'* "[32] Ultimately Browder set up

[31] Jack Bogle, the founder of the Vanguard group speaking about the ability of managers to outperform market indices through market timing.
[32] Browder, Bill. "Red Notice." London: Penguin/Random House – 2015.

his own hedge fund, Hermitage Capital Management, which became one of the world's best performing emerging market funds, gaining 2,679% from 1996 through December 2007.

In 2012, 15 year-old Jack Andraka made an invention and wrote to 200 top doctors and cancer researchers at the National Institute of Health and Johns Hopkins University. He discovered a new test for lung, ovarian and pancreatic cancer which was 168 times faster, 26,000 times cheaper, and over 400 times more sensitive than the standard test used by doctors. He received 199 rejections and only one acceptance.

Browder's and Andraka's stories have two elements in common: a compelling investment opportunity and an astonishingly myopic reaction on the part of supposed experts who should have been interested in such an opportunity. As Browder presented his Russian discovery to investment professionals at Salomon Brothers, virtually all ignored him or peppered him with irrelevant questions about trading spreads on privatization vouchers or advisory fees that could be earned on investment deals.

Jack Andraka's story shows an even more egregious failure of expertise. A fast, sensitive and accurate cancer test costing only $0.03 vs. nearly $800 for the standard test is an innovation which at the very least, deserves a second look. The fact that 99.5% of experts failed to recognize this innovation may have had something to do with Andraka's age. However, this in no way absolves the failure of their expertise. An expert should be able to judge a case on its merit and take the correct decision regardless of who presented the case.

The value of expertise

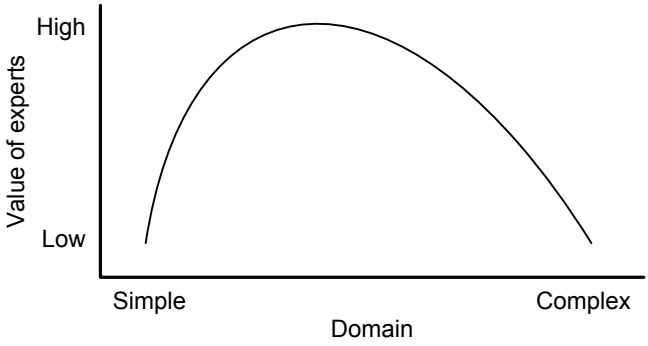
Expertise is an important subject in many, if not all domains of human activity, and this includes investing. To negotiate the complexities of our world, we tend to rely on the opinions and judgments of experts for many of the decisions we must take along the way. Expertise gives us a refuge from uncertainty and reassurance when a person knowledgeable in some domain helps us resolve our dilemmas. In many cases, this makes perfect sense. I'd rather not attempt to pilot a jumbo jet or set a broken bone myself – I'm quite happy to rely on the expertise of a trained pilot and a qualified physician in such situations.

In organized economic life where fragmentation of function and specialization have become pervasive, the reliance on expertise has become indispensable. In "Risk, Uncertainty and Profit," Frank Knight writes that, *"In the field of organization, the knowledge on which what we call responsible control depends is not knowledge of situations and problems and of means for effecting changes, but is knowledge of other*

men's knowledge of these things. So fundamental to our problem is this fact that ... the problem of judging men's powers of judgment overshadows the problem of judging the fact of the situation to be dealt with." Indeed, sourcing experts, consulting their know-how, and using their services has become critical to our ability to solve most of our problems in daily life. So accustomed have we become to relying on experts that we don't always discern whether their expertise actually provides the value we seek.

An expert's ability to provide value depends in part on the kind of problem we need to address and the domain in which this problem arises. In his 2005 paper titled, "Are you an expert?" [33] Michael Mauboussin proposes that problem solving domains span a continuum from simple, rule-based systems (like credit scoring and simple medical diagnosis[34]), to highly complex systems that can't easily be reduced to a finite set of rules (economic forecasting and stock market investing).

Exhibit 4.1: Where experts add value



Michael Mauboussin proposes that experts provide the greatest value in moderately complex domains.

Mauboussin suggests that experts tend to add the most value in moderately complex domains, but not in the simplest ones where machines can do the job better, cheaper and faster. Experts are valuable in domains that are too complex for simple algorithms to carry out, but as the complexity of the problem-solving domain increases, the value of expertise begins to diminish and in the most complex domains, expertise is again of little

[33] Mauboussin, M. "Are You an Expert?" Legg Mason Capital Management, 28 Oct. 2005.
[34] This strikes me as an unfortunate choice of examples; I'm not sure that very much of medical diagnosing is simple, unless we're talking about injuries like torn ligaments, broken bones, contusions or burns.

value. I partly disagree with the conception of expertise as Mauboussin presents it. Part of the problem lies in how we recognize expertise in the first place.

What is expertise?

Typically, we recognize trained meteorologists or physicians as experts, but not fishing boat captains or nurses. This dependence on academic credentials and labels as a way to recognize expertise will often prove mistaken. Experts *can* add value even in very complex domains, but this depends on whether they can arrive at their judgment by directly observing the relevant situation or not. Weather prediction falls into the most complex category of problems but expertise can be of considerable value here. An experienced sailor can make fairly good near-term predictions about the weather fronts coming his way simply by observing cloud formations, wind, humidity, and possibly a myriad of other subtle clues like the pain in his joints.

This, in fact, was how the first recorded forecast of an approaching hurricane was made.[35] While sailing in the West Indies in July 1502, Christopher Columbus watched cirrus clouds moving over the sky from the southeast and an unusually long ocean swell coming from the same direction. He also saw a large number of dolphins leaping from the water at the mouth of the Ozama river just outside the Santo Domingo harbour. In the ten years since his first journey to the West Indies, Columbus learned much about tropical weather. On his second journey to the region in 1495, a similar set of clues preceded a storm that ended up sinking two of the three ships under his command.

Taught by experience, Columbus now expected a large storm and sent a warning to the governor of the Spanish colony asking him to delay the dispatch of thirty ships that were due to sail for Spain and to keep them sheltered until after the storm's passing. The governor was Columbus's rival for the favors of the Spanish crown and to spite Columbus, he disregarded the warning and sent the armada off toward the homeland. Two days later, the storm caught up with the fleet and within hours, 21 of the ships and over 500 sailors were lost. Columbus himself was denied access to the Santo Domingo harbour, but he anchored his four ships in a sheltered bay and all four survived the storm intact.

Another complex domain where expertise can be demonstrably valuable is medical diagnosing. The human body is a complex system and when something is wrong, determining the cause requires a high degree of expertise (unless we're talking about a simple defect like a cut or a

[35] Sheets, Bob and Jack Williams. "Hurricane Watch." Vintage Books, New York 2001.

sprained ankle). In 1989, Beth Crandall of Klein Associates studied how intensive care nurses make decisions.[36] Crandall interviewed 19 nurses who cared for new-borns in distress at the neonatal ward of Miami Valley Hospital in Dayton, Ohio. One of the situations such facilities regularly deal with is the risk of septic infections in premature babies. Sepsis can spread rapidly throughout their bodies and kill them. Recognizing the infection quickly is critical in saving their lives. The nurses' testimonies indicated dozens of cases where this condition was recognized upon a glance and emergency measures were taken, saving the baby's life. When asked how they knew the baby was succumbing to an infection, the nurses invariably replied, "you just know."

Upon further investigation, it emerged that the nurses were able to instantly recognize a variety of cues – some of them extremely subtle – that indicated that a baby was in the early stages of an infection. But when Crandall went over the list of cues with specialists in neonatology, she found that half of these cues were not even described in the medical literature at the time. The nurses, which many of us might not recognize as experts, really *just knew*. And by saving the babies' lives, their expertise clearly provided the greatest conceivable value even though they were dealing with a complex problem. The reason they were able to do this – besides their training and experience – was because they had timely access to the needed information: they were able to observe the babies directly and in the real time, just as Columbus was able to directly observe the weather cues in his immediate environment.

Had Columbus and the nurses been limited in their reading of the situation to numerical measurements and statistics, they would be looking only at a very rough sketch of the actual conditions, leading perhaps to very different decisions and fewer happy endings. This is the handicap that economists and investment professionals have with regards to their domain of expertise. Market professionals have no way to directly observe the economy or the markets in the same way a seafarer can observe the weather. Instead, they largely depend on the rough – and often distorted – sketches of the economic system through various econometric measures, statistics, prices and the news flow. It should hardly be surprising that their expertise adds little value if any at all. We know in fact, that in most cases market experts tend to destroy value.

Investment experts

We know that most market experts tend to destroy value because a very large body of empirical evidence tells us so. That evidence consists of

[36] Breen, Bill. "What's your intuition?" FastCompany issue 38 - September 2000, p 290.

accurate and objective performance track records for thousands of managers. Our departure point in analysing their performance are market indices like the S&P 500, Eurostoxx 50, or Nikkei 225. These benchmarks give us a proxy for the aggregate valuation of various global stock markets.

Over the past 100 years or so, stock markets have mostly trended up, in spite of periodic crashes and corrections. In this sense, stock markets generated economic value for investors over time, enabling them to benefit even if they invested only passively. Passive investing requires very little expertise and generates results that correspond with the overall performance of the overall market. From this base, we might expect that expertise in stock selection and market timing should enable active investors to outperform[37] their benchmarks over time. Because this is such an enticing goal, the investment management industry deploys staggering resources in trying to achieve it. Many of the active fund managers are among the best educated, most experienced and highest paid professionals in the world, with vast information resources and analytical talent at their command. The question is, does all that expertise actually lead to superior performance? In most cases, the answer is, no.

For decades now, one study after another found that active asset managers have had a fairly robust tendency to fall short of their benchmarks. The studies consistently paint a picture that can be summed up as follows: in any given year about two thirds of all active managers underperform their benchmarks. Most of the managers who do outperform in any given year fail to repeat their success from one year to the next. Measured over longer time periods, as many as 85% or more of the world's investment managers underperform relative to their benchmarks.

REPORTS SPIVA U.S. Scorecard

Report 1: Percentage of U.S. Equity Funds Outperformed by Benchmarks

FUND CATEGORY	COMPARISON INDEX	1-YEAR (%)	3-YEAR (%)	5-YEAR (%)	10-YEAR (%)	15-YEAR (%)
All Domestic Funds	S&P Composite 1500	63.43	83.40	86.72	86.65	83.74
All Large-Cap Funds	S&P 500	63.08	80.56	84.23	89.51	92.33
All Mid-Cap Funds	S&P MidCap 400	44.41	86.34	85.06	96.48	94.81
All Small-Cap Funds	S&P SmallCap 600	47.70	88.83	91.17	95.71	95.73

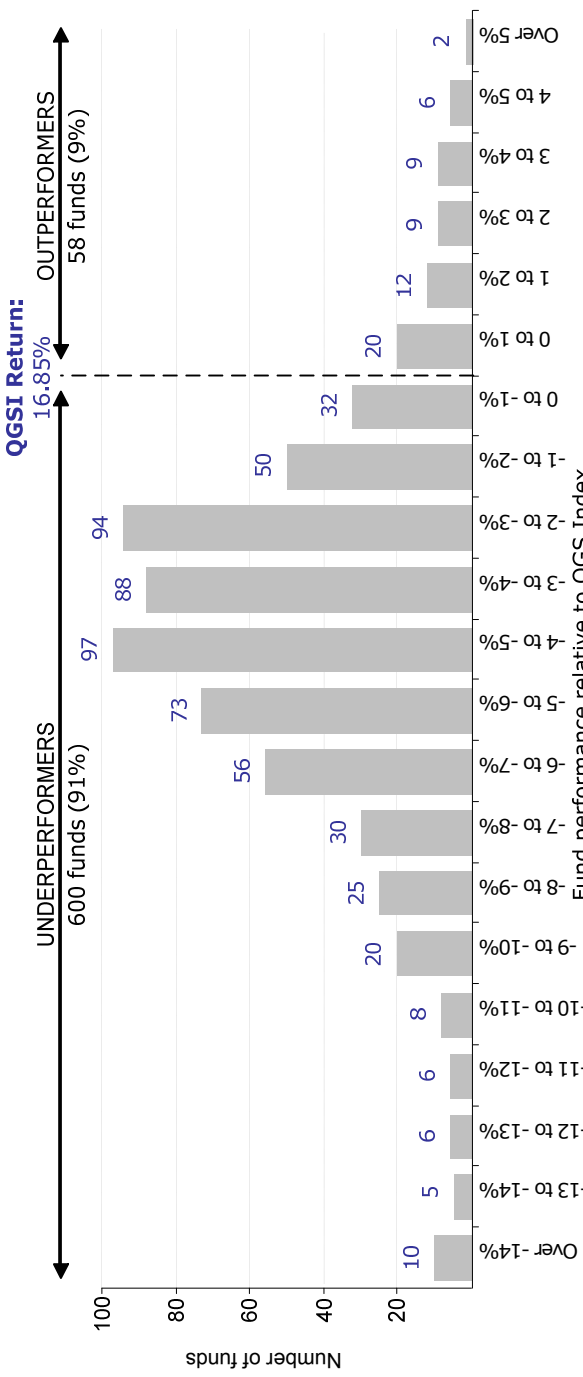
Active managers in various fund categories who underperform their benchmarks.

Source: S&P Dow Jones Indices - www.spglobal.com

The largest of these studies is the "SPIVA U.S. Scorecard" published semi-annually since 2003 by the S&P Dow Jones Indices research. The table above summarizes the 2017 year-end results. These are largely consistent from year to year and with other similar studies done in the past.

[37] In investment management-speak, this added value is referred to as alpha.

Exhibit 4.2: Expertise does not add value – most active managers underperform



Daniels and Alldredge compared the performance of 658 global stock funds to the Quantindex index, which includes securities from all developed and developing nations. Over a 10-year period (1987-1997), 91% of funds failed to match the index, many falling short by a very wide margin.

But while they reveal the reality of how few active managers succeed at outperforming their benchmarks, they omit an important insight: the distribution of managers' performance: how many managers outperformed or underperformed and by how much. We got this insight from a study by the investment advisory Daniels and Alldredge (see exhibit 4.2), which quantified the performance of 658 global equity funds over a ten-year period and compared it to the QGS Index of securities from all developed and emerging markets.[38] Besides the fact that only 9 percent of all funds outperformed the QGS Index, two other significant points stand out from Daniels and Alldredge data.

First, the performance range spans more than 14 percentage points below the benchmark, but only 6 percent above it. This suggests that managers' tendency to underperform is much greater than their ability to outperform. Second, the distribution has a fat tail, but only on the left side. Thus, while there is some likelihood of very poor performance (ten managers falling short by 14 percent or more), achieving high positive performance is limited (none of the managers outperformed by more than 6 percent). What this tells us is that consistent outperformance is a difficult and unlikely achievement. Given that all the managers sampled in all these performance studies are experts in their domains, supported by professional staff and armed with advanced information and analytics tools, the fact that on the whole they have a robust tendency to underperform their benchmarks leads us to the conclusion that expertise *does not* add value in investment speculation – to the contrary, it actually destroys it.

[38] Malkiel, Burton and J.P. Mei, "Global Bargain Hunting" New York: Touchstone, 1999

Chapter 5: Quantitative Investing

As people get the data and learn how to use the data, I think there is going to be alpha generated and therefore, will give active managers more opportunity than they've had in the past to actually create returns.

Rob Capito, Black Rock[39]

Trained economists have never seen a really first-class model. ... In finance, you're playing against... agents who value assets based on their ephemeral opinions... When you take on other people, you're pretending you can comprehend other pretenders...

Emanuel Derman

Investing is a speculative endeavor fraught with risk. As we have explored thus far, the domain is highly complex and its information universe unreliable and to a significant degree distorted. The insurmountable problem of uncertainty makes it very difficult and unlikely to harness market expertise in order to generate consistently superior performance.

[39] Rob Capito, President of the investment behemoth Black Rock made these remarks at a Barclays conference in September 2016. Source: Durden, Tyler: "BlackRock's Robo-Quants Are On Pace To Post Record Losses" – ZeroHedge, 11 January 2017.

To try and overcome these challenges, many market professionals have turned to *quantitative* or algorithmic trading. Indeed, the last decade saw something of a gold rush into quantitative investing strategies. Their benefits are numerous and rather obvious. For example, they offer a solution to our imperfect knowledge about markets and the impossibility of forecasting asset prices. Quantitative strategies can also eliminate rogue trader risk by imposing decision making discipline. Where trades can be executed directly through electronic trading platforms, they can bypass human action almost entirely. Further, because they are based on mathematical algorithms, we can back-test their performance over historical market data to gauge the performance we might expect in the future. In addition, by virtue of running on computers, algorithmic strategies are accurate and fast, capable of running round the clock without ever losing focus or needing a break. All these perceived benefits significantly boosted the industry demand for quantitative analysts, or quants.

Advantages of quantitative strategies	
Solution to imperfect knowledge	Quantitative trading does not require perfect knowledge about markets or correct forecasts. Data, a valid hypothesis about markets, and a working model can suffice to generate trading decisions
Decision making discipline	A well modelled algorithm won't lose composure and insist that it is right when markets go against it; it will simply continue to operate according to the predetermined set of rules.
Objective measure of expected performance	Quantitative strategies can generally be back-tested providing an objective measure of success against which we can measure future performance.
Focus	Algorithms don't get distracted. They remain 100% focused on executing their strategy (for as long as they're plugged in)
Work ethic	Algorithms don't get tired, call in sick, take vacation or ask for a raise.

However, quantitative investing also involves considerable challenges and risks. These partly stem from the conceptual nature of the problem and from practical difficulties involved with modelling trading algorithms.

Conceptual issues

In formulating quantitative trading strategies, firms typically rely on mathematicians or physicists who work with ideas and theories borrowed

from natural sciences. But while applied mathematics and physics deal with the mechanical properties of natural phenomena, markets reflect the aggregate psychology of their human participants. The difference is very significant. Interaction of inanimate particles or fluids might be sufficiently well understood to make the prediction of certain behaviors possible. By contrast, human conduct doesn't conform to the crisp laws of physics or mathematics. In his book, "My Life as a Quant," physicist and quantitative analyst Emanuel Derman[40] reflects on this point:

> *In physics, the beauty and elegance of a theory's laws, and the intuition that led to them, is often compelling, and provides a natural starting point from which to proceed to phenomena. In finance, more of a social than a natural science, there are few beautiful theories and virtually no compelling ones, and so we have no choice but to take the phenomenological approach. There, much more often, one begins with the market's data and calibrates the model's laws to fit...*[41]

Derman's words encapsulate what is a formidable challenge for quantitative analysts and their employers. Starting with data and working backwards toward a working hypothesis hinges on inventiveness and conceptual thinking in a domain that is complex as well as abstract. Mired in numbers and lacking any tangible concepts to grasp upon, quantitative analysts can easily churn out erroneous hypotheses whose flaws can be very difficult to recognize. In such an environment, intellectual exertion can lead analysts to lose sight of clear thinking and common sense. The more abstract the subject matter, the more ways we have to reach mistaken conclusions.

This is not a trivial problem: in his bestseller, "How the Mind Works," Steven Pinker shows how easily we go off the rails when conceptualizing certain types of problems. For example, psychologists Michael McCloskey, Alfonso Caramazza, and Bert Green asked college students to describe the trajectory of a ball shot out of a curved tube. A "depressingly large minority" of students, including many who studied physics, guessed that the ball would continue in a curving path. Students were even quite prepared to provide scientific explanation for this.[42] Dennis Proffitt and David Gilden asked people simple questions about the motion of spinning

[40] Emanuel Derman had been the chief quantitative analyst at Goldman Sachs for 17 years.
[41] Derman, Emanuel "My Life as a Quant: Reflections on Physics and Finance" John Wiley & Sons, Inc., Hoboken, New Jersey, 2004
[42] "The object acquires a 'force' or 'momentum' which propels it along the curve until the momentum gets used up and the trajectory straightens out."

tops, wheels rolling down ramps, colliding balls, or solid objects displacing water. They found that even physics professors often got their answers wrong unless they were allowed to fiddle with equations on paper. Pinker notes that cognitive misconceptions run deep, but points out that errors tend to arise from "conscious theorizing." When respondents were shown animated illustrations of their answers, they instantly recognized their errors, usually with a burst of laughter.[43] But if conscious theorizing can get us lost in problems as simple as the motion of objects in the physical world, how confident should we be about our comprehension of more complex problems?

In "The Language Instinct" the same Steven Pinker provides an illuminating example from the field of early artificial intelligence research.[44] In the 1970s and 1980s scientists at some of the leading American universities spent tens of millions of dollars attempting to solve the mystery of language in order to enable computers to speak. They based their solutions on the notion that language is a discrete combinatorial system (a finite number of words and a finite number of rules about how to form sentences), and advanced the concept of *word chain device*. Word chain devices would construct sentences by selecting words from different lists (nouns, verbs, prepositions…) based on a set of rules for going from list to list. At the time, some psychologists believed that all human language arose from a huge word chain stored in the brain. In their efforts to generate language artificially, scientists painstakingly calculated the probabilities that certain words would follow certain other words in English language and they built huge databases of words and *transition probabilities*. The following sentence is an actual example of what they got out of all that hard work:

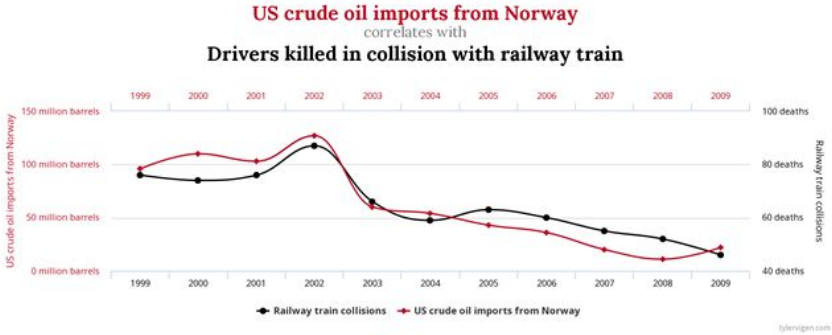
> *House to ask for is to earn our living by working towards a goal for his team in old New-York was a wonderful place wasn't it even pleasant to talk about and laugh hard when he tells lies he should not tell me the reason why you are is evident."*[45]

The output sounds like language, but the whole magic ingredient of meaning never made it into these clever models. It is easy for us to recognize the gibberish flowing out of word chains because our brain was designed to process language and it effortlessly detects the meaning

[43] Pinker, S. "How the Mind Works" W. Norton and Company, New York 1997 (319, 320).
[44] Pinker, Steven. "The Language Instinct," Harper Perennial, New York, 1995
[45] This word-chain model worked by estimating the most likely word to follow after each four-word sequence, growing the sentence word by word.

language conveys. But what our mind was *not* designed to do, is to process mountains of quantitative data. In this domain, we are not equipped to easily discern sense from nonsense and this can lead us to blindly pursue flawed hypotheses.

BIG DATA: A SMALL SAMPLE OUT OF 30,000+ SPURIOUS CORRELATIONS



The above two series are 95.45% correlated. Below are another few examples out of the 30,000 spurious correlations identified between 1999 and 2009 by data scientist Tyler Vigen

SERIES 1	SERIES 2	CORRELATION
U.S. spending on science, space and technology	Suicides by hanging, strangulation and suffocation	99.97%
Divorce rate in Maine	Consumption of margarine	99.26%
Drownings by falling into a pool	Number of films Nicholas Cage appeared in	66.6%
Total revenue generated by Arcade games	Number of computer science doctorates awarded in the U.S.	98.51%
U.S. crude oil imports from Norway	Drivers killed in collision with railway trains	95.45%
Total U.S. crude oil imports	Per capita consumption of chicken	89.99%
Electricity generated by U.S. nuclear power-plants	Number of people who drowned in swimming pools	90.12%
Japanese passenger cars sold in the U.S.	Suicides by crashing a motor vehicle	93.75%

Source: Tyler Vigen: "Spurious Correlations" – http://www.tylervigen.com/spurious-correlations

Mining the elusive 'big data' gems

This problem has become significantly more acute with the rise of so-called 'big data' – a field of research that has developed advanced methods of analyzing extremely large sets of data in order to systematically extract useful information from it. Big data's promise was that it could detect hidden but meaningful relationship patterns in the data and enable its users to make better decisions. While such relationships

indubitably do exist, *big data* has also generated large amounts of information junk: interesting and even amusing, but meaningless correlations. In his 2015 book, "Spurious Correlations" data scientist Tyler Vigen identified more than 30,000 such correlations over a ten-year period between 1999 and 2009.

For example, Vigen found that there was a 99.97% correlation between spending on science, space and technology in the U.S. and suicides by strangulation and suffocation. The number of films actor Nicholas Cage appeared in had a 66.6% correlation with the number of drownings by falling into a pool. The table we saw on the previous page shows another few examples from Vigen's research. Of course, most of these relationships are largely meaningless. But they underscore a very real problem in quantitative research: today, analysts can explore a virtually unlimited universe of possibilities and the very search for high conviction trading strategies has become a time consuming and resource intensive pursuit. Worse, it can induce investors to bet on flawed hypotheses and unstable, fleeting correlations.

Correlation vs. causation

There are many ways we can misconstrue amorphous reams of data. To begin with, we are susceptible to confusing correlation with causation. If some observation B follows the observation A 90% of the time, we tend to assume that there's a 90% probability that B will follow the next occurrence of A. Consider a simple exercise in logic.

Suppose that our price data shows that an event **B** follows an event **A** in 75 out of 100 observations. This might lead us to the conclusion that there is a 75% probability that **B** will follow the next occurrence of **A**. But that conclusion would probably be wrong. To illustrate, suppose we toss a coin 1000 times and mark the results, **H** for heads and **T** for tails, obtaining a string of 1000 characters like this:

…HTTHTHTHHTHHTTTTHHTHHTHHHHTTHTTHHHTT
HTHTHHHTHHTHTTHHTTTHTHTHTHTHHHTHHTTHT
HHTHTHTHHHTHTTTHHTHHHTHTTTHTHTHTHHTHH
TTTHHHTTHTHHTHTHHHHTTTTHTHTHTTTTHTTHTT
TTHHTHHTTHHTHTTHHHTTHHTTHHTTHHTTHHHTHT
THTTTTTHHTHTHHHHHTTHTHTHTHTTTHTHHTHHHT
TTTHHHHTHTHTTTT…

Suppose further that we identify 100 occurrences of the pattern TTTHH which is followed by a T in 75 of the observed occurrences. We can say that in our sample, a T follows TTTHH 75% of the time. But if we take

this to mean that there is a 75% probability of tossing a T after each TTTHH pattern, we'd take a wrong turn. The result of any coin toss is determined by two equally probable and mutually exclusive outcomes: a coin falls either on the head-side or on the tail-side. Therefore, whatever correlations we can mine out of our data series, each successive toss of a coin will always have a 50:50 probability of landing on either side.

The probability distribution of coin tosses is easy enough to grasp. However, our ability to interpret the cause-and-effect relationships in markets is easily overwhelmed by their complexity. Whatever we are capable of reading out of the market data, the figures can only represent a very limited manifestation of the vastly more complex system, and establishing any kind of causal relationship in the data is bound to be highly uncertain.

The struggles with probability

Stephen Jay Gould noted that, "Misunderstanding of probability may be the greatest of all impediments to scientific literacy." A fairly large majority of people, and this includes the experts, have real difficulties interpreting mathematical probability.

Here's an example: at Harvard Medical School, researchers posed a problem to 60 students and members of the faculty. The problem read as follows: a test to detect a disease that afflicts one person in a thousand has a 5% false positive result. What is the probability that a person found to be positive actually has the disease, assuming that you know nothing about their symptoms? The correct answer to this problem is 0.02. The most popular answer was 0.95 and the average answer was 0.56. Among the experts in this group, fewer than one in five got the right answer.[46]

To be fair, we tend to do much better when problems are presented in terms of *relative frequencies* rather than mathematical probabilities. As many as 92% of respondents gave the correct answer when that same problem was formulated as follows: in a given population, one person in a thousand has a disease and 50 of 1000 test positive. How many who test positive actually have the disease? The difference between the two formulations is subtle, but the implication it underscores is very important: we may often fail to grasp the substance of complex quantitative problems and that even experts aren't immune to misconstruing mathematical probabilities and arriving at wrong conclusions. In quantitative analysis of markets, these issues are highly relevant and represent an important source of risk.

[46] Pinker, Steven. "How the Mind Works" W.W. Norton and Company, New York 1997 (344)

Model risk

Even supposing that an analyst has done a good job analyzing the data and formulated a valid hypothesis, he still faces another daunting challenge: building the actual model and making sure that it correctly fulfils its intended purpose. This problem spills into the domain of software programming. Models are normally implemented in software programs that may require thousands of lines of code, large databases and a suitable user interface.

Software programming is a very error-prone business. Professional programmers on average make as many as 100 to 150 errors per 1,000 lines of code. This is according to a multi-year study of 13,000 programs conducted by Watts S. Humphrey of Carnegie Mellon University's Software Engineering Institute. At times coding errors can be extremely difficult to detect – until they cause an adverse outcome. For example, in March of 2013, UK intelligence agency MI5 had to entirely scrap a major IT project to centralize the agency's data stores. The work became such a morass that the agency's director at the time, Sir Jonathan Evans decided to abandon the project altogether and restart from scratch with a completely new team of IT professionals. According to The Independent, the abandonment of the project cost MI5 about $140 million.

In late 1999, the Mars Climate Orbiter crashed into Mars because an engineer at the Jet Propulsion Laboratories failed to convert British measurement units to the metric system. Shortly afterwards, a sister space vehicle, the Mars Polar Lander, also smashed into Mars because the line of software code that was supposed to trigger the vehicle's braking process was missing. In 1996, the European space probe Ariane 5 disintegrated 40 seconds after launch due to an error in the computer program controlling the rocket's engines. The list of similar incidents is long and interesting, including issues with motor vehicles, advanced military hardware and software, communication and navigation technology, airport baggage handling systems, medical diagnosing and treatment systems and just about every other kind of technology that uses computer software to function.

Model risk in financial services

In the financial industry, software errors don't cause things to blow up, so they can remain hidden or even go undetected for a long time. However, every now and again things get bad enough to attract some publicity.

On August 1, 2012, New York brokerage Knight Capital implemented a trading algorithm that in a very short time caused the firm a direct cash loss of $440 million and a market cap loss of about $1 billion. The faulty algorithm bought securities at the offering price and sold them at the bid,

and continued to do this some 40 times per second. Over about thirty minutes' time, the algorithm wiped out four years' worth of Knight Capital's profits. But this is just one of many quant trading blow-ups. Here are another few high-profile cases:

- In June 2010, an international bank's algorithmic trading system acted on bad pricing inputs by placing 7,468 orders to sell Nikkei 225 futures contracts on the Osaka Stock Exchange. While the pricing error would have been rather obvious to any human participant, the trading algorithm proceeded to execute approximately $546 million of the orders before the error was caught.
- In the summer of 2018, the $150 billion asset manager GAM had to freeze fund withdrawals after steep losses at one of its quant funds triggered a surge in client redemptions.
- In 2006, Amaranth Advisors' whiz-kid mathematician, Brian Hunter single-handedly lost $6 billion with his quantitative trading model in Natural Gas derivatives.
- And who could forget the 1998 collapse of LTCM whose all-star team of quants was led by Noble laureates Robert Merton and Myron Scholes.

These quantitative trading debacles are not isolated stories: I believe that model risk events are pervasive, but the vast majority of them remain unknown outside of the firms that experience them.

80% odds of losing

Anecdotal evidence from media stories tell us little about the relative merit of quantitative trading. But one company's experience provides an empirical case study: in December 2006, world's most popular trading platform provider MetaQuotes organized the world's first Automated Trading Competition. The $80,000 prize attracted 258 developers of quantitative strategies. More of them joined over the following six years and through 2012, a total of 2,726 quants competed in MetaQuotes' challenge. Of the 2,726 participants, only 567 (21%) finished their competitions in the black while 79% of them lost money.[47]

More rigorously vetted quants supervised by experienced managers may not be quite such loose cannons, but the MetaQuote experience does indicate that quantitative investing isn't as easy as Black Rock's Rob Kapito's words at the opening of this chapter suggest it might be.

[47] Robson, Ben. "Currency Kings" – McGraw-Hill Education, 2017.

The disconnect

Over the years I personally came across a good many cases where an important part of a firm's business process got bogged down with poorly designed software. In each of these cases, frustration with the software dragged on for years and I am not aware of even a single case where the issues were resolved in a satisfactory way. The usual course is eventually to abandon the software tools and return to the old manual process.

The main reason these things happen is due to the lack of appreciation on the part of decision makers of just how difficult it is to build, implement and maintain well-functioning software. Therein lies the disconnect: developing quantitative strategies is an engineering problem, but the financial services industry is stubbornly trying to solve it by employing quantitative analysts, or quants. But quants are not engineers – they are scientists, usually mathematicians or physicists. They can be very effective as researchers. As a rule, they are also capable of writing software code, which they learn as part of their training – but they are not professional programmers either.

Unfortunately, most of the decision-makers in the industry don't really understand the difference. I've asked many quants if they had any training in software engineering. Virtually none of them do and many of them were unsure what I meant by software engineering – isn't it the same thing as programming? Well no, it isn't. A software engineer is to a programmer as an architect is to a construction worker. You could get away with hiring a construction worker to build a simple house, but to accomplish a more complex, mission-critical structure like an airport or a hospital, you had better hire a capable architect and one or more experienced project-managers. Only once you know exactly what you are planning to build should you bring in the builders.

When I make the analogy in terms of physical structures, it is more intuitive and people get it. But in finance, even when they get it, many professionals resist – and even resent – the implications: that if you want to get your quantitative models right, use your quants as researchers. Let them do research and come up with ideas. When they formulate good ideas, team them up with software engineers and programmers to build good quality, robust solutions. Do not expect the analysts to do everything themselves – not well, at any rate.

But in finance, the typical approach is going straight from ideas to coding, done by the same individuals who originated the idea. As a rule, the job is rushed as all involved are eager to see the proverbial rubber hit the road, and to start making money. Applying best practices in systems engineering, sticking with methodology, documenting the process and conducting the necessary testing are all regarded as overkill, unwelcome

waste of resources and needless delay of the trading gratification. In finance, the quants are expected to do the work of scientific researchers, software engineers and programmers.

This is unrealistic and profoundly mistaken. In the aftermath of Knight Capital's trading model blow-up, the firm's CEO Thomas Joyce rather flippantly declared on Bloomberg TV that, "*if you get involved in the day-to-day minutia, this will give you a headache occasionally.*" I agree with Mr. Joyce on that, but if you venture to bet money on a trading algorithm, enduring some headaches could prove to be your best investment of time and effort. In any endeavor where performance substantially depends on software, it pays to be thorough.

Organizational issues

Software quality is a strategic issue of the first order in quantitative trading and asset management in general. Sooner or later, failure to adequately manage model risk is likely to have a very meaningful adverse impact on performance. Another important aspect of quantitative modelling involves organizational issues. This is particularly the case in larger organizations where quantitative analysis functions are separate from, and subordinate to the key decision making functions. Particularly in organizations run by clubby management cliques, decisions are frequently based on influence, authority, or group allegiance rather than on a clear-minded analysis of ideas and facts. In such organizations, quality ideas are less likely to be recognized and given support. This is a weakness of many large organizations, even if it isn't directly apparent to outside observers. At times however, we can get a glimpse of them indirectly. One of them may well have been Rob Kapito's Black Rock: in its well-funded pursuit of the great expectations with quantitative trading, Black Rock assembled more than 90 scientists, 28 of them with PhDs and even went as far as poaching Bill McCartney, one of Google's leading scientists, to develop the BlackRock's *machine learning* applications. In reality Black Rock's (and other firms') results would soon prove to be a mixed bag at best.[48]

An earlier example came to my attention in 2007 with the growth in popularity of the so-called 130/30 funds, or short extension funds, which were predominantly managed by quantitative managers. A 130/30 fund balanced 130% long exposure with 30% short exposure in capital markets. The idea was to outperform traditional equity benchmarks, especially in falling markets. But by 2007 it had become clear that most of these funds by far fell short of expectations. When the market fell in the summer of

[48] Durden, Tyler: "BlackRock's Robo-Quants Are On Pace To Post Record Losses" – ZeroHedge, 11 January 2017.

2007, short extension funds managed by large organizations like State Street Global Advisors, Barclays Global Investors, Goldman Sachs Asset Management, Deutsche Asset Management, JPMorgan Chase, Charles Schwab and ING all left investors with bigger losses than the S&P 500 index. According to Morningstar, only three of the 38 short extension vehicles did better than the S&P 500. They disappointed equally through the aftermath of the 2008 financial crisis. Morningstar reported in April 2009 that 130/30 strategies on average lost 43.1%, compared to a 40.9% drop for long-only funds.

More recently, financial services have become enamored of outsourced robo-advisory solution providers, usually teams of quantitative analysts and technologists from places like Stanford, MIT or similar institutions. Backend Benchmarking tracked the performance of 60 robo portfolios and compared it to plain vanilla 60/40[49] exchange-traded funds (ETFs) as a benchmark. Over a four-year period, only 14.3% of robo-portfolios beat that benchmark. The study concluded that, "Robos underperformed their benchmarks in every period… the average underperformance was approximately 1% for each period."

* * *

Clearly, quantitative investing is not a slight challenge. However, if done right, it can be highly rewarding for the practitioners. As with so many things in life, achieving success entails clear thinking together with meticulous and disciplined adherence to best practices in systems engineering. With a valid market hypothesis and a well-built investment model, quantitative approach to investment trading is significantly superior to discretionary speculation. The reasons for this lie in certain features of human psychology that are robust and which set us at a serious disadvantage in speculative pursuits. We turn to exploring this fascinating subject next.

[49] "60/40" is the 100-year traditional standard in asset allocation. It entails allocating 60% of a portfolio to stocks and 40% to bonds.

Part 2

PSYCHOLOGY

Chapter 6: The Trading Experience

For indeed, the investor's chief problem – and even his worst enemy – is likely to be himself

Benjamin Graham

Some people enjoy trading but I'm not one of them. Early through my markets apprenticeship I got my fill and rapidly fell out of love with the game. During that time in the late 1990s, I had the idea of devoting some time and money to actual trading and to enhance my experience and know-how in this way. This seemed like the logical extension of my day job working as a market analyst and managing the R&D project focused on commodity price risk. One of the features of the price charting software I was using enabled me to set up virtual trading accounts and trade stocks, bonds, commodities and currency pairs in real time. At first this seemed like an irresistible bit of fun as well as a way for me to test a variety of trading ideas. Basically, I used this system to execute simple directional trades: if I thought the price of something was going up I bought it and if I thought it was going down I sold short. I started with oil derivatives and currency futures, but with time proceeded to dabble in other commodities like copper, coffee, soybeans and equity index futures. Although I wasn't trading with real money, the sheer desire to see profits and get the sense that I might amount to something as a trader quickly got me emotionally

engaged in the process. I'd love to tell you that this was fun and that I got all passionate about trading, but the fun wore off with the novelty and after a while I found it mostly stressful. I didn't enjoy it.

The losing game and its lessons

Gradually it became clear to me that I had a significant tendency to lose money and eventually wipe clean one account after another. This was very disturbing and I tried to uncover any errors of my ways by keeping a trading journal. One of the insights I gained – this may seem obvious, but it was not obvious to me at that time – was that each trade actually consisted of two separate decisions: the decision to commit to a trading position and the decision to un-commit.

Generally, getting into a trade was easy. It was the *getting out* that often got messy. I noticed that regardless of how clear-minded I wanted to be about formulating trading ideas and executing them, once there were profits or losses involved, I ended up veering off plan and pulling the trigger for reasons I couldn't easily explain to myself. Closing a trade with a profit was satisfying, but this satisfaction would quickly fade if it turned out that I could have made more money had I stayed in the trade. Next, I'd find myself scrambling to reopen the position, but doing so at a price less favorable than the price at which I closed the last trade seemed almost unbearable. Closing a position at a loss was even more unbearable, and I realized that this game came with a disconcerting dose of stress.

The feeling of satisfaction was relatively rare and usually short lived while stress fouled up most of the time I spent trading, which sadly was very considerable. There were days when I spent most of my time glued to the screens, watching numbers and charts blinking in front of me, setting up trade orders and price alarms, revisiting my analyses, second and third-guessing them, cancelling my trades then putting them on again. I thought that I could become positively obsessed as I found myself turning down lunch invitations and drinks with friends because I didn't want to be away from the screens. And I wasn't even trading with real money! I had to ask myself if I really wanted to spend my life in this way, obsessing over something that had a huge tendency to make me stressed out and anxious most of the time. The answer was clearly, no. That in itself was one of the most useful lessons I gained from the experience.

Another lesson was the realization that this game was not so much about mastering the markets or statistics or even the charts as much as it was about mastering oneself. In speculation, markets are the external reality, but what decides the game's outcome is the inner process that determines one's actions.

Key lessons from trading	
Each trade entails two decisions	Getting in and getting out are two separate decisions. Getting out tended to get messy.
Trading is very stressful	Satisfaction in trading was rare and usually short lived, but stress was nearly constant. This was a good way to have no life away from the markets and computer screens.
Losing is the most likely outcome of speculation	I found that I had a significant tendency to lose money. Soon enough I realized I had this in common with most other speculators.
This is no way to spend a lifetime…	… and probably end up broke.
It's me, not the markets	The markets are the outside, objective reality. Winning or losing depended on me, the decision maker. Thus, the Holy Grail entailed mastering myself more than mastering the markets.

With the realization that the Holy Grail was in the decision making process rather than in the knowledge of markets, I became keenly interested in human psychology and especially in the mystery of how we make decisions when facing uncertainty and risk. I wanted to understand how we learn, how we know, how we form judgment, how we handle risk, and how making or losing money affects us. Soon enough, I would have the chance to experience all that myself.

Trading my first asset bubble

The fateful event that induced me to take up active stock trading was my aforementioned purchase of Amazon stock in April 1998. When I made that purchase, I did not intend to actively trade Amazon or any other stock – this was simply an investment in a game-changing retail platform which I thought would grow by leaps and bounds for years to come. But Amazon's sharp, stratospheric ascent whetted my appetite for investing in stocks and a few months later I opened my first online brokerage account with Datek Technologies, which was subsequently acquired by E*Trade. At first, I was delighted with the experience: the trading was dead easy, commissions were low, and I had full control and transparency over my investments – all in the real time. I even had the facility to leverage my trades by 50% and take short positions if I wanted. Things went incredibly well for a few months – the money I was making in the stock market eclipsed my salary more than four-fold. I had to pinch myself: I was only

in my late twenties and I was a millionaire. It all somehow felt rather surreal and perplexing. I even thought about quitting my job and devoting my time fully to investment trading. Thankfully I had friends who were wiser and who talked me out of that idea. Soon enough, I would be very glad that I had heeded their advice.

Here's how it all went wrong

Through the Nasdaq bull market, many investors became convinced that, *this time it's different,* which meant that stupid stock valuations were justifiable, that internet commerce would change everything and that stocks prices might actually have reached a permanently high plateau.[50] But like *all* asset bubbles in history – without exception – the dotcom bubble would soon also collapse.

In March of 2000, after Nasdaq had more than doubled in only 5 months' time, I thought I'd be clever and start selling my stocks. I did well with it and sold some of them very near the top and others still at acceptably high prices. Then I decided I would stop trading for a while and wait for things to calm down. Unfortunately, I didn't wait long enough.

One of my top performing stocks was Yahoo! which I bought at about $60/share and watched skyrocket to more than $250. At that point the stock price rally went almost vertical and I decided it was time to sell. I put in several limit orders that turned out overly optimistic, but within a few days I sold out of my position within 10% from the top. Then I thought I'd wait for a deep, serious correction, expecting that this could take months. But Yahoo! started to drop like a stone and in just a few days it fell below $150/share. To resist temptation I decided I wouldn't touch the stock unless it fell below $100. At the time, this seemed like an impossibly low target. But only a few weeks later Yahoo was below $100 and I decided to cautiously buy again, expecting that the $100 level would be a psychological barrier and that the stock would bounce back.

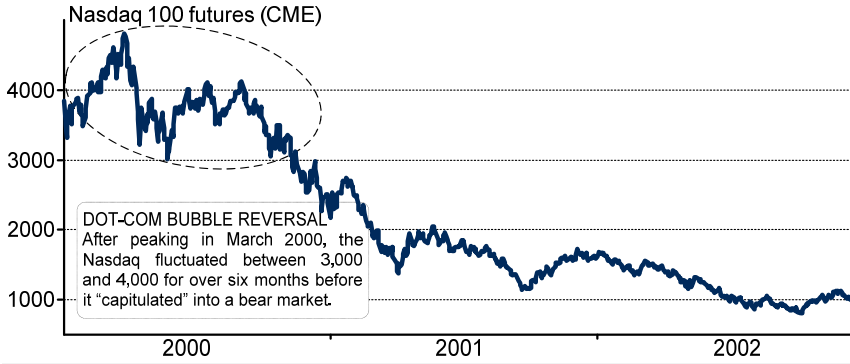
It did not. Instead, it continued sinking and in another few weeks it fell below $60. Such a deal! – I decided to double down and buy more. But Yahoo kept going lower and lower. Nursing heavy losses I was no longer concerned about caution and when the price hit low $30s I decided to buy again – this time with leverage. Come on – a nearly 90% decline in just a few months? That just had to go back up! But it did not. Yahoo and all other internet stocks went into a freefall and at some point in 2001 my E*Trade account was liquidated. Yahoo continued in its downward spiral all the way to $4 per share before it would begin to recover. All of the

[50] On 21 October 1929, just before the epic market crash, economist Irving Fisher stated that "Stock prices have reached what looks like a permanently high plateau."

internet stocks sustained similar or worse declines and many of the firms went out of business. My only saving grace through this experience was that I kept my investments divided in two separate brokerage accounts. I used E*Trade for active trading and kept my long-term, *buy-and-hold* investments in another account. In that way, what might have been a 100% wipeout ended up being only a 75% drawdown. Ouch!

Once I had the chance to sober up and make peace with my losses, I realized that I had made nearly every mistake there was to be made. One of them was trading against the trend. Namely, after the initial sharp correction in March 2000, Nasdaq traced a large double-top reversal pattern which signalled the onset of a bear market.

Exhibit 6.1: In 2000, Nasdaq signaled a trend reversal.



The large double-top formation signaled the trend reversal and the onset of a bear market. In a bear market, there's good money to be made by shorting stocks.

Had I thought to trade tech stocks as a trend follower, at some point in 2000 I would have reversed course and shorted them. Unfortunately I become too emotionally caught up chasing after my losses and thinking that low prices were the opportunity to average down the cost of my positions. At every point along that bear market I *wanted* stock prices to bounce back up and I became attached to desiring that outcome. As I would soon learn, I succumbed to loss aversion. For investors, loss aversion is one of the most consequential features of human psychology.

Chapter 7: Rogue Traders

There are so many ways to lose, but so few ways to win. Perhaps the best way to achieve victory is to master all the rules for disaster, and then concentrate on avoiding them.

Victor Niederhoffer

After my very unfortunate initial stints with trading, I was comforted to learn that I wasn't the only aspiring speculator with the tendency to lose money. It turned out that I had this in common with the vast majority of traders. Well before I had even thought about trends and trend following, my boss at Greenoil already told me several stories about high-flying traders he knew personally, who appeared very successful but ended up losing everything. He would often spice up those stories with remarks like, *"What, you think you're better than those guys? You think you're the next George Soros?"*

Another story which made an indelible impression on me early on was exactly about one of George Soros's top traders, Victor Niederhoffer.[51] Niederhoffer seemed like the archetype of a successful, sophisticated market speculator. In February 1997, Business Week had a full page article about him titled, "*Whatever Voodoo He Uses, It Works*," showing a small graph with Niederhoffer's investment performance with the caption, "*Crazy like a fox"*. In the article, Niederhoffer is quoted stating how, "*By paying attention to the little things, the nitty-gritty, the humdrum things in*

[51] See the Introduction to this book.

life, you become a great speculator." Naturally, I was intensely interested in his voodoo. In 1997 he published a book titled, "The Education of a Speculator" that soon became a New York Times bestseller. As soon as I had the chance I got a copy and took time to study his book carefully. I'll admit, I became a bit dazzled with the man's charisma, and tried to emulate his style, thinking, and analytics in my job as a market analyst. But on the morning of the 18th November 1997, only weeks after I'd finished reading Niederhoffer's book I picked up a copy of the Herald Tribune and found the most astonishing article on the front page. The title read, CONTRARIAN GETS CAUGHT FLAT-FOOTED BY MARKET. Below, the sub-title said, FUND MANAGER LOST ALL IN OCTOBER STORM. The article was about none other than Victor Niederhoffer: on 27th October 1997, he sustained a total, 100% loss in a single trading day.

I was dumbfounded. Shocked. Flabbergasted. This story struck me like a ton of bricks: I was eagerly embarking upon a career path that – for all I could predict – might wind through swamps of mediocrity only to lead to a capital disaster at the end. Niederhoffer wasn't just some naïve gambler who had a lucky run – he had a degree in economics and statistics from Harvard University, a PhD in finance from the University of Chicago and an assistant professorship at Berkeley. In 1996 he won the distinction as the world's number one hedge fund manager. If this could happen to Victor Niederhoffer, why not to the next guy? Why not to me? Imagine a lifetime of ambition, effort, and hope crowned at the end with a humiliating defeat? I was truly stunned by this story, but it was far from an isolated incident. Over time I came across many more cases of great traders who had a charisma that mesmerized investors and corporate directors, and who would routinely execute huge trades, make news with their opinions and move markets with their statements. Eventually, many of them came crashing to the ground in disgrace. In some cases, they blew up their entire firms. One of the most notorious examples was Nick Leeson whose "brilliance" brought down the 232-year old Barings Bank in 1995 when it came to light that he lost over $1.4 billion of the bank's cash. Back in 1995, that was a lot of money! Then there was Sumitomo Corporation's Yasuo Hamanaka who managed to accumulate $2.5 billion in trading losses between 1986 and 1996. Daiwa Bank's Toshihide Iguchi lost $1.1 billion. In 2002, Allied Irish Bank's trader John Rusnak ran up losses of about 860 million Euros.

China Aviation Oil was bankrupted by its star trader, Chen Jiulin who lost over $500 million trading oil derivatives. In 2006, whiz-kid mathematician, Brian Hunter lost $6 billion trading Natural Gas derivatives at Amaranth Advisors hedge fund. The following table

provides a list of the best known speculative debacles since the early 1990s, a list that is almost certainly very incomplete:

The landfill of speculator talent – a very partial list

Year	Company	Market	Loss
1992	Bank Negara Malaysia	Foreign exchange	$5.5 billion
1993	Metallgesellschaft	Crude oil	$1.3 billion
1994	Kashima oil (Japan)	Foreign exchange	$1.5 billion
1994	Orange County, California	Financial derivatives	$1.7 billion
1995	Barings Bank	Japanese securities	$1.4 billion
1996	Daiwa Bank	Bonds	$1.1 billion
1996	Sumitomo Corporation	Copper	1.8 billion
1997	Yamaichi securities	Various investments	¥200 billion
1997	Morgan Grenfell	Equity investments	$650 million
1998	LTCM hedge fund	Russian securities	$4.2 billion
2000	BAWAG (Austria)	Foreign exchange	€1.4 billion
2001	General Electric	Financial derivatives	$1.2 billion
2001	Frostman Little & Co.	Various investments	$ 2 billion
2002	Allied Irish Bank	Foreign exchange	€860 million
2003	GPIF (Japanese pension)	Various investments	¥6 trillion
2004	National Australia Bank	Foreign exchange	A$ 360 million
2004	China Aviation Oil	Oil derivatives	$540 million
2005	HSBC	Interest rate derivatives	$500 million
2006	Amaranth Advisors	Natural gas derivatives	$6.6 billion
2007	WestLB (Germany)	Equity investments	€600 million
2007	Bank of Montreal	Natural gas derivatives	C$680 million
2008	Morgan Stanley	Credit default swaps	$9 billion
2008	Societe Generale	Equity investments	$7.1 billion
2008	Peloton Partners	Subprime mortgages	$2 billion
2008	Aracruz (Brazil)	Foreign exchange	$2.5 billion
2008	Deutsche Bank	Derivatives	$1.8 billion
2008	Groupe Caisse d'Epargne	Derivatives	€750 million
2008	Sadia (Brazil)	FX derivatives, credit	$1.1 billion
2008	Saracen Group	Natural gas derivatives	$700 million
2009	SEM Group LP	Oil derivatives	$3.2 billion
2009	Harvard University	Interest rate derivatives	$500 million
2011	Olympus Corporation	Various investments	¥376 billion
2012	UBS	Exchange-traded funds	$2.3 billion
2012	JPMorgan Chase CIO	Credit default swaps	$6.2 billion
2015	Standard Chartered Bank	Commodity loans	$4.4 billion
2018	Unipec	Energy derivatives	$690 million
2018	Trafigura	Oil trading	$254 million
2020	RyanAir	Oil hedging	$325 million
2020	Hin Leong	Oil trading	$3.8 billion

In 2008, another star trader went down in flames. His name was John Wood. He had built a stellar track record at UBS bank and ranked as the

bank's top trader. In 2006, John Wood set up shop in the Principality of Monaco where I lived. The launch of his hedge fund, the SRM Global Master Fund, generated a great deal of publicity. Seduced by Mr. Wood's star status, investors piled into his fund with such zeal that SRM became the largest ever European hedge fund at launch. This was in spite of its highly unfavorable terms that included a five-year capital lock-up. But it did not take five years for John Wood's clients to regret their investment. SRM took a huge hit during the 2008 global financial crisis and its investors sustained an 85% loss, significantly worse than the overall stock market decline: the S&P500 "only" declined by about 60% from peak in 2007 to its low point in 2009.

Stories like that are not isolated incidents: smaller cases likely count in the thousands but most of them manage to avoid the media spotlight. However, even if the majority of cases remain unknown, their impact is real and significant. A McKinsey study[52] published in 2003 gave us another valid empirical insight into the prevalence of such incidents and the very real impact they have in the financial services industry. McKinsey looked at the performance of 200 leading financial firms over a five-year period from 1997 to 2002. During that time, they identified fully 150 incidences of "significant financial distress". The authors of the study set the bar for significant financial distress quite high, defining it as either a bankruptcy filing, a credit ratings downgrade of two or more notches, an earnings decline of over 50% below analysts' consensus estimates, or a decline in total returns to shareholders of 20% or more below the overall market in any one month. Thus, McKinsey's analysis implies that the average financial firm had a staggering 75% probability of experiencing such severe adversity in any five-year period. In many cases these risk events are related to the excesses of speculation. The perpetrators frequently turn out to be respected managers and highly skilled market professionals

* * *

Between the consistent failure of expertise to add value in investment management, the frequency of rogue trader incidents and the heavy impact of similar risk events on financial services firms, we should contemplate a few important questions: why is failure so pervasive in speculation? Why is it so much more probable than success? Why do so many smart, respected traders end up producing disasters? To understand the reasons for this, we need to explore certain aspects of our own psychology that strongly affect the outcomes in investment speculation.

[52] Buehler, Kevin and Gunnar Pritsch, "Running with risk" – McKinsey Quarterly, November 2003

Chapter 8: Human Brain and Speculation

The person is a conglomerate of independently functioning mental systems that in the main reflect nonverbal processing systems in the brain.

Michael Gazzaniga

The above statement, written by the cognitive neuroscientist Michael Gazzaniga might seem incomprehensible at first glance. What it suggests however, is that the way we perceive and interpret our actions isn't necessarily consistent with the true reasons that motivate them. At times,

these reasons are hidden from our conscious understanding. This is true in general, but it is also very relevant to our speculative behavior.

Of course, the ultimate motivation behind our speculative action is the desire for gain – that much is clear. But our ability to realize that desire will depend on our thinking, judgment and decisions which seldom, if ever, have a predictable outcome. With respect to investment trading, sustained success at speculation depends on our ability to consistently make good decisions about getting into and out of trading positions. While it's nearly impossible to make money on every transaction, a successful speculator would need to get it right most of the time. More realistically, he should try to make more money when he gets it right than he loses if he gets it wrong so that over time his cumulative gains outweigh his losses.

In practice, this is extremely difficult for most people to accomplish, due to a number of systemic biases in our psychology. Some of these biases are hardwired in our brains by design and they can't easily be cured by education or experience. They include phenomena like overconfidence, anchoring, the endowment effect, loss aversion, and several others that can induce a strong emotional pull on our judgment and distort a reasoned analysis of facts even in the most experienced professionals. Take the overconfidence bias: a large majority of us – close to 90% – rate ourselves above average in our ability and intelligence. In speculation, a measure of success can give us an exaggerated sense of our own competence, making us prone to taking risks even in situations we understand only vaguely.

We are also susceptible to the anchoring bias whereby we tend to rely, or anchor our decisions on a single issue or piece of information while ignoring or underestimating the importance of other relevant factors. The endowment effect predicts that we'll demand a higher price for an asset we already own than we would pay for that same asset if we didn't own it. This may strike close to common sense, but it has important implications for how we deal with risk. Behavioral economist Richard Thaler studied how individuals evaluate risk to their lives. He asked a group of people two questions. First, how much would you pay to eliminate a one-in-a-thousand chance of immediate death? The second question was, how much would you demand to accept a one-in-a-thousand chance of immediate death? Typically, his subjects would pay no more than $200 to eliminate the one-in-a-thousand chance of death, but they wouldn't accept the extra one-in-a-thousand risk of death for $50,000. The disparity between the two answers is intriguing, given that the subjects were evaluating essentially one and the same risk.

The ways we interpret and act on new information are also rife with complexity. Fluctuating almost around the clock, modern markets generate a constant flow of news and information enabling traders to keep on alert

at all times and remain in control of their positions and risks. This may seem like a good thing, but the reality is that most traders would be better off staying away from the news flow altogether. Numerous empirical studies have shown that even among experts, more information doesn't, in fact, improve decisions. One such experiment, conducted by psychol ogist Paul Andreassen at the Massachusetts Institute of Technology looked at the way access to information influenced investment performance.

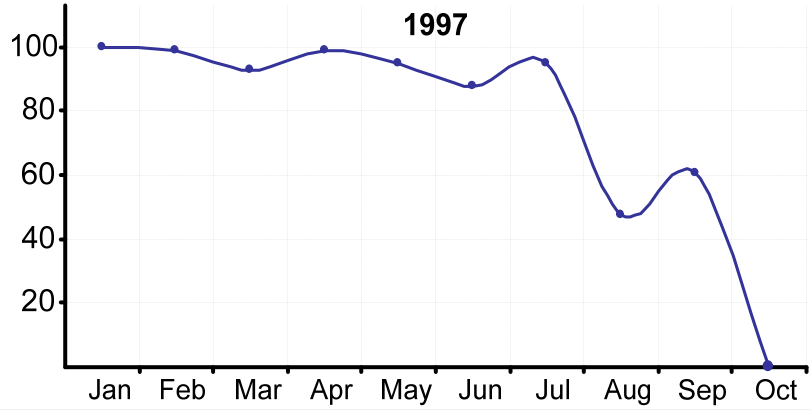
Andreassen divided students into two groups whose participants each selected a portfolio of stock investments. In each group, students were free to buy and sell stocks as they saw fit, but while one group had access to the constant flow of stock markets news, the other group was allowed to monitor their portfolios only through changes in stock prices. The experiment showed that students who got no financial news at all earned double the returns of those who frequently checked the news. This outcome is in part related to the one bias that perhaps more than any other, predisposes us to losing: our aversion to losses.

Loss aversion

Trading and investment management are long-term pursuits where performance reflects the cumulative results of a long series of transactions. However, rather than considering every decision as just one of many, we treat each transaction as a departure from the status quo, where our fear of loss overpowers our desire for gain. In fact, the logic we apply to decisions about gains is quite opposite that which we apply to decisions about losses. This phenomenon was first described by psychologists Daniel Kahneman and Amos Tversky, who named it the "failure of invariance." Through a series of empirical studies, they discovered that we tend to be strongly risk averse with regard to gains, and risk seeking when faced with losses. Thus, failure of invariance predicts that we are risk averse when preserving a favorable status quo, but prone to taking risks when dealing with losses. In trading, this creates the disposition to exit profitable trades too soon, and "work" the losing trades too long.

The pressure to recover losses frequently leads traders to escalate risk – at times even to massive proportions. This in turn, can precipitate disasters like those we saw in the previous section. In fact, that's what happened to Victor Niederhoffer. After 15 years of success and outstanding performance his business came to an abrupt end in October 1997. At that time, his entire fund was wiped out in a single day when the market moved against his short positions in S&P500 put options. The fact that an investor with his credentials, experience and track record should take such massive risk on a single trade was quite astonishing.

Exhibit 8.1: Niederhoffer Intermarket Fund (Jan. '97 = 100)



Game over: A large loss in August 1997 led Victor Niederhoffer to take excessive risks to try and recover from his draw-downs. His short trade in S&P500 put options was so large that when the market moved against him, it entirely wiped out his fund in a single day in October 1997.

Mr. Niederhoffer's fatal trade was partly a consequence of loss aversion: in August 1997 he sustained heavy losses on investments in Thailand's currency and stock market. In September, after recovering some of those losses, Niederhoffer was still down nearly 40% for the year. The pressure to recuperate the losses led him to excessive risk taking, a mistake which he warns against repeatedly in his book, "The Education of a Speculator".

We tend to let losses run and cut our profits short

Loss aversion explains why it is so difficult for most people to follow the often quoted formula for successful investing: "*let the profits run and cut losses short*." We are predisposed to take profits while they are a sure thing, and let losses run, gambling that the markets will turn around in our favor. In other words, we seem to be hardwired to follow the exact opposite formula – we are inclined to cut our profits short and let losses run. This creates a strong tendency in most traders and investors to gradually lose ground against the markets.

Loss aversion underscores the fact that our mental faculties simply aren't suited to the task of speculating in fast moving securities markets. Human brain is the product of our natural evolution, designed to solve problems of survival we confronted through our evolutionary history. During more than 99% of that time, we lived as foragers in small nomadic bands, and in that environment, loss aversion bias did make good sense.

With no refrigerators, bank vaults or stock certificates, most improvements to our natural state had sharply diminishing marginal utility.

More food is good, but there's only so much you can eat or hoard before it starts to become a liability. By contrast, reduced access to food, or an injury could rapidly spell "game over." As MIT professor Andrew Lo fittingly put it, "*This notion of loss aversion, being more aggressive when you're losing and more conservative when you're winning, is a very, very smart thing to do when you're being hunted on the plains of the African savannah. However, it's not a smart thing to do when you're on the floor of the New York Stock Exchange.*" [53]

A matter of judgment

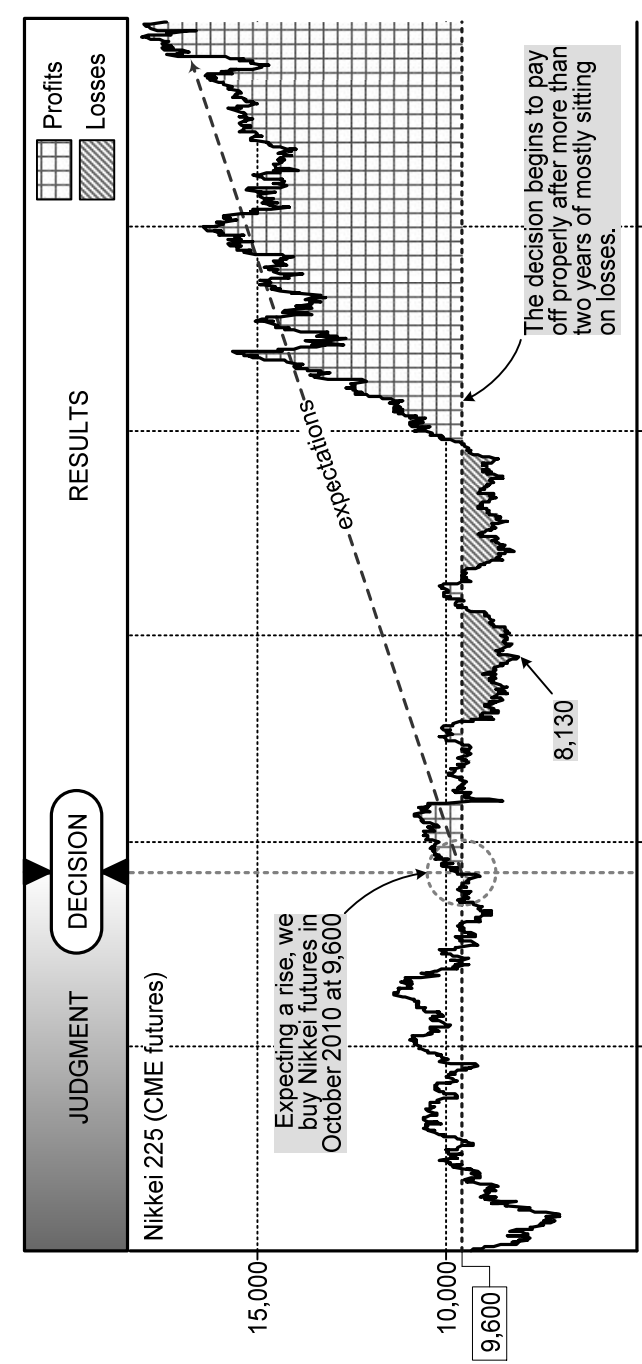
Loss aversion can cause a trader to lose money even when his judgment is correct. Judgment is a discrete process that fluctuates continuously with time and new information. Decisions are binary; they take effect at a precise point in time and determine the results of our actions. Unless his decisions are executed with flawless timing, a trader may have to endure unrealized losses on his positions for a period of time, straining his emotions and putting his conviction to trial.

Consider the scenario depicted in Exhibit 8.2 on the following page: In 2010 when the Nikkei 225 index was trading around the 10,000 level, numerous analysts thought that Japanese equities were a bargain. Suppose that agreeing with these analysts, in October 2010 you bought some CME U.S. dollar-denominated Nikkei futures contracts at 9,600. Potentially, that would have been a good decision. However, in March of 2011 Japan was hit by a massive tsunami that exacted a very significant human and economic toll, and Japan's stock market fell accordingly. For most of the following two years, the Nikkei traded sideways, at one point reaching a low of 8,130. For the investor who bought Nikkei futures at 9,600, this represented a loss of 1,470 points, corresponding to $7,350 per contract.

At the time, the Chicago Mercantile Exchange set the initial margin for Nikkei 225 futures at $1,760 per contract. In all, to convert their good judgment into profits, Nikkei traders would have to endure two years of heavy losses without losing faith in their initial judgment. This is easy to say but actually very hard to do; at its highest, their loss per contract ($7,350) would be more than four times the initial margin ($1,760), and for any aggressive trader the loss aversion bias might cause them to discard their good judgment and try to reverse their losses with some clever improvised maneuvers. That usually makes things worse.

[53] Fitzgerald, Michael "Survival of the Richest," – MIT Technology Review, 19 April 2006.

Exhibit 8.2: Even with correct judgment, investors may sustain losses



Even where decisions are based on correct judgment, unpredictable market fluctuations can temporarily lead to considerable losses, eroding an investor's confidence in his judgment and triggering the loss-aversion impulses that tend to have adverse effect on performance.

I had the unhappy privilege of experiencing a similar scenario first hand with my boss at Greenoil as the drama's protagonist. A veteran with more than 20 years of experience managing an independent commodity trading business, he was a very sharp man and undeniably a successful trader. In early 2003, as the United States and her allies seemed poised to invade Iraq,[54] he believed that the market had already factored the crisis into the oil price and that the invasion itself would lead to a major price correction.

Confident in his judgment, in mid-January 2003 he started taking short positions in IPE Gas Oil futures. Unfortunately, the Gas Oil price kept rising through January and February, causing very substantial losses on his positions. This led him to second guess his judgment. As he endeavored to recover his losses, his trading became more frequent and more erratic. Price averaging, intraday trading maneuvers and guessing about the next few days' or hours' price moves only made things worse. Ultimately, although his timing was off, his judgment proved correct: from its March 2003 highs, the price of Gas Oil dropped by 39%. In spite of that, his activity produced a large loss. Over a 14-week period he made 46 different transactions. Rather than profiting through his good judgment, he ended up with a large loss.

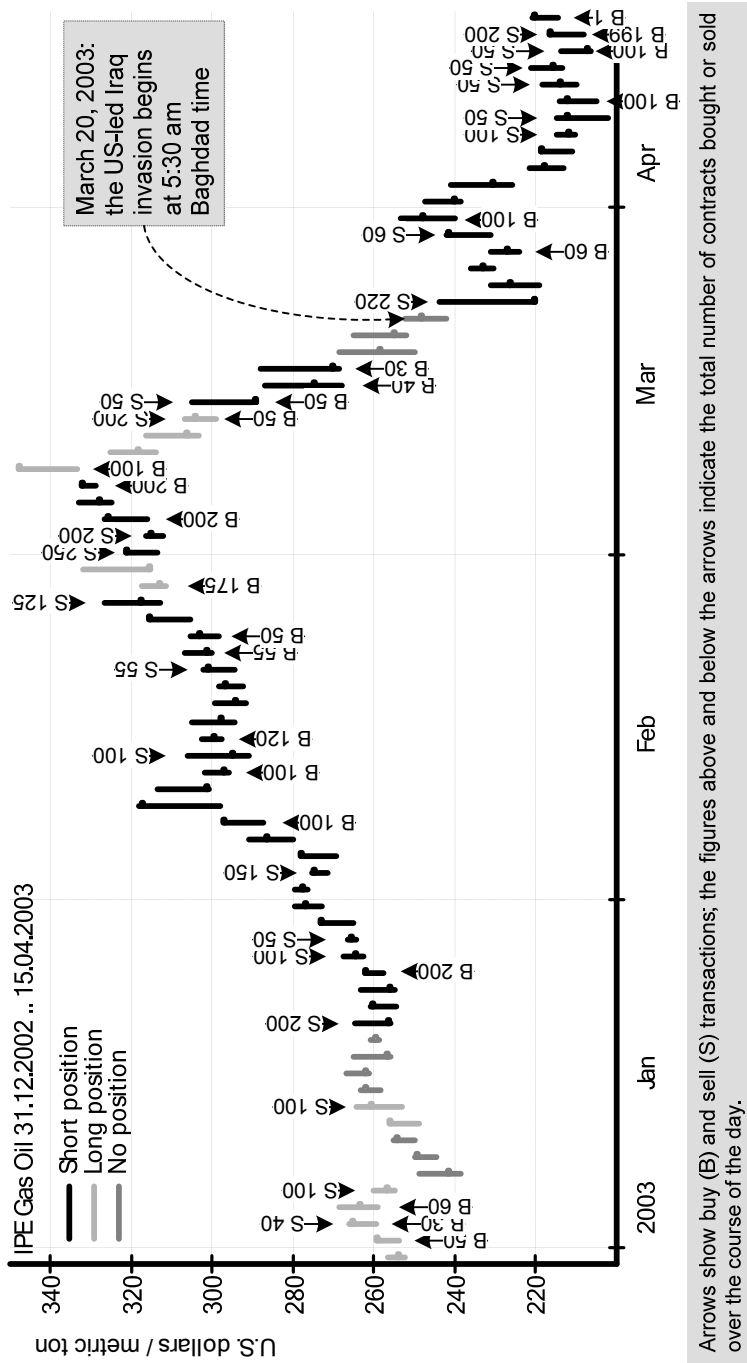
Similarly, in early 1995, Jeffrey Vinik, the manager of Fidelity Magellan, at that time the world's largest mutual fund, got trampled by the markets as the internet technology boom was about to take off. At the time, Vinik held over 40% of the fund's assets in technology stocks, proclaiming that most of his investors "*have invested in the fund for goals that are years away… I think their objectives are the same as mine, and that they believe, as I do, that a long-term approach is best.*"

But only six months after he wrote this, Vinik dumped almost all of his technology shares, selling close to $19 billion worth in two frantic months.[55] In retrospect, it's clear that Vinik was right on the money with his large allocation to technology companies, but fearing that the already "overvalued" tech stocks were due for a large correction, he deprived his investors of the windfall from one of the most spectacular bull markets ever as NASDAQ soared another 400% (from around 1,000 level to more than 5,000) over the following five years.

[54] At the time, the American invasion of Iraq was by no means a foregone conclusion and most of the media treated this as the last resort, worst-case scenario outcome that might yet be avoided, so the conflict's consequences for the oil market were far from clear.

[55] J. Zweig in commentary on Chapter 1 of Benjamin Graham's "The Intelligent Investor" (p. 37).

Exhibit 8. 3: Good judgment, dismal results – transactions of an oil trader with 20-years of experience



Arrows show buy (B) and sell (S) transactions; the figures above and below the arrows indicate the total number of contracts bought or sold over the course of the day.

At the other end of that same bull market, another star manager made a similar and equally unfortunate mistake. While working for George Soros in 1999, Stanley Druckenmiller accumulated a significant short position in internet stocks which he believed to be extremely overvalued. He was right, of course, but the Nasdaq's meteoric rise eventually made him blink, cover his shorts and join the bulls on the long side.

Shortly thereafter, the dot-com bubble burst and 75% of the internet stocks Druckenmiller shorted eventually went to zero. The rest of them fell between 90% and 99%.[56] Instead of making an absolute killing in 2000, Stanley Druckenmiller ended up with the biggest loss in his career.

[56] Price, Tim. "The Emotional Investor" – PFP Wealth Management Newsletter, December 2013. (Citing also research by fund manager David McCreadie).

Chapter 9: The Deeper Mysteries of Our Psyche

The interpretive mechanism of the left cerebral hemisphere is always hard at work, seeking the meaning of events. It is constantly looking for order and reason, even when there is none - which leads it continually to make mistakes.

Michael Gazzaniga

The stories we explored thus far underscore the fact that speculation is primarily a problem of human psychology. A speculator's performance depends on his decisions. At times, speculative decisions unveil some of the deeper mysteries of our psyche. We might ask ourselves why such learned and experienced men like Stanley Druckenmiller, Jeffrey Vinik and my former boss all ended up going against their (much) better judgment to join the herd as it was stampeding toward a cliff? Loss aversion clearly played a role, but other, more obscure aspects of human psychology also had an impact.

The mute hemisphere

Our thoughts, the nearly constant stream of awareness that shapes our self-identity, is our only means of consciously formulating new knowledge about anything at all. This conscious thinking is always expressed in language (try to think a thought – any thought – without it being expressed in words; it is almost inconceivable). It is this internal monologue that gives us the experience of what being ourselves *feels* like; it's an independent, totally individual, sovereign experience. In our own minds, we think our own thoughts, arrive at our own truths, craft our free will and choose our conduct. To an important extent however, this feeling is an illusion. Our thoughts and actions appear to be open to outside influences in ways we can't fully account for. This is not limited to just good advice or some new information: thoughts and decisions can quite literally infect our minds from the outside without our conscious awareness.

Part of the mystery stems from the way our brain is designed. It consists of two hemispheres, each specialized in running a different set of processes. Our left hemisphere specializes in processing language and concepts that can be expressed in language. It articulates our speech and generates the internal monologue that we experience almost constantly during our waking hours. Our right hemisphere is the epicenter of our emotional experience. It has *some* language capability, but is largely nonverbal, processing visual information and managing spatial and personal relationships. The two hemispheres communicate through *corpus callosum,* a bundle of nervous tissue that connects them. Working in concert, the two hemispheres process what we experience as our unified system of awareness. When neurosurgeons began to separate the two hemispheres by severing the corpus callosum – as a way to treat patients with severe epileptic seizures – they discovered that each hemisphere had its own separate systems of attention and action capable of independently influencing a person's conduct. A study of these *split-brain* patients by neuroscientists Michael Gazzaniga and Roger Sperry showed us how these systems can impact our behavior.

In their experiments, Gazzaniga and Sperry channeled visual stimuli from one side of a patient's visual field to the opposite hemisphere of the brain. For example, they showed a funny slide to a patient's right hemisphere (by making it visible only to his left eye). On cue, the patient started laughing, but when asked why he was laughing, he contrived an explanation that sounded credible but was false. This was evident to the experimenters but not to the patient whose two brain hemispheres couldn't communicate with one another since his left hemisphere, which was

articulating his speech – was unaware of the slide that triggered the laughter through the right hemisphere.

In another experiment, when the command "WALK" was flashed to a patient's right hemisphere, he promptly got up and started to walk out of the room. When the experimenter asked him why he just got up, he replied quite sincerely that he wanted to get a drink. Again, the patient's left hemisphere unhesitatingly contrived a credible explanation although it was in the dark as to the real causes of the man's actions. These experiments suggest that our left brain is responsible for producing a sense of coherence and purposefulness of our actions, manufacturing it from whatever ingredients it finds, regardless of whether they are true or invented. What's disturbing about this discovery is that even with intact brains, we can't be sure that our left hemispheres are any more truthful with us about our own conduct. It is our left hemisphere's process that produces the chatter in our conscious awareness. But our conduct might equally be directed by our "mute" right hemisphere whose influence may be indiscernible to us.

Sigmund Freud seems to have understood this when he wrote that often our conscious minds do not control how we act, but merely tell us a story about our actions. In his book, "Escape from Freedom," Erich Fromm offers another telling example of this same phenomenon at work. Fromm recounts an experiment where a subject was put under hypnosis. During hypnotic sleep, the experimenter suggests to this man that after awakening he will want to read a manuscript which he will believe he has brought with him, that he will seek it and not find it, that he will then believe that another person, Mr. C who was also present, has stolen it, and that he will get very angry at Mr. C. The truth of the situation was that the subject never brought any manuscript and that Mr. C was a person toward whom the subject never had reason to feel any anger. Fromm describes the situation after the subject awakens from hypnosis:

"…after a short conversation with the therapist, he says, 'Incidentally, this reminds me of something I have written in my manuscript. I shall read it to you.' He looks around, does not find it, and then turns to C, suggesting that he may have taken it; getting more and more excited when C repudiates the suggestion, he eventually bursts into open anger and directly accuses C of having stolen the manuscript.

He goes even further. He puts forward reasons which should make it plausible that C is the thief. He has heard from others, he says, that C needs the manuscript very badly, that he had good opportunity to take it, and so on. We hear him not only accusing C, but making up numerous 'rationalizations' which should make his accusation appear plausible."

Again, the subject of the experiment seems fully convinced that he is thinking his own thoughts and acting on his own inclinations; only the observers who have witnessed the entire episode are aware that the subject was manipulated during hypnosis into believing what never happened: that he brought some manuscript, and that Mr. C stole it.

While his anger also seems to have been planted by the therapist, the subject has clearly injected a narrative of his own: he has supplied the rationalizations about why he just knew C was the culprit, and why he was right to be angry at him."

These experiments revealed that we all have an inner spin-doctor charged with giving us a convincing account of our actions. But this spin-doctor seems to have no scruples about telling us lies, which we "hear" loud and clear while we remain largely deaf to our brain's mute processes that can nevertheless significantly influence our actions.[57]

What does any of this have to do with investment speculation? Here's what: sustained success at trading depends on the decision making process rooted in rational thinking, independent judgment and some form of strategy. We can only formulate and process these elements verbally, which means through our brain's left hemisphere. At the same time, our actual conduct could well be influenced by our right hemisphere which is nonverbal. The right hemisphere processes emotion, and in speculative trading emotion can strongly influence our actions.

These obscure aspects of our psyche may hold the key to the mystery of why intelligent, successful and disciplined traders at some point abandon their better judgment and take action they rationally understand to be wrong. We can clearly see this in the way Stanley Druckenmiller described his failure managing George Soros's Quantum Fund in 2000. Answering the question about what he thought the biggest mistake of his career was and what he'd learned from it, he said:

"... in 1999 after Yahoo and America Online had already gone up like tenfold, I got the bright idea at Soros to short internet stocks. And I put 200 million in them in about February and by mid-March the 200 million short I had lost $600 million on, gotten completely beat up and was down like 15 percent on the year. And I was very proud of the fact that I never had a down year, and I thought well, I'm finished.
So the next thing that happens is I can't remember whether I went to Silicon Valley or I talked to some 22-year old with Asperger's. But whoever it was, they convinced me about this new tech boom that was

[57] Some psychologists suggest that we can recognize these processes as a *gut feeling.*

going to take place. So I went and hired a couple of gunslingers because we only knew about IBM and Hewlett-Packard. I needed Veritas and Verisign. … So, we hired this guy and we end up on the year – we had been down 15 and we ended up like 35 percent on the year. And the Nasdaq's gone up 400 percent.

So I'll never forget it. January of 2000 I go into Soros's office and I say I'm selling all the tech stocks, selling everything. This is crazy. [unintelligible] This is nuts. Just kind of as I explained earlier, we're going to step aside, wait for the next fat pitch. I didn't fire the two gunslingers. They didn't have enough money to really hurt the fund, but they started making 3 percent a day and I'm out. It is driving me nuts. I mean their little account is like up 50 percent on the year.

I think Quantum was up seven. It's just sitting there. So like around March I could feel it coming. I just – I had to play. I couldn't help myself. And three times during the same week I pick up a – don't do it. Don't do it. Anyway, I pick up the phone, finally. I think I missed the top by an hour. I bought $6 billion worth of tech stocks and in six weeks I had left Soros and I had lost $3 billion in that one play.

You asked me what I learned. I didn't learn anything. I already knew that I wasn't supposed to do that. I was just an emotional basket case and couldn't help myself. So, maybe I learned not to do it again, but I already knew that." [58]

Day after day, Stanley Druckenmiller watched technology stocks skyrocket and his younger and much less experienced employees make huge returns while his fund was just treading water. What they were doing seemed to be working, and what he was doing wasn't. Day after day the markets were telling him that his "gunslingers" were right and he was wrong; that they were smart and he stupid. Eventually he threw caution to the wind and joined the herd even while in his rational mind he knew he was doing the wrong thing. "*I was just an emotional basket case and I couldn't help myself,*" said Druckenmiller. Any and every would-be speculator should ponder those words, because what happened to him can happen to every speculator.

The objective of this discussion is not to suggest that being a successful investor isn't possible, but to point out that certain parts of our mental circuitry can make it difficult for us to be consistently successful as speculators over long stretches of time. We *can* learn to be diligent and rigorous in conducting our research, discerning in our judgment and

[58] Armour, Timothy. "Stanley Druckenmiller Lost Tree Club 1-18-2015" Transcript, 12 Feb. 2015.

disciplined in making decisions. Clearly, there *are* individuals out there who manage to outperform markets year after year over long periods of time (but for his 2000 debacle and more recent mishaps in 2019 and 2020, Druckenmiller was one of them). But these individuals are very rare – perhaps the proverbial exceptions to prove the rule. Myself, I did not feel inclined to bet my future on the notion that I might be one of these wizards. If you choose to make a living by walking a tightrope, keeping perfect balance 99% of the way across a ravine is not good enough. If I was going to pursue a career in trading, I had to find a way to sidestep the human shortcomings that could spell my doom. There was only one alternative, and that was to go quantitative and systematic.

Part 3

TRENDS AND TREND FOLLOWING

Chapter 10: Prices, Time Series and Technical Analysis

One thing I have learned over time is the best thing to do is let market price action guide your decision-making and then try to understand the fundamentals as they become more evident and comprehensible."

Paul Tudor Jones[59]

In Part 1 of this book we explored uncertainty and the reasons why our understanding of markets would inevitably remain incomplete and inadequate. However diligently we study economic fundamentals, we can't attain anything near complete understanding of the market environment. Much of the available information about them is untimely, partial and distorted. Some of it will prove outright false. In consequence, the idea that we could make reliable predictions about the future is simply

[59] *"The Great Monetary Inflation"* - Paul Tudor Jones' May 2020 investment newsletter.

unrealistic, no matter how much effort and resources we put into that endeavor.

However, there is one specific kind of market information that is generally accurate, unambiguous, and almost instantly available: the prices of assets themselves. Security prices and the data series describing their fluctuations over time provide an important way to understand markets. By "understand," I do not mean the kind of understanding that forms opinions, expert commentary or cocktail party discussions about this or that market, but the kind that enables us to make decisions with a certain degree of confidence and positive expectancy[60] for speculative profit.

Price discovery process

The concept of price is different in capital markets from what it is in consumer markets. The first kind of price is fluid, the second solid. In everyday life, the price of something is what the seller demands and the buyer pays. If the buyer thinks the price is too high, perhaps he can bargain, or he can shop for an alternative product or a seller with a better price. In organized financial markets, security prices constantly fluctuate as a function of what we call the *price discovery process*.

This process is driven by an ongoing interaction between numerous buyers and sellers. Buyers come to the market with bidding prices, and sellers with their offering, or asking prices. When a buyer's bid matches a seller's asking price, the transaction can take place and the settlement price is recorded along with the number of securities exchanged. The process continues with other bids and offers (or asks) throughout the trading session. At any particular moment in time, a price quotation for a financial product may look like this:

Security	Bid	Ask	Last	Open	High	Low	Chg	Vol.
CME Dec '13 EUR futures	1.3074	1.3077	1.3074	1.3004	1.3107	1.2986	+0.007	125000

This is what is called a "level 1" price quote. What we see here are the trading session's highest, lowest and opening prices as well as the last transacted price and the closest matched bid and ask prices. But there are many other traders in the market wishing to transact different size trades with bid and ask prices further away from the current price. "Level 2" price quotes provide this deeper insight into the market. Here's a basic illustration of a level 2 quote:

[60] In this sense, expectancy is simply an answer to the question of what happens if we continue doing something. Thus, in my mind, a visit to a gambling casino has a negative expectancy – there, the house usually wins, and gamblers usually lose.

CME Dec. 2013 EUR futures			
Bid		Ask	
Price	Size	Price	Size
		1.3083	2
		1.3081	8
		1.3078	5
1.3074	3	1.3077	12
1.3073	7		
1.3071	11		
1.3069	8		

As buyers' bids match up with sellers' asking prices, trades are continually transacted with prices fluctuating throughout the trading session. Each trading session is marked by an opening price (the price at which the first transaction took place), the session's high and low prices, and the last or closing price of the trading session. The volume of trading is also recorded as well as open interest[61] in the case of futures markets. Each set of *open-high-low-close* prices can be graphically represented by price bars, as illustrated in the following exhibit:

Exhibit 10.1: The anatomy of a price data series

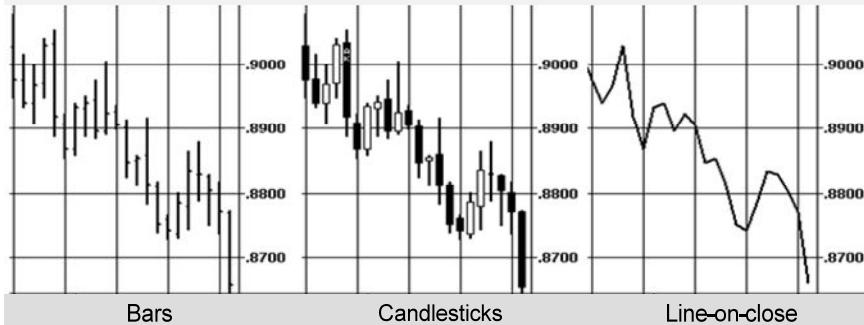
For most publicly traded securities, price history is a series of price bars, each summarizing a session's trading range

[61] In futures trading, when a buyer and a seller enter into a transaction, they may open a new contract. This contract remains outstanding or open until it is settled. Open interest in any futures market denotes the total number of such outstanding contracts (or options).

A series of bars makes up an asset's historical price chart. Volume and open interest figures are normally plotted in a sub-chart on a separate scale. Price bars can also represent weekly or monthly price ranges, as well as intraday periods. With sufficiently granular data, we can construct time series made up of weekly, 60-minute, 5-minute, or any period price bars.

Besides price bars, charts can also be drawn using line-on-close or candlestick charts. Line-on-close removes the "noise" of intraday price fluctuations and shows a chart plotted only through closing prices. Candlesticks convey essentially the same information as price bars, but make a visual distinction between the "up close" and "down close" days: when the closing price is higher than the opening price the candlestick body is left unfilled, or is colored green; when closing price is lower than opening price the candlestick body is filled solid, or colored red.

Exhibit 10.2: Three main types of price charts

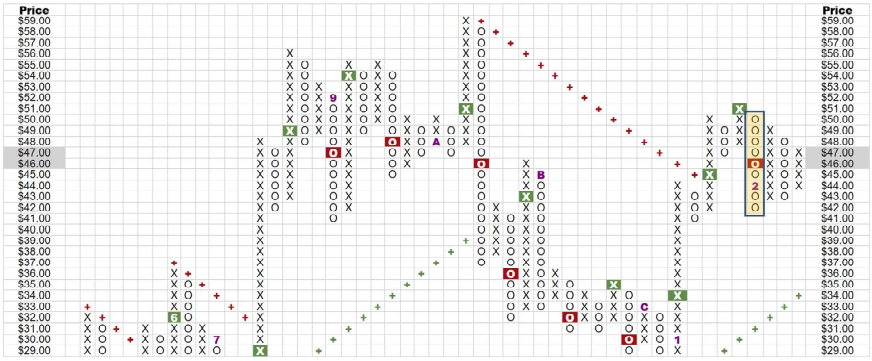


A less common approach is using point-and-figure charting. Point-and-figure charts are constructed by plotting vertical columns consisting of "X" and "O" symbols where X denotes a price increase and O a price decrease over the period in question – usually daily or weekly. Accordingly, a column of Os implies a possible down-trend, while a column of Xs an uptrend (see exhibit 10.3).

The peculiarity of point-and-figure charts is that they do not have a linear horizontal time-axis, so they focus purely on price changes. Many of the early trend followers based their trading on point-and-figure charting. The strategy was simply that after you had stacked up five or six Xs (the price closed higher for five consecutive days), you buy. This is denoted by Xs framed in a solid square in the exhibit below. Similarly, after five or six consecutive Os you'd sell. This approach apparently gave

excellent results for a number of years. In more recent times however, point-and-figure strategies haven't been as effective.

Exhibit 10.3: Point and figure charting



Note, there's no horizontal time-axis on point-and-figure charts.

In whichever way we use price fluctuations data, what distinguishes this kind of market information from other kinds is that prices are clear, unambiguous and they can be communicated to market participants without delay. For the most part (but not always) we can also rely on price information being true. Things get a bit more complicated when we try to interpret what the price information might be telling us. Having large amounts of price data makes it tempting to try and extract higher-order information from it or even analyze it for predictive attributes. This temptation has led many investors to devote a great deal of time and resources to studying the data using a broad variety of quantitative techniques, but as we have seen in chapter 5, this practice is fraught with risk and very susceptible to errors and misinterpretation.

The practice of plotting historical price charts has given rise to another distinct approach to analyzing markets. It is called "technical analysis" and it's different from other methods in that it is based on human *judgment heuristics* rather than on rigorous quantitative methods. Technical analysis has evolved simply through observation of price chart patterns which revealed many regularities that appeared predictable and in that sense exploitable. Over time, analysts have accumulated a large body of knowledge which gave technical analysis significant acceptance and legitimacy in the world of investment speculation. We'll expand our discussion of technical analysis in the following section.

Technical analysis

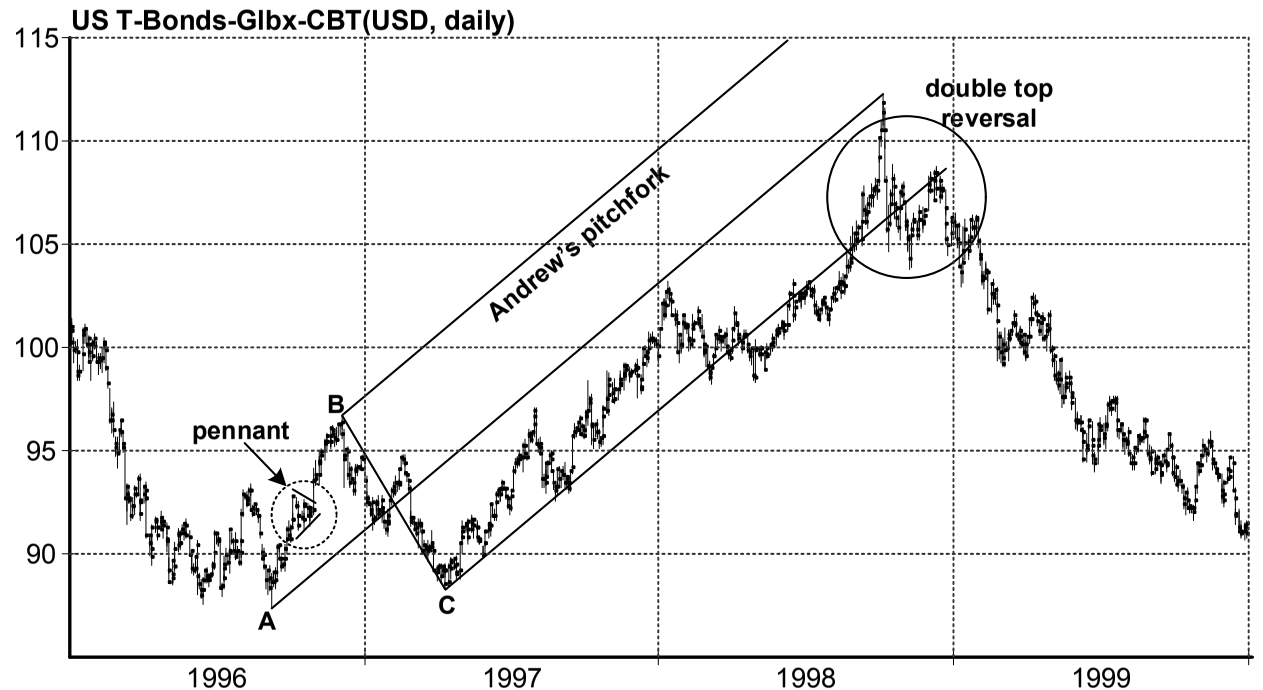
The most important tool in investing is a ruler.

Nick Glydon

Technical analysis concerns itself with the study of price charts using a bit of uncomplicated mathematics and simple geometry. Chart analysts use such concepts as trend lines, channels, speedlines, Fibonacci retracement levels or Andrews' pitchforks to divine where the price of some asset might be headed in the future. They also look for patterns in the price charts such as flags, pennants, double tops, double bottoms or head-and-shoulders reversals. In addition, they normally use a variety of simpler mathematical concepts including moving averages, stochastics, parabolic trailing stops and Bollinger Bands.

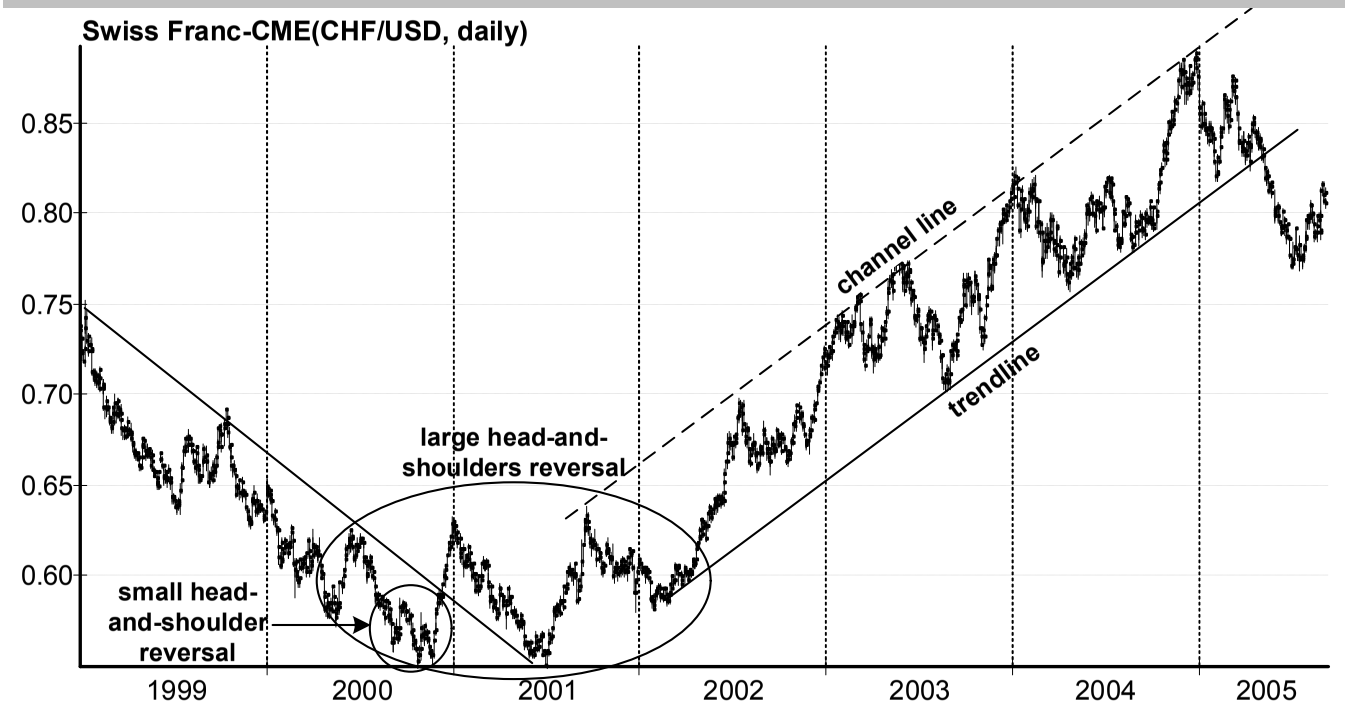
I started studying these by reading John J. Murphy's textbook "Technical Analysis of the Financial Markets," the book I'd warmly recommend to anyone interested in exploring the subject further. At first, I had a hard time keeping an open mind. In fact, I thought the whole concept was a bit ridiculous. To my mind, the subjective nature of chart analysis and a general absence of any scientific rigor placed technical analysis in the same category as astrology and fortune telling. However, after some time spent analyzing price charts myself I realized that perhaps this wasn't such a total waste of time. All those strange constructs and patterns I'd read about in John Murphy's book kept appearing before me again and again, in any market I looked at and on nearly any time scale. Below are just a handful of examples:

Exhibit 10.4: Andrew's pitchfork and a double-top reversal



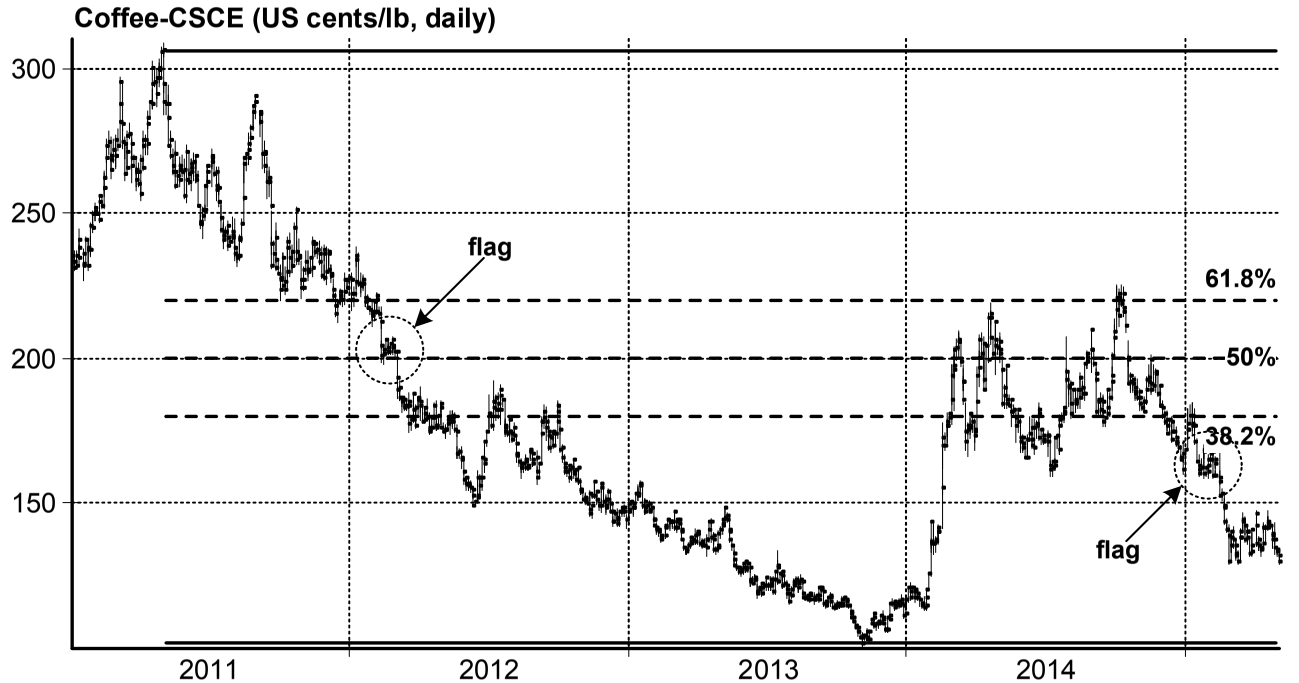
U.S. 30-year Treasury Bond prices advanced during 1997 and 1998 along the lines determined by the so-called Andrew's pitchfork formation, defined by points A, B and C. This advance reversed with a fairly clear double-top pattern.

Exhibit 10.5: Trendlines, channels and trend reversal patterns



Swiss Franc futures traded lower for two years from 1999 through 2000, but then started to reverse, first completing a small head-and-shoulders pattern, couched within a similar but larger reversal pattern. From 2002 through 2004, Swiss Franc trended upward within a channel defined by two parallel lines.

Exhibit 10.6: Fibonacci retracement levels



A three-year decline in coffee prices sharply corrected in 2014; the correction rapidly covered about 59% of the previous drop, then 61.8% and spent the bulk of 2014 fluctuating between the 38.2% and 61.8% retracement levels acting as support or resistance during the price consolidation period.

There are countless examples of asset prices advancing along straight lines or remaining confined within parallel channels. Trend reversals frequently trace head-and-shoulders formations, double bottoms or double tops. Often, significant trend moves correct by about 38.2%, 50%, or 61.8% – the so-called Fibonacci retracement levels. And while these occurrences aren't precise, prices do seem to broadly gravitate toward certain technical targets. As a chart analyst, I found myself even more mystified by concepts like speedlines or the so-called Andrew's pitchfork, where some chart formation would determine trend lines and support or resistance levels for years into the future.

The recurrence of these patterns in just about any price chart I looked at genuinely puzzled me. Why should prices bounce off of straight lines or remain bound within parallel channels for months or years? Why should reversals so often form double top, double bottom, or head-and-shoulders patterns? Why should trends unfold for years on end within the bounds of speedlines whose slope was defined at the very outset of a trend move? Clearly, all these patterns are merely the result of the price discovery process – the buying and selling activities of traders. But just how or why this process regularly produced such patterns remained a bit of a mystery to me. Technical analysis makes little attempt to explain the mystery, as it does not pretend to be a science. It is merely a repository of many decades of experience and observations by thousands of market practitioners, within the framework defined by three core *beliefs*: that prices move in trends, that the market price discounts everything, and that history repeats itself. We examine each of these beliefs, in reverse order.

History repeats itself

History may not really repeat itself, but what this principle means is that certain chart patterns observed in the past will likely continue appearing in the future with similar predictive implications for future price fluctuations. Stated otherwise, various patterns tend to occur repeatedly, offering analysts valid grounds to make predictions about future price moves. For example, completion of reversal patterns like a double top or head-and-shoulders signifies that the recent trend may have reversed and that prices will proceed in the opposite direction. Continuation patterns like flags, pennants and various triangles indicate that the prevailing trend will likely continue enabling us to project possible target prices for subsequent moves. The trouble with this belief is that like most of the rest of technical analysis, it is nearly impossible to verify through rigorous science. Price patterns don't always reappear in a precise form, identical to previous occurrences, so identifying them in charts is a matter of judgment rather

than exact science. Still, the experience of many practitioners – and I include myself here – strongly supports the belief that in this sense at least, history does repeat itself frequently enough.

Price discounts everything

Like the Efficient Market Hypothesis, technical analysis also assumes that all the information that's known and relevant to the value of some asset is already reflected in its price. So far as it refers to efficient markets – markets where large numbers of relatively small participants interact on a level playing field – this tenet is not terribly controversial. In efficient markets, the participants' collective knowledge of all the factors relevant to some security will tend to set the price roughly at the correct level. Again, this is a belief, not something we know for sure or even understand with much clarity. Exactly *how* price may discount everything is also a rather mysterious phenomenon. In his fascinating book "The Wisdom of Crowds," James Surowiecki recounts one illuminating instance of the price discovery process at work.

On 28 January 1986, 73 seconds into its flight, the space shuttle Challenger exploded over the Atlantic Ocean off the coast of central Florida. This tragic event triggered a revealing reaction in the stock market. In large part, Challenger's launch was the work of four major NASA contractors: Rockwell International, Lockheed, Marin Marietta and Morton Thiokol. Each of them was a publicly traded company. On the day of the Challenger disaster, the stock price of each contractor started dropping some 30 minutes after the explosion, before most people even had the time to digest what had happened.

One firm was hit harder than others: within an hour of the explosion, Morton Thiokol's stock was down 6% and its trading had to be halted. After trading resumed, its stock continued falling and by the end of the day, it was down 12%. By contrast, the stock of other three contractors rebounded and closed with a loss of only about 3% for the day. The reasons why the stock market singled out Morton Thiokol weren't clear; on the day of the disaster, there were no public comments declaring that Morton Thiokol might be responsible for the incident.

On the following day, rumors about what had happened published in the papers did not implicate Thiokol either. In fact, it was fully six months after the explosion that investigators concluded that the Challenger blew up due to the O-ring seals on booster rockets that were built by Morton Thiokol, and that the other three contractors were not liable.

Can it be that within 30 minutes of the incident the stock market determined what took investigators months to ascertain? I must confess that I found this account hard to believe and as I read it, my immediate

thoughts were that Morton Thiokol insiders must have dumped their shares in a thin volume session and as the price started dropping, some other participants may have followed suit and that's how the stock ended up battered. However, an analysis of the episode by finance professors Michael T. Maloney and J. Harold Mulherin cited by Surowiecki found that insiders did not sell their stock on that day. In fact, Maloney and Mulherin were entirely unable to come up with a convincing explanation for why Morton Thiokol stock was so quickly singled out by the stock market. It may well be that the market, in its mysterious collective wisdom somehow *knew* the relevant truths and set the price accordingly.

Surowiecki's book compellingly supports this possibility. Of course, as fascinating as it is to ponder the omniscience of collective wisdom, we must also acknowledge that markets periodically manifest manias or panics offering a very different perspective on their wisdom. But as Surowiecki argues, the ability of the collective to reach intelligent solutions to problems depends on certain conditions like decentralization of the flow of information, diversity of the participants, and their independence from one another in making decisions. If either of these conditions is compromised, the wisdom of crowds can – and periodically does – morph into a madness.

In modern securities markets, the sources of information are centralized to a large extent, and independence of decision making often gives way to herd-like action. At times when certain momentous events are taking shape, large numbers of individuals follow the action of others rather than think independently. At such times, the wisdom of crowds can get dysfunctional, contaminating the price discovery process with unwarranted fear or excessive enthusiasm that can push prices far beyond levels that could be rationally justified. Wise or not, the psychology of market participants is what ultimately determines asset prices, so the belief that *it's all in the price* remains valid. Whatever the state of a market at any given time – be it rational, depressed, or exuberant – it forms the objective reality and we have no choice but to reckon with it.

Markets move in trends

The third tenet of technical analysis should be obvious to anyone who ever looked at the price chart of almost any market security. Still, numerous learned members of academic institutions have managed to prove that this is not so. Some have gone as far as to claim that those who think they see price trends in markets are probably hallucinating. I find it perplexing that intelligent people and tenured professors at top universities can find ways to refute something that's obvious even to my golden retriever. Academia's disdain for chart analysts and trend following has a rather

long tradition, drawing much of its intellectual inspiration from the Random Walk Theory.

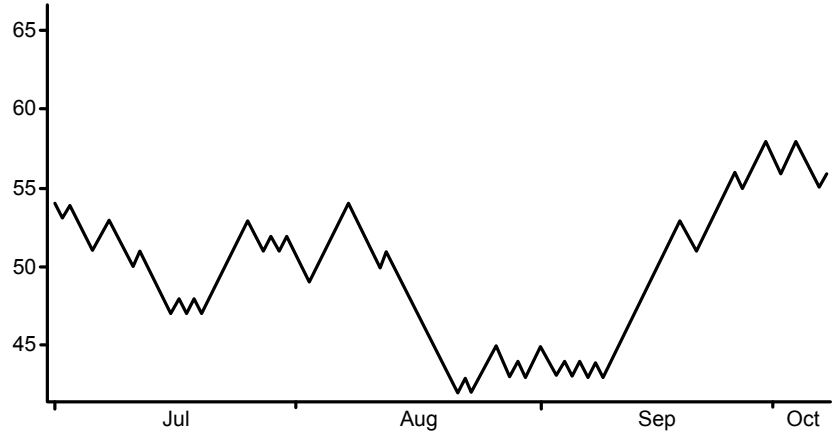
In a nutshell, Random Walk Theory views modern securities exchanges as models of efficient markets where all the information relevant to the traded stocks is already reflected in their prices. Future price fluctuations will be driven by random and unpredictable future developments, which will render those fluctuations random as well. This hypothesis was advanced by a number of theoreticians and academics including MIT Sloan Business School's Paul Cootner who wrote the book "The Random Character of Stock Market Prices"[62] in 1964, Eugene Fama who wrote an influential paper[63] titled, "Random Walks in Stock Market Prices," (1965) and Princeton University professor Burton Malkiel who popularized the Random Walk Theory. Malkiel also popularized the derision of technical analysis with his 1973 best-seller, "A Random Walk Down Wall Street."[64] His book has enjoyed remarkable success and has sold in eleven editions through 2012. However, the part of his refutation of chart analysis, which seems compelling at first glance reads like a bit of a fable – not the standard that rigorous science should aspire to.

The fable of the shrewd scientist and a foolish chart analyst

> Malkiel's is a fable about the shrewd scientist and a foolish chart analyst. In this story, the shrewd scientist (Malkiel himself) goes to the foolish chart analyst and shows him a chart which he had previously conjured up by flipping a coin. Explaining that the chart represented the price fluctuations of some stock, the shrewd scientist pretended that he was interested in the "wise" chart analyst's divination. Not realizing the scientist's clever trick, the gullible chart analyst looked at the chart and said unto him: "Oh scientist, if you wish to become rich, you must buy this asset at once, for its price is heading higher." Upon hearing the chart analysts' words, the shrewd scientist laughed and replied, "Do you realize, foolish chart analyst, that this chart is based entirely upon coin-tosses?" Recognizing that he had been outwitted, the chart analyst turned red in rage.

[62] Cootner, Paul H. (1964). *The random character of stock market prices*. MIT Press.
[63] Fama, Eugene F. (September/October 1965). "Random Walks In Stock Market Prices". *Financial Analysts Journal* 21 (5): 55–59.
[64] Malkiel, Burton G. (1973). "A Random Walk Down Wall Street" (6th ed.). W.W. Norton & Company, Inc.

Exhibit 10.7: A tosser's "trend"



The "price chart" constructed by coin tosses in Burton Malkiel's experiment

> The shrewd scientist had unmasked his sorcery and showed it to be futile and worthless for the whole world to see. The foolish chart analyst would now be forever banished from the realm of serious discourse.

Something like that. Namely, Malkiel conducted an experiment where he gave university students a hypothetical stock priced arbitrarily at $50/share. Each day's closing price was subsequently determined by the flip of a coin: *heads,* the price goes half a point up, *tails,* it goes half a point down. Malkiel took the resulting "price" chart to a chart analyst who promptly advised him to buy that stock. When Malkiel told him that the chart was based on flipping coins, the chartist was allegedly very unhappy. The story of this experiment, the resulting "price chart," and some inept analyst's recommendation was deemed by Malkiel as a solid ground to argue that stock price fluctuations are as random as coin-tosses. A more astute analyst might have caught onto the fact that all price changes occur in equal increments ($0.50 up or down each day), something you've never seen in real-life price charts. Also, an experienced analyst would have declined to make any recommendations based on only three months' worth of data. Indeed, since the first edition of Malkiel's book, much evidence has emerged suggesting that price fluctuations aren't entirely random, and that market prices do indeed move in trends.

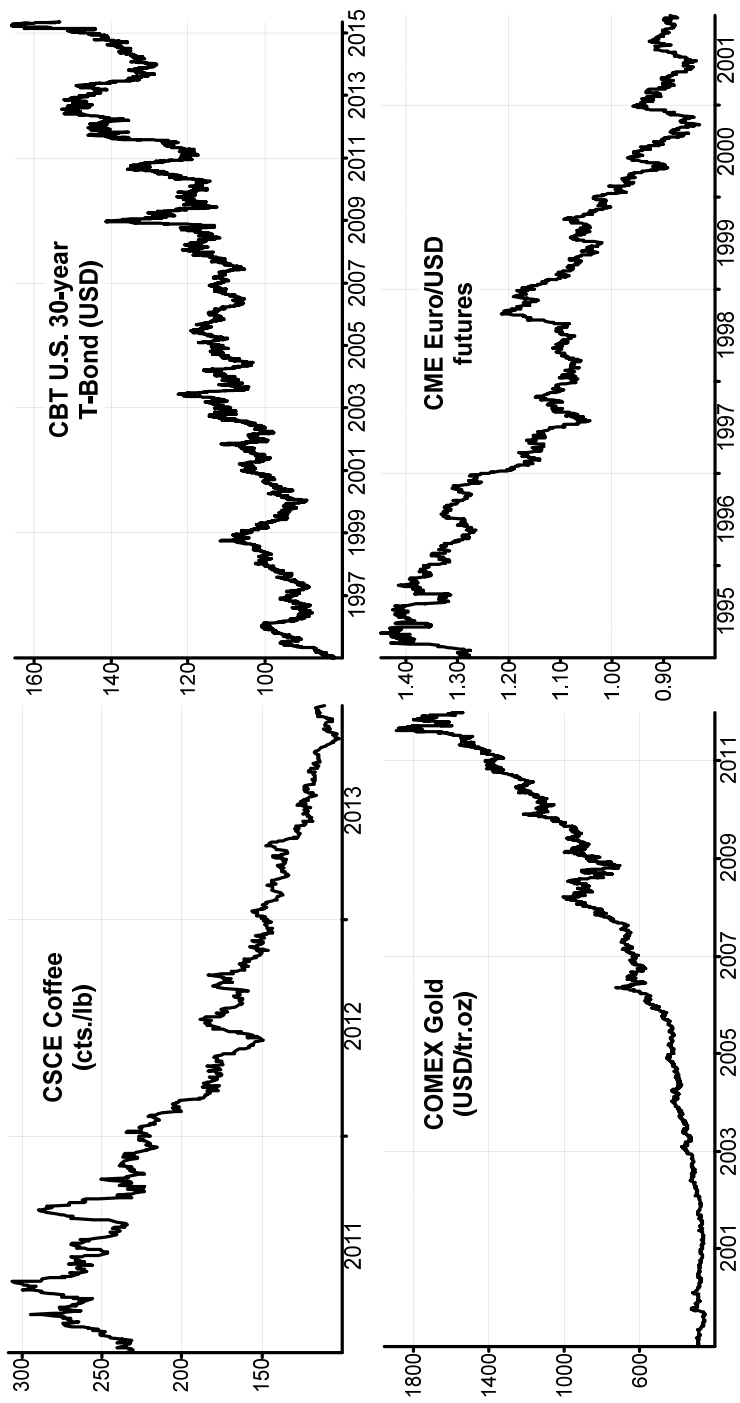
Chapter 11: Markets Move in Trends

We are always subject to a fear, when a market is moving up or down, that others know something we haven't yet figured out. So we feel a strong impulse to do what they are doing.

Robert Schiller, "Herd Behavior"

If you ever lived in a town or a city, attended school, read fashion magazines, or invested in stock markets, then you've inevitably experienced more trends in your life than you could name. The rising or falling popularity of music groups, fashion styles, political leaders or parties, social causes and even spiritual movements all frequently manifest unmistakable trends that surge through a society, reach their peak, and eventually fade. These are indeed such regular occurrences, so firmly rooted in human psychology that most everyone intuitively recognizes and understands them. Because financial and commodities markets also consist of human beings, trends are just as present and pervasive there.

Exhibit 11.1: Markets move in trends



This should not be a controversial assertion

Still, some humans, particularly those occupying the ivory towers of academia, continue to earnestly argue that there is no such thing as trends. Conceding that trends are real would clash with the theoretical framework that much of the academia explicitly adopted in studying markets.

The Efficient Market Hypothesis and the Random Walk Theory maintain that market price fluctuations are random. If they're random, there can be no trends, and that's that. You would think that a few price charts would suffice to settle this issue. Apparently this is not the case. This attachment of learned men to their theoretical home turf is something of a mystery of human psychology all in itself. An old Hebrew anecdote captures the point perfectly:

While a group of elder rabbis debated a section of Holy Law, a younger rabbi found himself in disagreement. He stated his case compellingly, but the elders disagreed, and pressed him to defer to them on this point. Convinced that he is right, he finally called upon god himself to help him convince the elders, asking god to make the rivers of Israel flow uphill if his position was right. God responded and the land's rivers promptly reversed direction. But the elders were not impressed and refused to change their mind.

Next, the young rabbi asked god to make all trees in Israel bend to the ground, and god obliged him again. Again, the elders were dismissive and unyielding. Exasperated, he finally asked god to speak to the elders directly, at which point the clouds parted, and a booming voice from heavens addressed the elder rabbis: "Hear me wise men, I confirm that the young rabbi is correct. He is right and you are wrong. What he says is what I intended." The young rabbi felt triumphant; surely the elders would now concede… But the elders remained unmoved: "we pay no attention to heavenly voices," they said, "the correct interpretation of this point was written long ago."

It appears that rigidity of convictions and aversion to contrary evidence is as old as history itself. All the same, let's look at some further evidence supporting the notion that trends do exist.

Trend followers

One group of hedge fund managers explicitly uses trends to generate investment returns. Trend followers are often referred to as CTAs (commodity trading advisors) and their investment vehicles as *Managed Futures* funds because as a rule, they tend to trade in commodity futures markets.

A partial list of trend followers and their performance vs. the S&P 500 index through April 2015						
Trend followers		Track record	Compound annual rate of return *		Value of $1,000 invested over the matching period	
Manager	**Fund or program**	**Years**	**Fund**	**S&P500**	**Fund**	**S&P500**
Mulvaney Capital Management	Mulvaney Global Markets Program	16	15.77%	3.00%	10,304	1,602
Drury Capital	Diversified Trend Following Program	18	11.01%	5.14%	6,506	2,458
Superfund Group	Superfund Green Q-AG	19	10.63%	6.33%	6,883	3,230
Clarke Capital Management	Worldwide	19	12.29%	6.36%	9,324	3,279
Transtrend B.V.	Diversified Trend Prog. – Enhanced Risk	20	13.37%	7.63%	12,710	4,433
Eckhardt Trading Company	Standard Program	24	13.94%	7.27%	21,990	5,273
Rabar Market Research	Diversified Program	26	11.54%	7.70%	17,606	7,010
Saxon Investment Corp.	Diversified Program	27	12.13%	7.96%	21,012	7,669
Chesapeake Capital	Diversified	27	12.30%	7.84%	23,408	7,786
Abraham Trading Company	Diversified Program	27	16.95%	7.98%	71,462	8,111
Dunn Capital Management	WMA Program	30	14.63%	8.72%	63,770	8,111
Campbell & Company	Financial Metal & Energies	32	11.02%	8.26%	28,434	12,681
Milburn Ridgefield Corporation	Diversified Program	38	15.16%	8.50%	219,222	22,539
* Over the matching time interval from each fund's inception through April 2015						
Data source (except last two columns): Institutional Advisory Service Group (www.iasg.com)						

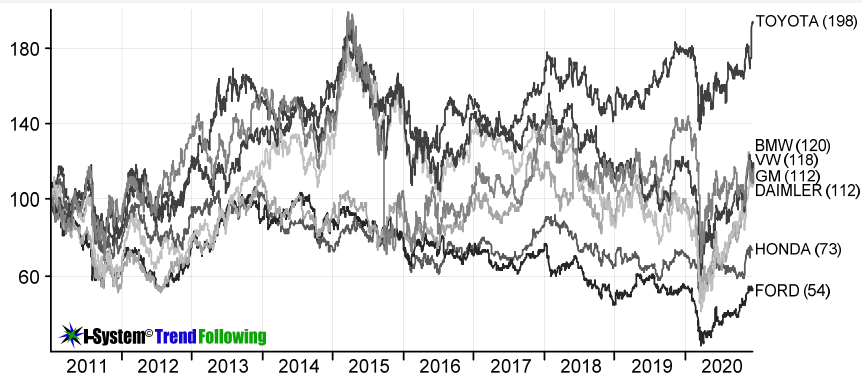
Rather than cultivating expertise on any specific market, industry, or geographical area, trend followers seek to identify trends in any liquid securities market and generate returns from advancing or declining prices. If Random Walk Theory adherents were right, then trend followers couldn't achieve positive returns on investment over the long term. But on this count, the random walkers would be emphatically wrong.

The table on the previous page summarizes the performance of thirteen trend followers with between 16 and 38 years of continuous track record: as we can see, each money manager listed in the above table has generated very high investment returns over the matching time frames, even outperforming the U.S. stock market over the same period. If trends really didn't exist, this achievement would have to qualify as a miracle.

Momentum investing

On Tuesday, 15 December 2020 at market close, the market capitalization of the electric vehicle manufacturer Tesla surpassed that of the next seven car manufacturers combined (Toyota, General Motors, Daimler, VolksWagen, BMW and Honda). At that point in time Tesla's market cap reached $606.5 billion while the other seven car makers together were valued at $578.2 billion. This seeming anomaly would be difficult to justify on the basis of rational asset valuation, but the experience yet again underscored the power of market trends.

Exhibit 11.2: Global car manufacturers (03 Jan. 2011 = 100)

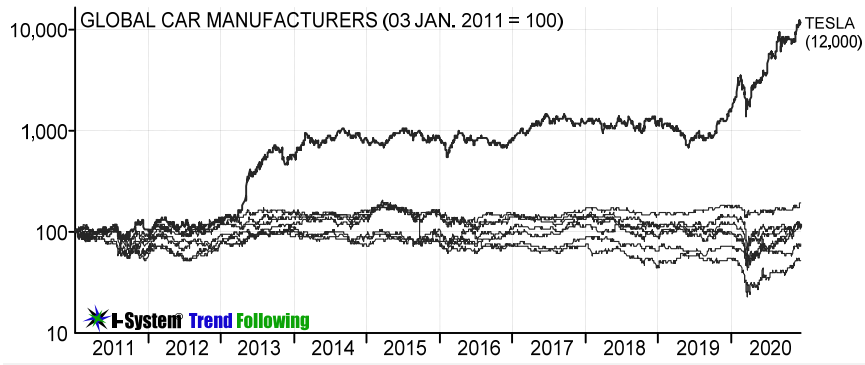


Stock price trajectories of seven large global car manufacturers.

While the S&P 500 appreciated by almost 300% over the same period, car manufacturers have lagged considerably. For every dollar invested in Toyota, at the end of 2020 you'd have about two dollars. If you were unlucky to invest in Ford Motor Co, your investment would be worth

about half and with most of the others, you'd be about even. Then there was Tesla. Over the same period its stock price increased 120 times! To include Tesla's shares in the chart I had to rescale it to logarithmic scale, else other car makers' stock price curves look like a bumpy horizontal line:

Exhibit 11.3: Global car manufacturers vs. Tesla (03 Jan. 2011 = 100)



Tesla's shares far outstripped other car manufacturers

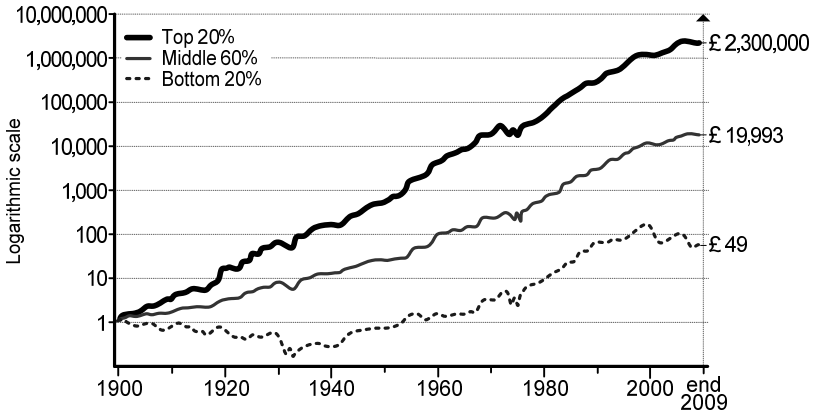
One could argue that Tesla shouldn't be compared to other car manufacturers because it produces electric vehicles, that its strengths and potential lie in technology and battery production, and so forth. Many analysts have advanced such arguments to explain the markets' appetite for Tesla's shares. But I've also read as many analysts compellingly argue that short-selling Tesla's shares would be a better bet. On both sides, such arguments tended to be based on rational asset valuation metrics. Whichever side was right, the undeniable reality that unfolded before us was that Tesla had massively outperformed it peers in a trend that's held throughout the decade of 2010s. Investors who had the wisdom and foresight to buy Tesla shares and to hold them for ten years, would have done extremely well.

But who can have such wisdom and foresight about any particular stock? Probably not very many of us. But what if you systematically picked the best performing stocks and invested in them regardless of what you knew about the companies in question, their valuation, products or about their management teams? Indeed, then you'd be on to something quite powerful. Tesla's ascent was not an anomaly but only perhaps a rather spectacular case of the recurring theme: that market prices move in trends. When trends get going in earnest, they often eclipse all our notions about rational asset valuation – both on the up-side and to the down-side. The strategy of harnessing the power of trends in the stock markets is called momentum investing, and it seeks to systematically pick such

ascendant stocks and hold them for as long as they outperform. How well does this strategy perform? The evidence suggests that it performs remarkably well.

To test the momentum strategy, researchers Elroy Dimson, Paul Marsh and Mike Staunton from the London Business School analyzed nearly 110 years' of stock market price history starting with the year 1900. They constructed investment portfolios by selecting 20 top performing stocks in the previous 12 months from among UK's 100 largest publicly trading firms, and compared their performance to portfolios of 20 worst performers, re-calculating the allocations every month. They found that previous year's lowest-performing stocks would have turned £1 invested in 1900 into £49 by 2009. By contrast, previous year's top-performing quintile of stocks would have turned £1 into £2.3 million,[65] which reflects a staggering 10.3% difference in compound annual rate of return!

Exhibit 11.4: Investing with trends through momentum strategy



Source: The Economist

The gap between investments in best and worst performing stocks was even wider when data from the entire London stock market was taken into account. From 1955 onward, the portfolio of previous year's top performers generated a compound annual rate of return of 18.3% against the return of 6.8% for the portfolio of worst performing stocks. Dimson,

[65] These figures correspond to the outcome at the end of 2009, following the 2008 market crash. At the close of 2007, the figures were even more impressive: the portfolio of winners generated a compound annual rate of return of 15.2%, turning £1 invested in 1900 into more than £4.2 million. The portfolio of worst performers would have returned only 4.5% a year, turning £1 into £111.

Marsh and Staunton found that these excess returns from the strategy of buying top-performing stocks were "striking and remarkably persistent" as it proved successful in 17 out of 18 global markets studied, with data going back to 1926 for the United States and to 1975 for larger European markets. The only exception was Japan, where the results were based on post-2000 data – a relatively short, 9-year sample which coincided with a sustained bear market in Japanese stocks.[66]

Professor Marsh's reaction to his own research was symptomatic of the academics' discomfort with objective reality when it fails to conform to theory. In a statement to Financial Times Marsh said that, "It is a very simple strategy, buying winners and selling losers. In a well-functioning market it ought not to work. We remain puzzled and we are not the only ones; most academics are vaguely embarrassed about this."[67] In spite of the researchers' puzzlement, the data strongly supports the performance power of the momentum investing strategy. The significance of the Dimson, Marsh and Staunton study is that it has offered perhaps the most compelling evidence to date that market trends are by far the most potent drivers of investment performance over time.

Market trends and value investing

The success of trend following and momentum strategies may seem puzzling from the strictly common-sense point of view. Namely, they both involve buying high and selling low, which is contrary to our natural inclination to buy things at low prices and try selling them at higher prices. After all, this approach is at the core of *value investing* that made Benjamin Graham and his disciple Warren Buffet some of the world's most successful investors of all time.

Investment performance of world's best known value investors

	Compound annual rate of return	S&P 500*	Outperformance
Benjamin Graham	20%	12%	8%
Warren Buffett	18%	10.8%	7.2%

*Measured over the same time period

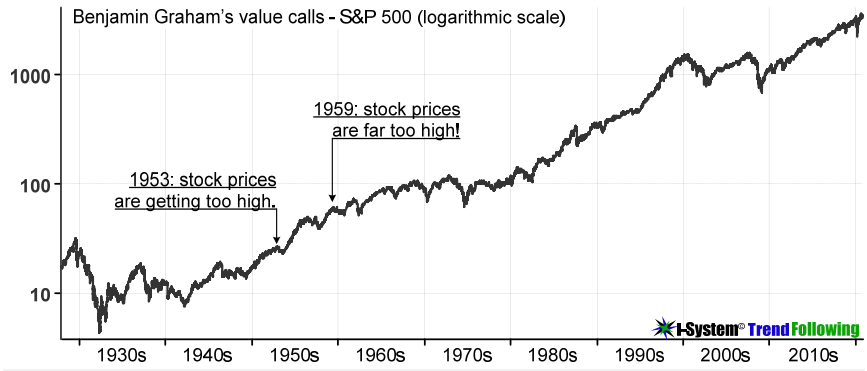
Benjamin Graham authored "Security Analysis" and "The Intelligent Investor," widely considered as the most important books on investing ever written. He generated an annualized return on investment of about

[66] Financial Times, "Momentum effect gains new admirers" by Steve Johnson, 23 Jan 2011
[67] Financial Times, "Ignore momentum at your peril" by Steve Johnson, 18 Feb 2008

20% over a 20-year period. During this time the stock-market overall returned about 12% per year. Warren Buffett himself generated a compound annual rate of return of over 18% during 30 years of his career.[68] The S&P 500 index returned 10.8% during the same period. While Graham and Buffett are generally regarded as value investors, a closer look at their performance reveals that their success had more to do with market trends than with superior value-finding skills. In "The Intelligent Investor," Graham observes powerful market trends as they confound his judgment on the valuation of stocks.

In 1953, as the US stock market enjoyed one of the longest running bull-markets until that point, he cautioned investors that the stock prices were getting too high. "*As it turned out,*" he later wrote, "*this was not a particularly brilliant counsel. A good prophet would have foreseen that the market level was due to advance an additional 100% in the next five years."*[69] By 1959, the Dow Jones Industrial Average reached an all-time high at 58.4, and again Graham warned investors that stock prices were "*far too high.*" Nonetheless, the Dow rose another 26% to 73.5 by late 1961 and after a subsequent 27% correction in 1962, it soared on to 89.2 in 1964.

Exhibit 11.5: Spot the trend – the "overvalued" S&P 500



Since the 1940s, the great bull market in the U.S. stocks greatly contributed to investment returns. The chart's logarithmic scale visually diminishes the magnitude of the massive bull market and of the periodic price corrections. On the linear scale, the price chart goes almost vertical by 2020.

In sum, Graham thought that stocks were overpriced in 1953 as they were about to treble in value over the next eleven years. Selling your investments ahead of a 200+ percent bull market isn't a good way to earn high investment returns. So how did Graham generate the remarkable

[68] Sizemore, C. "The Worst Investment of Warren Buffett's Career." Forbes, 5/8/2013.
[69] Graham, Benjamin. *The Intelligent Investor*. New York: Harper Business, 2003. (73)

results from his investments? The simple answer: by not following his own investment advice. Instead, Graham inadvertently did what a trend-follower or a momentum investor might have advised him to do: he held onto his best performing investment even though it was overpriced from the get-go.

Namely, in 1948, Benjamin Graham and his partner Jerome Newman purchased a 50% interest in the Government Employees Insurance Company (GEICO). The $712,500 purchase was roughly a quarter of their fund's assets at that time. Here's what Graham says about their GEICO investment in the postscript to "The Intelligent Investor": "*... it did so well that the price of its shares advanced to two hundred times or more than the price paid for the half-interest. The advance far outstripped the actual growth in profits, and almost from the start the quotation appeared much too high in terms of partners'*[70] *own investment standards."*[71]

Graham explains why he and Newman did not sell GEICO even though they judged its price *"much too high"* from the start. Because of the size of their commitment and involvement in the firm, they regarded it *"as a sort of 'family business,' "* and maintained ownership in it in spite of its spectacular price appreciation. In Graham's words, the profits from this single investment decision, "*far exceeded the sum of all the others realized through 20 years of wide-ranging operations in the partners' specialized fields, involving much investigation, endless pondering and countless individual decisions."*

In other words, *far* more than one half of Graham and Newman's performance came from the one investment they kept through a two-decades' bull market and *did not* sell it even though it was grossly overpriced *"in terms of partners' own investment standards"*. That implies that all their "*investigation"* and "*endless pondering"* contributed less than 10% in annual returns, underperforming the stock market by at least 2 percentage points over 20 years. That further implies that if Graham and Newman *only* invested in GEICO and spent the rest of their careers fishing and golfing rather than burdening themselves with investigations and endless ponderings, they would have done at least twice as well as they *have* done, generating annual returns of 40% or more from 1948 to 1966!

For his part, Warren Buffett's style reveals much more of a momentum player than value picker. He made many of his large investments on the back of major run-ups in stock prices. Examples include his investments in Capital Cities (1985), Salomon Inc. (1987 and 1994), Coca Cola (1988),

[70] When Graham says, "partners," he means himself and Newman.
[71] Ibid., 532, 533.

Gillette (1991), Freddie Mac (1991/2), General Dynamics, (1992), and Gannett Company (1994).[72] When Buffett bought over $1 billion of Coca-Cola shares, they had appreciated more than five-fold over the prior six years and more than five hundred-fold in the previous sixty years. This decision proved right, as his investment in Coca Cola quadrupled in value over the following three years, far outstripping the S&P 500.[73]

And like Graham before him, Buffett owes much of his success to GEICO. He started buying its stock in 1975 at $2 per share, and kept adding to this investment even as GEICO's market cap went from $296 million in 1980 to $4.6 billion in 1996. This growth in valuation corresponded to a compound annual rate of return of 29.2%, an outperformance of more than 20% per year over the S&P500![74] Did Warren Buffett sell his stake in this overvalued[75] company? To the contrary, in 1996 Buffett bought 50% of it, making Berkshire Hathaway 100% owner of GEICO. This was not exactly a value pick, but the decision again proved a winner: by 2011, GEICO's market cap nearly quadrupled to $20.5 billion based on Warren Buffet's valuation model.

Even though Graham and Buffett somehow came to epitomize the so-called value-driven investing, both owed their success to market trends. In American stock markets, bullish trends were out in full force through most of Graham's as well as Buffett's careers which were most abundantly blessed by some of their most "overvalued" investments. In essence, Graham and Buffett may both have overtly espoused value investing because it's a rational style that sits well with investors. However, they both achieved their outperformance thanks to their momentum plays and market trends and not by their value picks.

Human psychology: the driver of trends and bubbles

Economic value is central to our decision making and it plays a major role in our intuitive psyche. In daily life, when we buy a loaf of bread or a tank-full of gasoline, we tend to have a good idea about what we think is cheap and what's expensive. We like to find bargains and don't enjoy being ripped off. Just as we are inclined to shop for value as consumers, we find value investing intuitively appealing. However, there's a critical bit of difference between buying goods and investing: buying investment assets is speculative while shopping for stuff isn't. We normally acquire

[72] These investments are detailed in R. Hagstrom's "The Warren Buffett Way."
[73] Hagstrom, Robert G. *The Warren Buffett Way.* New York: Wiley Investments, 1995. (v)
[74] During the same period, S&P500 grew by 8.9% per year
[75] At the time, GEICO's book value was $1.9 billion, which means that the remaining part of its $4.6 billion market cap was goodwill, rendering GEICO's shares very "expensive."

goods for some use but when we invest we do so in order to profit as much as possible. Speculation thereby activates certain emotional parts of our mental circuitry that can heat up to a boiling point and overwhelm any rational consideration of value.

When a multitude engages in speculation on some desired asset, their activity can gradually inflate that asset's price and create a price trend. At times, such trends can escalate and grow into bubbles of great proportions. Here's how this dynamic shapes up: in making investments, our rational goal is to obtain the best possible return with the least risk necessary. If we buy a house or a stock for investment, we want to receive a stream of rents or dividends and preferably the opportunity to resell the asset for a price that's higher than what we paid. Since those outcomes depend on other market participants, we are obliged to reflect on what they might do. Thus, if house prices are going up we infer that people are keen on investing in real estate and that rising demand would push future house prices even higher. If we are convinced that this is the case, we might disregard the fact that houses are already expensive. In effect, led by the actions of others, we might accept inflated house prices and proceed with the investment anyway.

This dynamic was demonstrated empirically in a clever experiment designed by Colin F. Camerer at Caltech's Experimental Economics Laboratory.[76] In this experiment, a group of students were asked to trade shares in a hypothetical company during 15 five-minute periods. The students were not allowed to discuss their actions and only communicated via *buy* and *sell* orders. To start with, each student received two shares and some money with which to buy more shares. At the end of each of the 15 periods, the shares paid a $0.24 dividend for a total payout of $3.60 per share throughout the experiment ($0.24 x 15).

This provision removed any uncertainty about the shares' value: at the start of the experiment, the maximum value of one share was $3.60 and this amount diminished by $0.24 after each round, since that amount of dividend was already paid out. The highest price any player should accept to pay for a share should not be one penny more than what that share would yield in remaining dividends. However, Camerer's experiment showed otherwise. When the experiment started the share price immediately jumped to $3.50, close to the shares' rational value. But rather than steadily declining with each new round, the price remained near that level almost to the very end of the experiment. Even when the value of each share fell below $1, students were still willing to pay $3.50 to buy them. When Camerer asked the students why they bought the

[76] Surowiecki, James. *The Wisdom of Crowds*. New York: Anchor Books, 2004.

shares at prices that obviously far exceeded their value, he reported that the students typically replied that, "*Sure I knew that prices were way too high, but I saw other people buying and selling at high prices. I figured I could buy, collect a dividend or two, and then sell at the same price to some other idiot*."[77] A strange confluence of circumstances produced this very same dynamic in a real-life experience that became known as the Chinese Warrant Bubble, described in a remarkable paper by Princeton University's Wei Xiong and Columbia University's Jialin Yu.[78]

Chinese Warrant Bubble

In an effort to develop China's financial derivatives market, from August 2005, China Securities Regulatory Commission (CSRC) started introducing a small number of warrants – financial instruments similar to options, issued by publicly traded corporations. Firms were allowed to issue call or put warrants. With call warrants, issuing firms granted investors the right to buy stock from them, and put warrants gave them the right to sell stock back to the issuing company at a specified strike price and time period during which investors could exercise their option to buy or sell stock shares. Between 2005 and 2008, 18 put warrants with maturities from 9 to 24 months were issued to the public.

During this very period, the Chinese stock market experienced a strong bull run and its index vaulted from 1,080 points in June 2005 to 6,124 in October 2007. This rally quickly pushed most put warrants so deep out of the money that they became worthless. In spite of this, feverish speculation on these securities produced an extraordinary financial bubble, unique in the history of bubbles because warrants continued trading at spectacularly high levels of turnover and very inflated prices, even as it became evident that their value had clearly dropped to zero.

Consider the case of a Chinese liquor producer, WuLiangYe Corporation. On April 3, 2006 WuLiang issued 313 million put warrants with a two year maturity and a strike price of 7.96 yuan. The initial price of the warrants was 0.99 yuan and company stock traded at 7.11 yuan. Although the warrant was *in the money*[79] when issued, the dramatic rise in WuLiang's shares pushed it out of the money in only two weeks after which it never came back in the money. WuLiang's stock price rose ten-fold, reaching 71.56 yuan in October 2007 before retreating to about 26 yuan on April 2, 2008 when the warrant expired. Rather than falling in value as they got farther out of the money, WuLiang's put warrants rose

[77] Idem.
[78] Wei Xiong and Jialin Yu. "The Chinese Warrants Bubble." National Bureau of Economic Research, Working Paper 15481
[79] Meaning, the warrant's strike price was higher than WuLiang's stock price.

along with the company's share price, at one point even surpassing their own strike price at 8.15! Paying 8.15 yuan for an instrument that has a maximum possible payout of 7.96 yuan (if the firm's share price went to zero) makes little sense, but someone did pay that much. Meanwhile, according to the widely used Black-Scholes model, the warrant's value fell below 0.0005 yuan after July 23, 2007 and remained below that level for the remaining nine months of the warrant's maturity.

Exhibit 11.6: The evolution of WuLiang stock and warrant prices

Note the astonishing gap between the market price (bold solid line) vs. Black-Scholes valuation (the bold dashed line sloping downward in the lower left corner of the chart).
Source: The American Economic Review, October 2011.

Still, the warrant continued trading at a price of several yuan, dropping below 1 yuan only in the very last few trading days and dropping to zero literally in the final minutes of the warrant's last trading day. This same phenomenon played out with all 16 put warrants analyzed by Wei Xiong and Jialin Yu. For each, the Black-Scholes valuation dropped to nearly zero (below 0.0005 yuan) where it remained on average for 54 days. During this zero-value period, each warrant traded at spectacularly high

turnover levels[80] corresponding to billions of US Dollars per day and at an average price of 1.00 yuan – more than 2,000 times their value.

Chinese warrants bubble provides some of the clearest evidence to date that in speculative decision making, our views about the actions of others can entirely override any rational appraisal of an asset's value. That in turn gives us a convincing perspective on the reality of market trends: asset prices are not determined by rational valuation metrics, only to be randomly affected by external events. Instead, prices are driven by human psychology and its self-stoking collective action capable of sustaining major trends that can last many years. Consequently, investors and traders have little choice but to recognize trends as a legitimate source of investment opportunity.

The one force moving stock market trends

Collective human psychology is the key element giving shape to market trends. However, we must also acknowledge and understand the material substance that has fueled large-scale trends in capital markets.

When I began trading stocks in the late 1990s and the markets were engulfed in a great stock investing frenzy, I had a gnawing suspicion that beyond the nonstop noise of the news flow, there was some great force pushing the whole rising tide, but I couldn't discern what it was. By today I think I worked it out. The most surprising thing about it is that it was so hard to work out. The first time I encountered an explicitly formulated hypothesis that justified my suspicions was years later while I was doing research for my book "Grand Deception." The hypothesis, relating to Russian stocks, was articulated by Bill Browder, then CEO of Hermitage Capital Management in his 2006 HedgeWeek interview: "*Hermitage has identified a 90% correlation between money supply growth and the Russian RTS equities index from 2003 to 2005. Increases in money supply are highly correlated with an increase in equity values in Russia. Interestingly, the stock market has recently become more sensitive to changes in money supply then it was in the past. While the correlation has always been high (between 85% and 95%), the slope of the correlation line (i.e. the impact of new money on the market) has recently increased. For example, in 2004 there was a 1:1 relationship between money supply and the stock market (a 10% change in money supply would lead to a 10% change in the stock market). Now there appears to be nearly a 4:1*

[80] During their zero value period, each warrant had an average daily turnover rate of 291% and an average daily volume of 1.26 billion yuan, meaning that each warrant changed owners three times during an average day even though it was essentially worthless.

relationship. New money supply is having a much greater impact on the stock market."

In other words, the predominant force behind the rise of Russian stocks was the central bank monetary inflation. Mind you, Browder was no ordinary hedge fund manager. He was – and still is – a well-connected operative in the way most investment managers aren't. His partner in crime was Edmond Safra, the late owner of the infamous money laundering outfit, Republic National Bank of New York. After Safra's mysterious death in 1999, his bank was absorbed by HSBC, which became Browder's new and bigger partner in crime. The reason why his background is relevant is that managers like Browder are privy to knowledge that is not typically taught in economics courses or discussed in mainstream finance media. Another money manager with privileged access is Stanley Druckenmiller. More recently he also articulated essentially the same idea about what moves stock markets: "*Earnings don't move the overall market, it's the Federal Reserve Board… focus on the central banks, and focus on the movement of liquidity… most people in the market are looking for earnings and conventional measures. It's liquidity that moves markets.*" [81]

While ordinary investors and market analysts exert themselves daily, analyzing a myriad of charts, business fundamentals, wholesale and retail sales, earnings reports, profit warnings, interest rates, employment and an endless alphabet soup of ratios and indicators, other investors have the advantage of understanding the force that moves those great tides which lift all boats. Those investors can therefore make much larger, higher conviction bets, earn greater returns, and exit the scene before the tide goes out, stranding the ordinary investors. When I read the Bill Browder interview, I knew that he was almost certainly a western intelligence asset, that he worked for high-level financiers and that he was certainly privy to higher level guidance. His HedgeWeek statements corroborated this.

But we also have good empirical evidence about the monetary tides behind large-scale stock market trends. In his masterful 1974 book "Dying of Money," Jens O. Parsson provides further support for this hypothesis: "*Monetary inflation invariably makes itself felt first in capital markets, most conspicuously as a stock market boom. … This happened at the commencement of the German inflationary boom of 1920, and it happened again at the commencement of the American inflationary boom from 1962 to 1966. Indeed, every monetary expansion in the United States since World War II was followed by a stock market rise, every cessation of*

[81] Riquier, Andrea: "Here's why investors are shrugging off coronavirus earnings warnings" – MarketWatch.com, 20 Feb. 2020

monetary expansion by a stock market fall. Conversely, every stock market rise was preceded and accompanied by money inflation. Bull markets rest on nothing but inflation." [82]

Parsson's book accounts for ten of these monetary easing and tightening cycles. I have extracted the data he presents and summarized it in the table below along with the Dow Jones Industrial Average level and the beginning and end of each cycle to underscore the fact that they almost perfectly coincide with great rallies and corrections in the stock market.

Federal Reserve's 9 easing and tightening monetary cycles and their effect on the stock market.

CYCLE	PERIOD (START / END)	DJIA LEVEL	M2 MONEY GROWTH	STOCK INDEX CHANGE
1	Apr '54	311	3.90%	58%
	Dec '56	492		
2	Jan '57	486	-0.70%	-10%
	Dec '57	437		
3	Dec '57	437	4.00%	52%
	Jul '59	663		
4	Jul '59	663	-1.20%	-12%
	Oct '60	582		
5	Jan '61	632	2.90%	9.2%
	Apr '62	690		
6	Apr '62	690	-0.70%	-13.5%
	Sep '62	597		
7	Sep '62	597	4.60%	58.1%
	Apr '66	944		
8	Apr '66	944	0.00%	-17.5%
	Oct '66	778		
9	Jan '67	831	7.20%	23%
	Apr '69	1,022		

Sources: Jens O. Parsson, "Dying of Money," Federal Reserve Bank of St. Louis - https://fred.stlouisfed.org/series/M1109BUSM293NNBR

But what is particularly interesting here is not just the absolute expansion of money supply but also its relative rate. If the *rate* of expansion of money supply slows down at all, it may lead to a stock market collapse. During the Nixon years, monetary inflation expanded to almost 8% per year, the fastest rate since 1946. Then in May 1969 Federal Reserve began to tighten, reducing the money supply growth to 3.8%. Although this was

[82] Parsson, Jens O. "Dying of Money: Lessons of the Great German and American Inflations." – 1974, republished in 2011 by Dog Ear Publishing, LLC

still a relatively high rate of inflation, within two months, average stock prices dropped by 14% and within another year they were off by 31%! This same principle was at work during and immediately after the roaring 20s (1930 through 1933). According to Murray Rothbard, the "M" money supply was growing at an 8.1% annual clip from mid-1921 through 1928 fueling a nearly 25% annual inflation of stock prices.[83] Our most recent bull market (2009-2020) was no different. In 2016, economist Brian Barnier of ValueBridge Advisors showed that up until that point, the Fed's Quantitative Easing (QE) program was behind 93% of that market cycle.[84]

Indeed, as Parsons wrote, "*The stock market dances to an inaudible tune that is played for it by the government's money inflation or deflation ... A man who fully understood what inflation was doing at all times would seldom be surprised by the stock market. Armed with that understanding and little else, he could participate profitably in every stock market rise, step aside safely from every stock market fall, and shepherd his property with reasonable security through the bombardment of inflation or deflation. ... When the government first turns on money inflation in times of slack business, the money has no work to do yet and nowhere to go but into investment markets. So the markets rise, even though business is still bad. ... A rising stock market signals nothing but freshening money inflation. It is the earliest and most sensitive indicator of the inflationary train of events to come."*

So then, what happens next? As I write these lines in February 2021, the U.S. stock indices are still trading at their all-time highs and the expansion is showing no signs of abating. Back in 2016, while 'smart money' was turning very bearish on stocks, I suggested on my blog that markets might not collapse and that instead, if central banks remained committed to supporting asset prices "we could see a significant and sustained rise in equity markets."[85] Soon enough, we found out: the Fed did remain committed to supporting asset prices and this commitment was highly unlikely to change. The last abortive attempt at quantitative tightening in 2018 promptly triggered an almost 20% correction in the S&P500, but once the Fed reversed itself and reopened the monetary inflation spigot, so did the stocks. The Fed couldn't risk tightening anymore and keeping the bubbles going is the only option, requiring an ever-expanding QE. This may have sealed the endgame: an accelerating

[83] Salerno, Joseph T. "Money and Gold in the 1920s and 1930s: An Austrian View" – Mises Institute, 18 June 2019.
[84] Lewitinn, Lawrence: "The Fed caused 93% of the entire stock market's move since 2008: Analysis." – Yahoo Finance, 11 March 2016.
[85] Krainer, Alex: "Stock markets might not crash. Investors might still lose big." – The Naked Hedgie, 24 Oct. 2016.

bull run accompanied by hyperinflation after which there would be an epic crash and probably a prolonged equity bear market.

Trends in the broader economy

Of course, there is more to trends than just asset prices, which are merely a singular expression of the broader economic process at work. An extensive study conducted by the consulting firm McKinsey & Co. will help us appreciate their importance. McKinsey analyzed the performance of some 100 of the largest US corporations from 17 different sectors of the U.S. economy over two business cycles, from 1984 to 1993 and from 1994 to 2003. The study[86] sought to answer the question: *"How does a large company achieve and maintain strong growth?"* The authors set out to understand which factors made some corporations more successful than others in terms of revenue growth and total returns to shareholders (TRS). They expected that answers would emerge from individual firms' performance in strategy, marketing, operations and organization. What they discovered instead was startlingly different. From among 102 corporations studied over the 1994-2003 cycle, they identified 32 "growth giants" – firms whose revenue growth outpaced the GDP and whose stock outperformed the S&P 500. Among these growth giants, 90% were concentrated in only four sectors of the economy: financial services, health care, high tech, and retailing.

Those four sectors enjoyed favorable market trends during the business cycle: financial services benefited from deregulation, increased borrowing and an increasing public participation in equity markets; health care expenditure grew with the nation's aging population and through innovation; the high-tech industry also enjoyed a massive wave of innovation in the 1990s; retailing grew through growing consumer affluence and format innovation by firms like Wal-Mart, Target, Lowe's and Home Depot. While the overall economy grew at a rate of 5% from 1994 to 2003, financial services grew by 7%. High-tech also grew 7% overall with services in the high-tech industry growing even faster at 9%. Health care expenditures grew at 7%, but most of the growth in the health care sector was concentrated in pharmaceuticals, which expanded by 12.5%! In retailing which grew slower than the GDP at 4.5%, growth giants expanded much faster.[87]

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[86] Smit,, S., et al. The do-or-die struggle for growth. McKinsey Quarterly, August 2005.

[87] Only one of the 102 corporations – perhaps the exception to prove the rule – built a big new business without the backdrop of a strong trend of growth in the market: Wal-Mart managed to grow rapidly in the slow growing market for perishable groceries through leveraging of its brand, supply-chain muscle and format innovation.

McKinsey's analysts wrote that, "*What's striking for a large growth-minded corporation is just how crucial it is to have this kind of favorable wind at their backs when they try to achieve strong growth*." Indeed, favorable market developments gave rise to trends that were the key driver of value creation for 90% of the most successful corporations. By contrast, "*when large companies face slow-growing markets*," wrote the report's authors, "*opportunities to change the growth trajectory are limited*." Warren Buffet anticipated this finding in his famous remark that, "*When a management with reputation for brilliance tackles a business with reputation for poor fundamental economics, it is the reputation of the business that stays intact*."[88]

* * *

To conclude this chapter, much compelling evidence supports the following simple assertions:

- Markets move in trends.
- Trends shape the price discovery process over the long run.
- Trends represent one of the key drivers of value creation (or destruction) for investors and businesses.

Far from being a figment in the imagination of the unlearned, market trends could well be the single most important element to consider in generating and sustaining investment returns over time. The case, at any rate, appears compelling and it is time we parted ways with elegant but erroneous models that contradict what is so plainly obvious to most participants in the real world.

[88] Berkshire Hathaway Annual Report, 1985, p. 9.

Chapter 12: Building Models

All things excellent are as difficult as they are rare.

Baruch Spinoza

In January 2014, a gentleman – let's call him Arnold – presented himself at the Monaco offices of Altana Wealth where I was employed at the time. He was soliciting funds to complete an ambitious quantitative investing model. During our meeting, we learned that his team had been working on this model since 1993, that he personally invested over 16 million British Pounds in its development, and that he needed further funds – about 500,000 euros – for his team to complete the software program and make it operational. This man was clearly not stupid, and his 12-person team included two PhDs, four masters-level scientists and several software developers. Nevertheless, after more than 20 years of continuous work and a fortune spent on research and development their model was still not operational. To the uninitiated, this may seem quite incredible, but I was not at all surprised at Arnold's problems.

Managing model risk

Over the years I've come across several similar cases where the software development process became bogged down in its own complexity and ultimately completely stalled without achieving completion. In fact, according to some estimates, more than 90% of all software projects ultimately fail to attain their objectives. This is due to the complex, but manageable challenges inherent in systems engineering. I was about to learn this lesson soon after my team and I completed the prototype version of the I-System.

In the summer of 1999, our software seemed to function beautifully, but it was very fragile and difficult to maintain. Any change to it carried the risk of introducing new errors and instead of implementing it to start trading, I felt compelled to ask my boss for further funds in order to hire professional software programmers and build a more robust version of the model. By this time however, our endeavors went quite off the company script, and I had a hard time persuading my boss to continue supporting the project. He specifically wanted us to produce a model that would generate price forecasts so that we could make high probability bets in energy and currency markets – an objective that no longer made good sense to me. Ultimately however, I managed to secure a very small budget to hire a software programmer and finish the job however best I could.

Having studied software programming during my high school days in Croatia, I knew a good many people in the software community there and I contacted a few of them to inquire about whom I should hire. I intended to find the very best programmers in the country and soon I had a list with two names on it. One of them was unavailable, but I was able to meet with the other gentleman: Boris Brec. I explained to Boris what I had been doing and what I would need him to do. Boris found the idea intriguing, but he politely explained that he was very weary of working with dilettantes and told me that he would be reluctant to take up the project. I had actually been warned in advance that Boris would almost certainly decline to work with me, but I tend not to take no for an answer easily. After our initial meeting I went to see Boris at his office several times over the following days (he was working at the IT department of the Croatian national utility company, HEP).

During that time, I noticed an interesting thing about him: he was very relaxed and appeared to have all the time in the world to chat. As I later understood, this was because his programs required very little maintenance and tinkering so he enjoyed much leisurely time at the office. However, our chats were frequently interrupted by his colleagues who would invariably step into his office stressed and exasperated about being

unable to solve some programming problem they were working on. In every case – and I must have witnessed a dozen or so – it took Boris mere minutes to identify the problem and suggest the solution for his colleagues who would then rush off happy and relieved, thanking him and dismayed that they haven't seen the solution themselves. This only made me more determined that Boris was just the man I needed to build an industrial-strength version of the I-System.

Systems engineering

After several days of talks and much coffee, Boris said he would consider taking on my project on the condition that I study up on the subject of software engineering under his guidance, which I accepted. He supplied me with study materials – four university textbooks on subjects covering systems analysis, software design, and process diagrams, as well as a number of papers and document templates produced by various software engineering institutes. Fully convinced that I was talking to an authority, I seized upon this opportunity and returned to Monaco with my stack of study materials.

> *Computer science is no more about computers than astronomy is about telescopes.*
>
> *Edsger W. Dijkstra*

I can't say that my reading assignment was boring in any sense, but it was very technical and I took almost a full year to work through all the materials. One thing I understood early on was the difference between software programming and software *engineering*. As I mentioned it in chapter 5, software engineering could be more appropriately compared to architecture while programing is the equivalent of construction. In building investment models, the industry usually employs quantitative analyst, most of whom can do a decent job of programming. However, software engineering involves a very different set of skills in which most quants have no training.

Among other things, software engineering focuses on the *process* or *methodology* used in building software systems, in which the actual programming is only one of the last stages. The quality of the ultimate product is largely determined by the quality of the process applied in a system's development and maintenance. To use an analogy with the

design of tangible, physical systems: if you asked an engineer to build you any kind of a machine, you would not expect him to immediately start cutting pieces and assembling them. You'd expect him to spend some time drawing up the blueprints and working out exactly how the machine should operate, the sizes and shapes of the pieces and how they all interact and work together. Only when the concept was clear and the dimensions of every last bit was defined and documented would the engineer start assembling the real thing. It is the engineer's methodical approach to designing the machine that would ultimately result in a quality functioning system, not his imagination and creative genius alone.

In contrast to our approach with the I-System prototype, which consisted of going from an idea straight to coding, best practices in engineering software systems require that a project advance through a number of distinct stages in the project life-cycle. In broad terms, these are:

1. user requirements
2. software (and hardware) requirements
3. software architecture
4. software programming instructions
5. production
6. transfer
7. maintenance

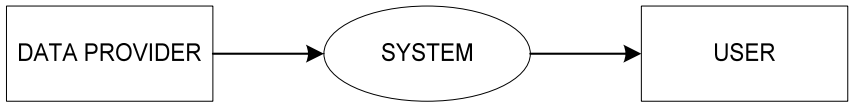
During the first stage, the future user of a software system must clearly articulate all the functions that the program should fulfil and how it should fulfil them. The user must document these requirements and produce the "user requirements document," which sets the foundation for the subsequent phases of the process. Producing this document forces the user to think in a clear and structured way about the processes and functionalities that the software solution must fulfil and to articulate them in a comprehensible way. It also forces the user to make countless decisions that must be made to remove any ambiguities a software developer is likely to encounter. Building any system involves many decisions, and most of these must be made by the user and not the software developer.

Defining the user requirements also imposes a scope on the development project so that new ideas which tend to emerge during the software's development don't end up sidetracking the project and dissipating time and resources on work that wasn't part of the original plan. The documentation of user requirements consists of process flow diagrams and text explaining the software's functions, detailing the procedures, and specifying the data involved. Once completed, the user requirements

document forms the basis on which software and hardware requirements are defined, then the software architecture, and so forth, so that each stage's outputs are the inputs for the next stage. In my case, the first stage was learning about the process and methods of systems development and about my own role in it as the user. After I had finished my reading assignments it was clear that my next task was drafting the user requirements document. This stage involved overcoming a good deal of reluctance on my part: I had already built the model which worked and I was eager to trade and start generating some concrete results. Going back to the drawing board and spelling out the whole system on paper felt like homework from hell.

It was clearly going to take a great deal of time and effort on my part. Unfortunately, I also knew that if my project was going to have a long-term future, this work was absolutely essential and that nobody else could do it in my stead. Boris helped me by drawing my first, top-level or context diagram:

System context diagram



Top-level, context diagram – my job was to decompose the system part down to the last individual process making part of the system. Data provider, refers to the source of historical and real-time price data which the system requires to perform its functions.

He further explained that I would need to break that diagram down to its most basic elements in such a way that I would have two, maximum three arrows pointing to each process and one arrow pointing out to the next one. So I got busy, bought myself a nice thick notebook and started charting out the process in pencil and drafting my requirements.

At first I found the process incredibly frustrating and difficult, which tends to happen when you have to structure and articulate your own mind's tacit knowledge so that it could be intelligible to others. It took me a full year to complete the user requirements document, which comprised 66 pages of process diagrams, descriptions, formulae, parameter specifications and a data dictionary. When I was done, I turned it over to Boris to study and take charge of the remaining phases of I-System's life-cycle from there.

Now, it is true that our project was perhaps uncommonly complex and ambitious, but even for simpler projects the development should follow a methodical and structured process. As we saw in chapter 5, building models entails a variety of risks and writing software code is a very error-prone work, generating between 100 and 150 errors per 1,000 lines of code even among professional programmers. In most cases by far, quantitative analysts are not professional programmers but scientists with limited software skills and this skill gap could make them even more error prone. By adhering to a methodology in developing trading models, we can significantly reduce the error rates and make errors easier to identify and correct without jeopardizing the model's integrity.

Another challenge with software development is that programmers themselves can often find it hard to decipher what they had written only weeks before. For this reason it is of utmost importance that developers thoroughly and meticulously document their code. Such documentation consists simply of remarks written alongside the code, which explain the processes in plain English. If the code is well documented, the original programmer will find it easier to navigate, and it will also be more easily discernible to future developers. This provision could prove important in speeding up the software's testing phase and ensuring its future ease of maintenance as well as longevity of use.

Getting it right is worth the effort

> *All human error is impatience, a premature renunciation of method…*
>
> *Franz Kafka*

> *Give me six hours to chop down a tree and I will spend the first four sharpening the axe.*
>
> *Abraham Lincoln*

Among traders however, the typical approach is to rush straight from ideas to code in eagerness to start trading and making money. Sticking with the methodology, adhering to best practices and doing the necessary testing are usually skipped over in a rush to get to the money-making part of the job. However, the effort to get it right is worth it, and you only need to do it once. When you complete the work your reward is not only a robust, high quality model – it is also the low maintenance productivity and the peace of mind that quality solutions afford. Taking shortcuts is tempting: it is easier and cheaper. You can get on with the business of trading quicker. But in doing so you are taking a gamble on the quality of systems you are using. In "Zen and the Art of Motorcycle Maintenance," author Robert Pirsig wrote that, "*Peace of mind isn't at all superficial to technical work. It's the whole thing. That which produces it is good work and that which destroys it is bad work.*"

Chapter 13: Analyzing Price Charts

Life can only be understood backwards - but it must be lived forwards

Soren Kierkegaard

The raw material for any trend following strategy is the price chart itself: it represents the foundational information of any model or strategy we might formulate and in accordance with which we ultimately transact our trades. If you only trade stocks or cash instruments, the ordinary price charts are all you need. But with regard to futures we have to address a small complication in the way we construct historical price charts.

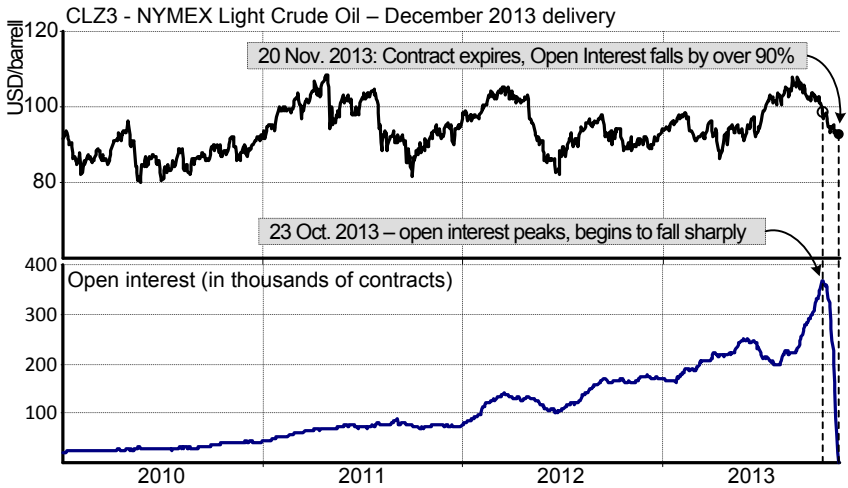
Futures and the problem of expiring contracts

Unlike stocks or bonds, futures contracts have a date of expiry, past which we can no longer trade them on the futures exchange.[89] Upon expiry, the

[89] At that point, we must either roll our positions out of the expiring contract and into the next one, or we must trade the actual physical commodity. If our position after the contract expiry is *long*, we must accept delivery of the specified quantity of the commodity in question; if our position is *short,* we must supply such quantity to a designated receiver.

time series of that contract's prices also stops. To construct a long term historical price chart for any futures market, we have to join together a sequence of futures contracts. By default, these so-called *continuation* price charts are constructed by adjoining contracts upon expiry: the price of the current contract is plotted on the chart until its last trading day, after which the price quotations for the next contract are plotted in continuity. This may be adequate for visual analysis, but it does not accurately reflect the prices we would actually trade. Namely, as a contract nears its expiration date, the trading volume and open interest begin to decline sharply at some point and may become quite thin during the last few days of trading.

Exhibit 13.1: an individual futures contracts and its open interest



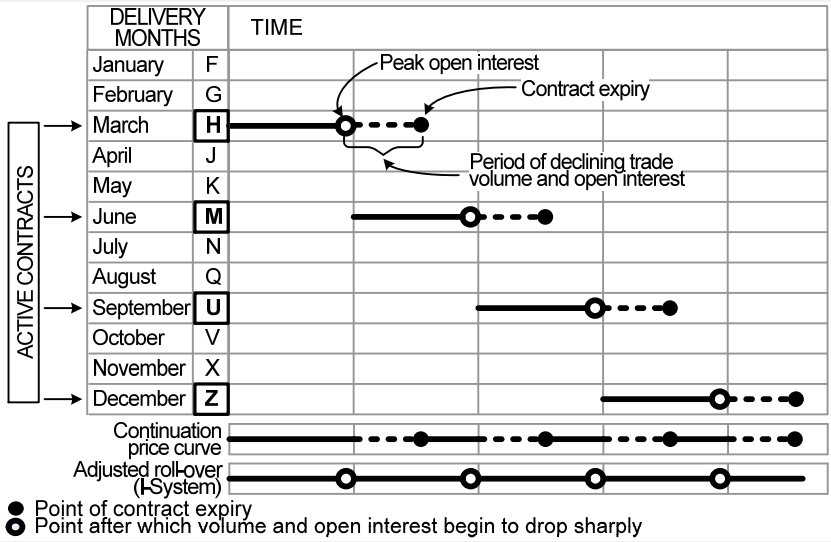
NYMEX Light Crude Oil December 2013 delivery futures contract – its last trading date was 20th November 2013, but open interest peaks about one month earlier (23rd October) and drops precipitously from over 356,000 contracts to fewer than 28,000 at expiry.

As open interest and volume thin out, the bid-ask spreads tend to widen and traders find it more difficult to trade out of their positions. For this reason, most traders prefer to roll out of expiring contracts well in advance of their last trading day. That in turn means that the price curve we would effectively be trading wouldn't exactly match the continuation chart constructed on contract expiry. The difference might appear very slight visually, but it could prove to be a significant consideration in formulating systematic trading strategies.

When we formulate trading strategies, we ascertain their effectiveness through backtesting. For this process to be valid, it is critical that backtest

simulations correspond as precisely as possible to the way we would actually trade in a given market. Otherwise, the simulated results could yield a distorted and unrealistic indication of a strategy's future performance. This was one of the lessons my team and I had learned the hard way. I've attempted to illustrate the principle in the following chart that represents the roll-over timelines visually.

Exhibit 13.2: Rolling over futures contracts



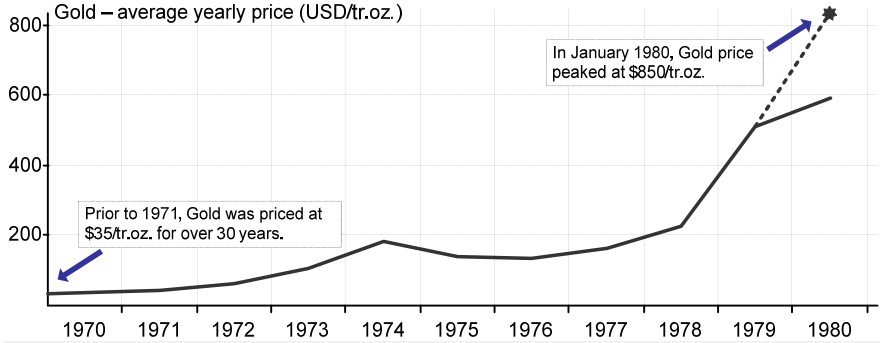
Financial and commodity futures markets trade in a number of delivery months. Some, like Brent Crude futures and other NYMEX energy markets trade in all 12 monthly deliveries (FGHJKMNOPQUVXZ). Others trade in only four or five. CME currency futures trade in March, June, September and December (HMUZ) deliveries, as in the above example.

Through our work on the I-System we initially assumed that the difference between the default continuation charts and the price curve we'd actually be trading was negligible and that it wouldn't meaningfully affect the validity of our backtests. As it turned out, we were wrong and we had to adjust the way I-System joined successive futures contracts. We had to ensure that the model's roll-overs coincided with the time when we would normally execute our roll-overs in live trading. To avoid using various calendar algorithms, which can get quite complicated, we decided to simply define for each market the calendar days when we would retire expiring contracts and roll our positions to the next ones. This adjustment may seem fastidious, and it did feel that way to us, but it was necessary for us to be sure that our model would accurately reflect the external environment in which we would trade.

Taking the correct aim

In addition to having *hi-fidelity* charts to work with, we must also have clarity about what it is that we should focus our attention on. If we examine price charts in their various time frames, including intra-day charts, we can always find many price events that could have been traded profitably if only we had bought and sold at the right time. But intra-day price events will prove relatively small and the idea that we could capture profits from them with any degree of consistency is perhaps overly optimistic. True trends entail large-scale price events that can span weeks, months and years. It is these price events that successful trend followers focus on, since they hold the greatest profit potential. Consider for example that in 1971 the price of Gold had been fixed at $35 per troy ounce for more than 30 years. Mounting economic imbalances prompted the US Treasury to devalue the USD to $38 per ounce in 1971 and again to $42 in 1973. It was hoped that these devaluations would be sufficient to redress the imbalances. However, within 1973 the price of Gold reached $90 and in 1974 it rose to then unthinkable three digit $105 per ounce.

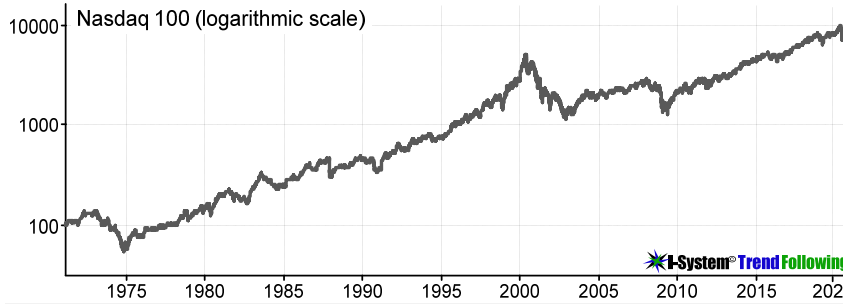
Exhibit 13.3: Trends unfold over long stretches of time - gold



Gold prices rose through the 1970s in an uneven but powerful trend, rising 24-fold over a ten-year period. The solid line represents the average price for each year; the dashed line extends to the 1980 peak at $850/tr. Oz.

Tripling of the gold price in just over two years' time was a shock, but these were only the beginnings of the trend that would last through January 1980 and reach $850 per ounce. The price of Silver followed a similar trajectory. Here are another few examples of this same dynamic in other markets:

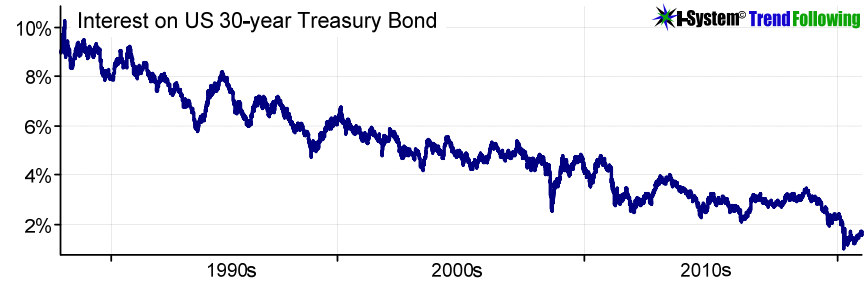
Exhibit 13.4: Trends unfold over long stretches of time - Nasdaq



Although with several bear markets and many large corrections, Nasdaq has been in a robust ascent during most of the past 50 years.

Over the past 50 years, Nasdaq 100 index experienced a few significant bear markets and many strong corrections. Nevertheless, during the bulk of that time, Nasdaq has been in a large uptrend that saw the index go up more than 100-fold. In this environment, trend following strategies can generate very strong performance, both during the bull and the bear cycles.

Exhibit 13.5: Trends unfold over long stretches of time – interest rates

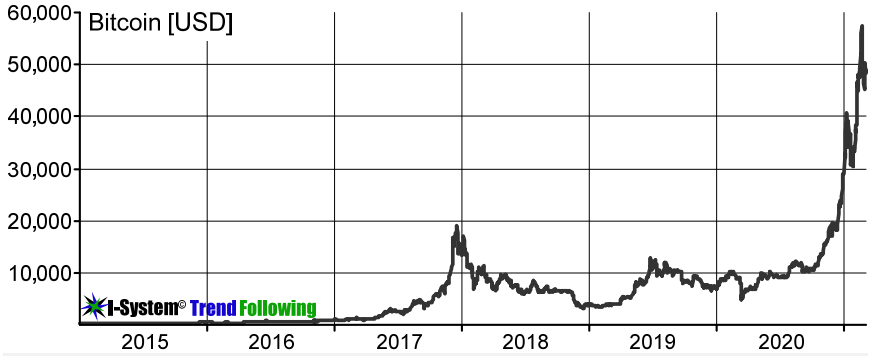


For over 30 years, US interest rates have declined along an almost straight trend.

Another remarkable trend that has spanned more than three decades has been the steady decline in interest rates. Here too, the opportunities to profit both from shorter-term up-trends and down-trends were frequent but the numerous shorter-term reversals and corrections saw many periods that were relatively difficult to navigate.

A newcomer in the financial markets, the Bitcoin has displayed the same principle at work:

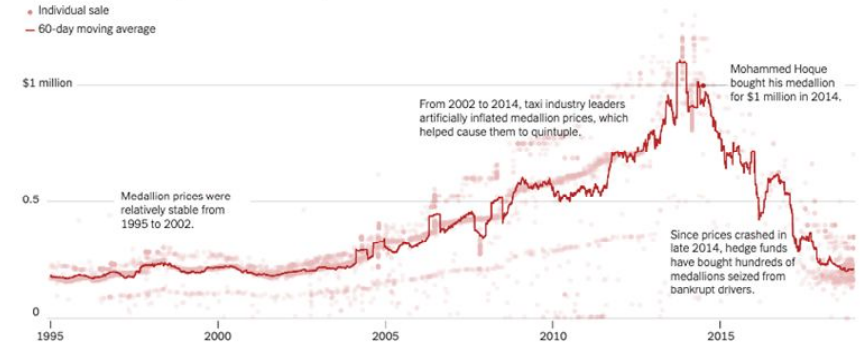
Exhibit 13.6: Trends unfold over long stretches of time - Bitcoin



Out of nowhere and into the stratosphere: could anyone have predicted this? And can anyone predict the future trajectory and the ultimate reach of this trend?

These are only a handful among literally thousands of similar examples in any security market. In fact, we can find trends in in any kind of market where people exchange stuff, including art, wines, collectible items and more. Below we have a 25-year chart of New York Taxi medallions, again revealing long-standing price trends: first a long, nearly 20-year uptrend, then a reversal followed by a sharp, steep down-trend.

Exhibit 13.7: Prices of New York taxi medallions, 1995 - 2019



By Scott Reinhard | Source: New York City Taxi and Limousine Commission

It bears repeating that trends which emerge from the collective psychology of market participants, and which can be systematically exploited, tend to shape up over longer time horizons. Hedge funds that use systematic trend following have built their success on the foundation of these macro events and not on intraday, micro trends. Therefore, a rational investor should aim to profit from these slow-moving macro trends.

Chapter 14: Formulating Systematic Trading Strategies

Remember, all decisions are made on the basis of models. The assumptions in a person's head are not actual systems, but assumptions about actual systems. You do not have a family or city or corporation in your head. You have mental models — often poorly and incompletely defined models — of these real-life systems. The heart of the matter is your relative degree of confidence in each of these models.

Jay W. Forrester

Once we set our aim correctly we can proceed to analyze charts and scan them for trading opportunities. Over the decades, analysts have identified countless chart patterns and formulated dozens of indicators that signal certain tendencies or significant events in the price data. When we were building the I-System we used Robert W. Colby's 820-page *Encyclopedia of Technical Market Indicators*, which I believe to be the most complete resource for any technical analysis practitioner. Today however, it is easy enough to find a large volume of excellent technical analysis content online. However, particularly for beginners, this large variety of study materials and analytical tools may seem overwhelming and hard to digest.

Choosing the right tools of analysis

Albert Einstein said that, "the definition of genius is taking the complex and making it simple," so that's what we'll try to do here. To begin with, it is useful to keep in mind that the raw material of all technical analysis is simply the time series of security prices. All we have to work with are series of open-high-low-close data points and no matter how you repackage that raw material, there is only so much useful information we can extract from it. Our starting point should be to clearly define what we are looking for in that data. In simplest terms, we use chart analysis to determine two things: (1) direction of the trend, and (2) the optimal entry and exit points for our trades. You can think of those two considerations metaphorically as deciding the direction in which to point your gun and then determining the right moment to pull the trigger.

Step 1: determining price trends

The faculty of recognizing price trends may seem like an easy one, but it actually poses a fairly difficult challenge for trend followers. Recognizing a trend in a price chart is not difficult, but the problem is that the trends we can see are already in the past, while we must make investment decisions in the present. At any point in time, the analyst has to answer the question: do *current* price fluctuations constitute a trend? Most of the time, this question cannot be answered definitively, with a simple *yes* or a *no*. Instead, we normally arrive at a *judgment* with some degree of *confidence*. If a trend is already clear and well profiled, we may have high confidence in that judgment, but most of the time our confidence will fluctuate between certainty and an utter lack of conviction. These psychological considerations give rise to a further challenge. Namely, by the time a trend is clear enough and we have high confidence in our judgment, the trend could be close to a correction or even reversal. Thus, the question of whether and when to put on a trade seldom has an obvious answer. Would the results of our trading be best when we are 100% certain in our judgment? Or would we do better by taking risk with lesser confidence? For a discretionary decision maker, taking risks with low confidence in his judgment would psychologically be very difficult to do. At the same time, it is clear that catching a trend early precludes waiting to be certain about it. This is where technical analysis can be quite helpful.

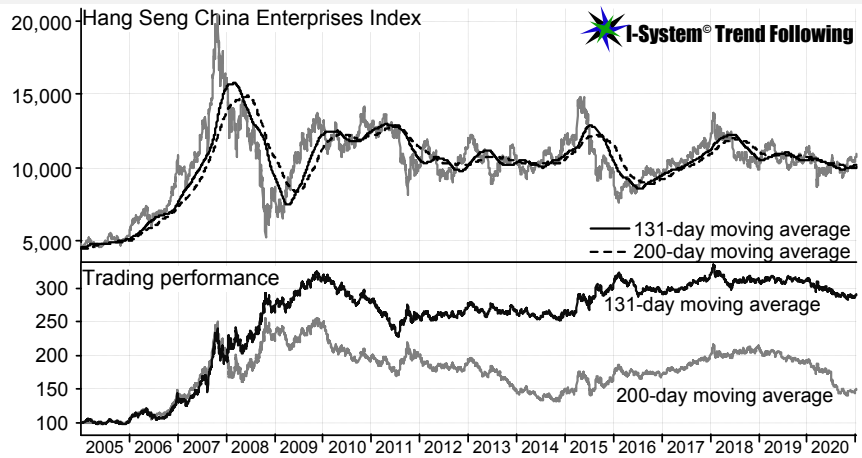
The simple determination we need to make in any given market is whether the price is trending, and in which direction. A handful of simple mathematical studies should suffice to make this determination in a precise, numerical way. The most effective studies in this sense are: (1)

moving averages, (2) local[90] extremes (local peaks and troughs) and (3) trend lines.

Moving averages

The moving average simply plots the value of the n-period average price over the last *n* periods along with the price chart. At its simplest, the moving average gives us an indicator of the trend: if the price is trading well above the moving average, we are likely looking at an up-trend, and if it is below it, we might be in a down-trend. If you follow the financial press, you'll often encounter analysts mentioning the 50-day or the 200-day moving averages: if the price of something falls below the 200-day moving average, it is usually implied that the trend has reversed (from bull to bear market). However, there is no special magic to the 200-day, 50-day, or any other moving average: the most useful parameter values will vary from market to market.

Exhibit 14.1: Which moving average?



For Hang Seng Index, the 131-day moving average has worked far better than the 200-day one often mentioned in the financial media. Different parameter values may work best in different markets.

We can determine this by formulating a simple trading strategy: *buy* when the price breaks above the moving average and *sell* when it drops below it. Then by testing this strategy for a broad range of values, we can determine which moving average best corresponds with the price trends in any given market. For example, between 2005 and 2020, the best longer-term moving average value for the Hang Seng index has been 131-days. In other markets, other moving averages might work better.

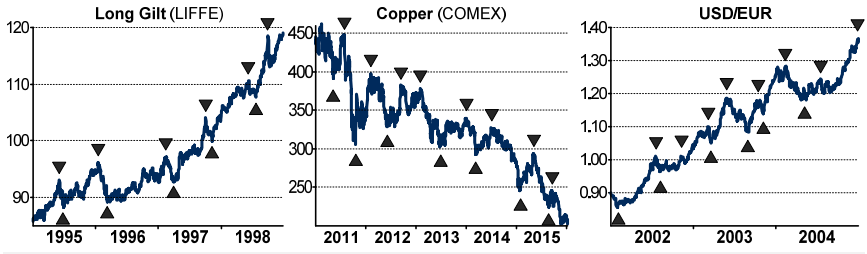
[90] What I mean by the term "local" is those preceding the current price in the recent past.

One significant shortcoming of the moving average is that it generates many losing trades in periods of price consolidation when price frequently crisscrosses the moving average. Experience has shown that markets trend about 1/3rd of the time and spend about 2/3rds of the time consolidating in a sideways drift. In the Hang Seng Index example, we saw such consolidation from 2011 through 2014 and again 2018 through 2020. A simple way to reduce the number of losing transactions during such periods is to use two moving averages – a shorter-term moving average and a longer-term one so that trading signals are generated upon these two moving averages crossing each other, rather than the price crossing a single moving average. Again, the best combination of parameter values should be ascertained by backtesting and will certainly vary from market to market.

Local extremes

Local extremes are minor peaks and troughs - points of correction, or pullbacks from the prevailing or incipient trend. In a market that's trending up we find successively higher peaks and higher troughs. In a downtrend, we find successively lower peaks and lower troughs.

Exhibit 14.2: Local peaks and troughs

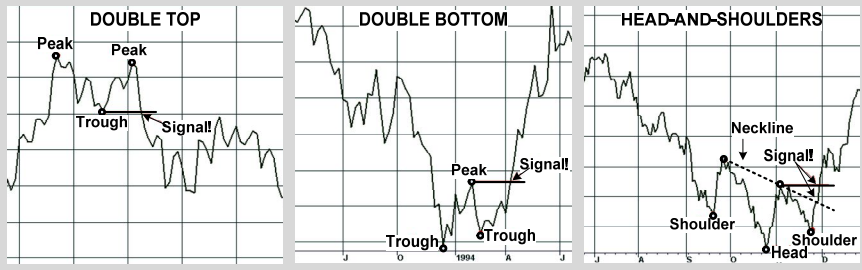


Successively higher peaks and higher troughs indicate an up-trend; successively lower local extremes indicate a down-trend.

Local extremes are also the basic elements of chart patterns like double tops, double bottoms and head-and-shoulders which are usually valid indicators of trend reversals. Thus, the relative positioning of local peaks and troughs could trace double top, double bottom or head-and-shoulders reversal patterns, signaling a trend reversal. But these patterns can equally serve as valid ways to generate trading signals as illustrated in exhibit 14.3.

With regards to the head-and-shoulders pattern in the right-hand panel, the chart shows two points at which we may define a trading signal: either when the price breaches the neckline (dashed line) or when it breaks above the last trough.

Exhibit 14.3: Double tops, bottoms and head-and-shoulder reversals



Local peaks and troughs comprise the elements of the trend reversal patterns.

Conventionally, we would use the neckline, but if we wish to construct algorithms, using a horizontal level could be considerably simpler (and thereby less error prone).

Trend lines

Local extremes are normally used as the points through which we project trend lines on price charts. In technical analysis, it is customary to project trend lines below the price in up-trends (i.e. through local troughs) and above the price in down-trends (through local peaks), as illustrated in the following exhibit.

Exhibit 14.4: Trend lines

We project trend lines through local troughs in up-trends and through local peaks in down-trends.

In chart analysis, we often see trend moves bounce off of straight lines over multi-year periods. This makes trend lines extraordinarily useful for traders. Trend lines are useful in three ways: (1) as an indicator of the prevailing trend, (2) as a trading trigger and (3) as an early indicator of trend reversal.

Interesting variants of simple trend lines are channels (lines that are parallel with the main trend line and that frequently enclose most of the price action), Speedlines and the so-called Andrew's Pitchfork.

Exhibit 14.5: Trend channel (channel line)

Channels are constructed by projecting a parallel with the main trend line.

Drawing trend lines is not an exact matter and analysts inevitably have to resort to a bit of discretionary fitting. Usually, it is advisable to project both trend lines and channels through the closing prices and cut through some of the intraday extremes. As the above example shows, the channel closely contained fully two years of trending price action. In the end, the price's inability to rally to the top of the channel was an early indication of the impending reversal. Once the price broke through the trend line, the subsequent upward correction reached close to the original trend line which now became the new zone of resistance, providing a good point of entry for a short trade. It is however important to recognize that the whole construct did not really become defined until past the point B and that it was only past that point that it could have provided a valid decision-making framework.

The episode in exhibit 14.6 (below) was part of the dot-com bubble collapse. The speed lines plotted on the chart were defined by the points A and B. This short, 5-week price drop seems to have determined the subsequent six months of the trend's trajectory. I would not know how to explain these phenomena and why this should happen at all, but I have seen such patterns so many times that I have no doubt that there's definitely something significant to this mystery. The same is true of Andrew's Pitchfork which we already saw in Chapter 10 (see exhibit 10.4).

Exhibit 14.6: Speedlines

Speed lines are constructed by selecting two local extremes, dividing the vertical distance between them into thirds and projecting trend lines through the 1/3 and 2/3 levels.

Whichever variant of trend lines we observe, they can be very useful in similar ways – primarily as an indicator of trend: where the dominant trend-line is sloping up and the price is above that line, we can be very confident that we're looking at an up-trend. The inverse situation gives us high confidence that we're in a down-trend. The idea here is not to state what's glaringly obvious, but to formulate explicit rules to use these lines as objective indicators of trend and in this way to sidestep the psychological dilemmas inherent in making discretionary judgments about market trends. Furthermore, trend lines can also be useful as a way to generate trading signals. For example, when a price correction pulls back to the trend line, this is often a good *buy* signal in an up-trend or *sell* signal in a down-trend. Finally, trend lines often give us valid early signals of an impending trend reversal: when the price crosses the trend line, this often indicates that the trend is running out of steam and is possibly ripe for a reversal. Indeed, these observations will prove valid so many times that Nick Glydon's quip that "the most important tool in investing is a ruler," is hardly an exaggeration.

Another systematic way to determine trends, which does deserve a mention, is the use of point-and-figure charting. However, this method may be obsolete and as we have already discussed it in Chapter 10, we'll omit further elaboration here. Whichever method we adopt, the important part is to try and set out objective rules we can formulate explicitly,

preferably test, and apply with discipline over sustained periods of time. Such rules can help us cultivate decision making discipline to execute trends even when we are in doubt and measure our actual performance against our expectations.

Step 2: identifying trade entry and exit points

With clarity about the prevailing trend's direction, we can further improve our trading results by defining trade entry and exit signals. Thus, in an up-trend, entry signals would produce *buy* decisions and exit signals would produce *sell* decisions. In a down-trend, entry signals would generate sell decisions and exit signals the decisions to buy. Exit signals can be either stop-loss trades when the market goes against our position or profit-taking trades when the price goes in our favor. Here again, technical analysis offers us a number of uncomplicated but useful studies like Stochastics, Relative Strength Index (RSI), Parabolic Stop-and-Reverse (SAR), Bollinger Bands and trend lines as well as chart patterns like double tops, double bottoms and head-and-shoulders patterns.

Relative Strength Index (RSI)

RSI was developed by J. Welles Wilder. It's an oscillator, or a rescaled study that converts normal price fluctuations to a horizontal scale with values ranging from 0 to 100. As such, it is used by market analysts as an *overbought* / *oversold* indicator: values over 70 are considered as overbought, and those under 30 as oversold. RSI alerts us when there is a significant pullback from a trending move – an event that occurs when we encounter oversold levels in an uptrend, or overbought levels in a downtrend.

Formula: $RSI = 100 * 100/(1+RS)$

Where:

RS = (modified MAV of X periods up closes) / (modified MAV of X periods down closes)

RSI parameters:

- Δt – time period for calculation of RSI's modified MAV
- Overbought / oversold levels – values above (or below) which the RSI is considered overbought (or oversold). Overbought level + oversold level = 100: thus, if 70 is overbought, 30 is oversold (integer).

Exhibit 14.7: Price chart with Relative Strength Index (RSI)

US 30-year Treasury Bond with RSI. RSI rescales the price fluctuation on a horizontal scale with values ranging between 0 and 100. For a trend follower, the RSI can be a very good entry signal. However, if used as an exit signals, it's liable to kick us out of profitable trades too soon.

In trend following, RSI should *primarily* be regarded as a trade *entry* signal: it alerts us when there is a significant pullback from a trending move – an event that occurs when we have oversold levels in an uptrend, or overbought levels in a downtrend. The reason why I do not advise using RSI as an *exit* signal is that in the direction of a trend move, RSI can remain at *overbought* or *oversold* levels for a considerable period of time during which the price might be strongly advancing (or declining). In such cases, the RSI might shut us out of a profitable trade too soon.

Stochastic

Like RSI, the stochastic (also slow stochastic) is a horizontal, rescaled overbought/oversold oscillator. It consists of two functions: Slow%K and Slow%D, which both range between 0 and 100. The *fast stochastic* is initially calculated by starting with the left-most price bar in the specified range. Fast%K is then calculated by subtracting the lowest lowefrom the current close, dividing the difference by the difference of highest high less lowest low, and multiplying the quotient by 100. The resulting curve is plotted in a sub-graph, on a 0 to 100 scale. Stochastic values higher than 80 are considered overbought, and those under 20 are considered oversold.

Exhibit 14.8: Slow stochastic

U.S. 30-year Treasury Bond with slow stochastic. Like the RSI, stochastic can be an excellent entry signal for trend moves but not always the best exit signal.

Formula:

Fast%K = 100*(current close–lowest low)/(highest high–lowest low)
Fast%D = 3 period modified MAV of Fast%K
Slow%K = Fast%D
Slow%D = 3 period modified MAV of Slow%K

Stochastic parameters:

- Δt – the time period for which Slow%K is calculated
- Overbought / oversold levels – Slow%K value above (or below) which it is considered overbought (or oversold). Overbought level + oversold level = 100; if 80 is overbought, 20 is oversold (integer)

Like the RSI, the stochastic can be a very useful *entry* signal. For example, we can test a simple rule: enter a trade in direction of the prevailing trend if the stochastic falls below 50 (in up-trends) or rises above 50 (in down-trends). Also like the RSI, the stochastic can start flashing *oversold* or *overbought* levels too soon during a trending move and kick us out of profitable trades before the trend move has run its full course.

Bollinger Bands

Bollinger Bands (BBs) are lines enclosing the price curve. They are plotted at a distance equal to k standard deviations (σ) above and below a chosen moving average (MAV). The distance between the high and low

Bollinger Band at any point in the chart reflects the relative volatility of price fluctuations.

Exhibit 14.9: Bollinger Bands

U.S. 30-year Treasury Bond with Bollinger Bands; BBs can provide excellent trading signals: both as entry and exit points.

BB parameters:

- $\Delta t1$ – time period for MAV calculation
- $\Delta t2$ – number of periods used in MAV2 calculation
- k – number of standard deviations from the MAV

BB calculation:

1. Add the values of data points in a series
2. Divide the sum by the number of data points (periods). The result is the Arithmetic Mean.
3. Subtract the Arithmetic Mean from each data point. The results are the Raw Deviations
4. Square each Raw Deviation. The products are the Square Deviations.
5. Add all the Squared Deviations. The sum is the Total Squared Deviation
6. Divide the Total Squared Deviation by the number of data points (periods). The quotient is the Mean Squared Deviation.
7. Calculate the square root of the Mean Squared Deviation. The result is the Standard Deviation
8. Multiply the Standard Deviation by the number of standard deviations.

9. Add this value to MAV value to generate upper BB
10. Subtract this value from MAV to generate lower BB

Formulae: $BB = MAV2_t (k * SD)$

$$SD = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(MAV1_t - p_i)^2}$$

Where:

BB = Bollinger band value
SD = Standard deviations (σ)
N = Number of periods
p_i = Price at period i
MAV1 = MAV of prices at period t
MAV2 = MAV of SDs times number of standard deviations, k

BBs can be used as both entry and exit signal triggers. For example, the price falling below the lower Bollinger Band can trigger a *buy* signal; the price rising above the upper Bollinger Band can trigger a *sell* signal. Setting the right parameters for the MAV and exactly how many standard deviations (k) from the MAV the BB should be, will involve some back-testing. The lower the value of k, the closer the Bollinger Bands are to the MAV and the price and the more frequently the price will break above and below it. Thus, with k=1.65, the price will break out on only about 5% of days; if k=2.33, the price will break out only on 1% of days. If we have determined the price trend's direction, we can use different BB parameters for entry signals (so entry is triggered more frequently) and different ones for exit signals (so exit is only triggered once we had significant profits on our trade). Importantly, with trend following strategies, Bollinger Bands can be very effective profit-taking signals. But in this sense, they should be used with caution: taking profits too soon in a trending move can be a good way to forego large profits when exceptional trend moves shape up. Normally, we'd use a BB closer to the MAV for entry signals (between 1 and 2 standard deviations), and a BB more distant from the MAV (2 to 3 standard deviations) for exit signals. Finally, as price might crisscross a Bollinger Band multiple times in close succession, the signal must be deactivated after it's 'fired' once and then only become active again after it moves away from the BB by one standard deviation (one SD below the top BB, or one SD above the bottom SD). Either way, it's best to formulate a rule that can be tested and applied systematically.

Parabolic SAR

The Parabolic function, also called Parabolic SAR (Stop and Reverse) is based on the *Parabolic Time/Price Trading Strategy* formulated by J. Welles Wilder (who also formulated the RSI study). It returns a series of points above or below the instrument's price curve:

Exhibit 14.10: DJIA index with Parabolic SAR overlay

Parabolic SAR can provide excellent entry and exit signals.

Parabolic SAR is calculated according to the following formula:

$$SAR_{t+1} = SAR_t + AF * (EP_{trade} - SAR_t)$$

Where:

SARt+1 = next period's SAR
SARt = current SAR value
AF = acceleration factor (a value between 0.002 and 0.2)
EP = extreme price (high if SAR < current close, low if SAR > current close)

The initial SAR point of a "long move" (where price > SAR points) is found by looking for the first price bar with a higher high and a higher low than the previous bar. The converse of this is used to find the initial SAR for a "short move" (where price < SAR points). The acceleration factor changes as the trade progresses, starting at 0.002 and increasing in increments of 0.002 for each bar in which a new extreme occurs, up to a

maximum of 0.2. So parabolic gives us a point on the chart for the next period, where the signal occurs.

Parabolic SAR can be an excellent entry and exit signal. As an entry signal, SAR will tend to function as a break-out indicator when price action begins a trending move. And just like the Bollinger Bands, it can be a very effective profit-taking signal where strong trend moves unfold. Again, if we have a set way of defining the price trend, we can use SAR points as entry, only in the direction of the prevailing trend and as a profit-taking exit. In other words, rather than stopping *and reversing*, we only *stop* positions (i.e. SAR without the R). For example,

- In uptrend (long only) trading:
  - Entry: when the price breaks above a SAR point ⇒ buy long
  - Exit: when the price breaks below a SAR point ⇒ sell (without selling short)
- In downtrend (short only) trading:
  - Entry: when the price breaks below a SAR point ⇒ sell short
  - Exit: when the price breaks above a SAR point ⇒ buy (without going long).

Parabolic exit signals can furthermore be qualified by the presence of price-oscillator divergence, as we'll discuss in the next section.

Price-oscillator divergence

The price-oscillator divergence (POD) occurs where in a trending move, we have rising price peaks together with declining oscillator (RSI or Stochastic) peaks (bearish divergence); or declining price troughs together with rising oscillator troughs (bullish divergence). The divergence of local peaks or troughs on the price curve and on the oscillators indicates that the trend move we are observing could be losing momentum. At that point, even though the trend is still largely intact, we can use the POD as the qualifier for certain exit signals, particularly the profit-taking kind like the Bollinger Bands or Parabolic SAR. Trend followers are often loath to take profits too soon in a trading move, so POD gives us a way to ignore exit signals until we can ascertain that the trend appears to be weakening.

Unlike most other trading signals, which occur as an *event* (at one point in time), the price-oscillator divergence occurs as a *state*, which can continue for a period of time. Therefore, if POD is used as a signal, it can be used by itself, or it can be used as a required condition for profit-taking exit signals like Bollinger Bands or Parabolic SAR.

Exhibit 14.11: Bullish price-oscillator divergence (POD)

Where we have successively lower price troughs and successively higher oscillator troughs (usually RSI and/or stochastic), we have a bullish divergence.

An important condition needed to validate the POD as a signal is that the first oscillator peak should begin at the oversold or overbought levels.

Exhibit 14.12: Bearish price-oscillator divergence (POD)

Bearish POD entails successively higher price peaks with successively lower oscillator peaks.

Here are a few concrete examples of the way we can use POD within a defined trend:

POD exit by itself:

- in uptrend trading – if there's bearish POD ⇒ sell
- in downtrend trading – if there's bullish POD ⇒ buy

POD with Bollinger Bands exit:

- in uptrend trading – BB signal and bearish POD ⇒ sell
- in downtrend trading – BB signal and bullish POD ⇒ buy

POD with Parabolic SAR exit:

- in uptrend trading – Parabolic SAR and bearish POD ⇒ sell
- in downtrend trading – Parabolic SAR and bullish POD ⇒ buy

Combining signals like BBs and Parabolic SAR can significantly increase the 'stickiness' of trading positions and avoid premature profit taking. This can meaningfully improve a strategy's long-term performance. The main difficulty with POD is that it can be difficult to construct an effective algorithm to detect its presence systematically. However, the divergence is easy enough to see visually and a diligent trader can observe a well-

formulated POD rule in his own discretion. The same can be true of other kinds of signals as we briefly discuss next.

Discretionary trading signals

A trader can use drawing objects as trading signals. He can project a number of objects on the price chart and integrate them with his trading strategy. These can include trend lines, channels, Speedlines, Andrew's Pitchfork, Fibonacci retracement levels and patterns like flags, pennants, double tops, double bottoms and head-and-shoulders reversals. While all these can provide excellent trading signals, the problem is that for most of them, it might be difficult to formulate valid algorithms that could generate systematic signals. Without valid algorithms, we could not back-test the signals based on such objects which makes it impossible to establish whether they add value over time or not. In that case, the use of such signals will inevitably depend on the trader's good judgment and discipline, but these are just the weak link trend followers should seek to circumvent.

Quantitative methods and technical analysis offer many different ways we can formulate effective trading strategies. However, we must always keep in mind that there are only so many ways to formulate reliable trend following strategies in any given market. Over the years, I have analyzed the performance of many successful trend following hedge funds and I found that most of the successful approaches tend to converge on similar speculative behaviors. The outperformance or underperformance among fund managers is usually far more dependent on their relative risk allocations rather than a clear superiority of their trading strategies. For example, if prices of precious metals rally strongly during a certain period of time, hedge funds with heavier exposure to gold and silver will tend to outperform their peers. In periods when prices of treasury futures trended strongly, large funds with the bulk of exposure in treasury instruments tended to excel. It is therefore important for traders to have realistic objectives and avoid overcomplicating their approach in pursuit of some *holy grail* strategy that could consistently generate significantly better performance. It is true that superior strategies *can* be formulated – I can state this categorically because I have formulated many of them myself – but the problem is that we have no reliable way to recognize such strategies in advance or to predict their future performance. For that reason, most trend followers prefer to formulate strategies for *reliability* and robustness rather than for their performance alone. As a matter of fact, as an investor, your relative *confidence* in whatever strategy you use could be the most important predictor of your long-term success.

Ensuring that your strategies are reliable

Distinguishing reliable strategies from less reliable ones isn't easy. Reliable strategies would be the ones that perform in line with the results we obtain through back-tests. The unreliable kind would be the ones that look great in back-tests but fall short in live trading. To distinguish ones from the others, we must carefully review how and why any given strategy performed as it did. We can do this along three key strategy attributes: (1) the quality of trading signals, (2) resilience to changing market environments, and (3) a strategy's trend cycle and trading dynamics.

The quality of trading signals

First we need to scrutinize the quality of our trading signals: for any kind trading signal to be considered reliable, we must make sure it is *systemic* to the market in question: that is, that it occurs relatively frequently over time. If some study, say a moving average, stochastic, or Bollinger Bands only generates a handful of profitable signals over a ten or twenty year time period, this implies that a similar signal might not recur for a very long time in the future. Or it might never occur again, meaning that the strategy that depended on such trades couldn't replicate its past performance. To formulate more robust, reliable strategies, we have to be sure that every study we use to generate signals does so with some regularity of occurrence. With strategies based on daily price history, this should mean at least 15 or 20 occurrences over any ten year period.

Resilience to changing market environments

Another consideration relevant to the quality of our strategies is in the way we deal with the changing market environments. In every market, price fluctuation dynamics change somewhat over time. Novice traders often make the error of focusing on the most recent periods and use shorter lookback periods in formulating their trading strategies with the idea that these would be better adapted to the current market environment. But this might be a bad idea: formulated over a shorter time interval, a strategy could go out of sync with the market as the price fluctuation dynamics change again. We can only recognize these changes after the fact, perhaps after suffering a sustained period of losses. At that point we might need to formulate a new strategy and find a better fit for the new market environment. However the new one could also fail as conditions change, and so on. A robust trading strategy should perform reasonably well in all market environments and generate results as evenly as possible in all periods. A strategy that generates strong gains over a short interval but then does poorly for long stretches of time might still look good in terms of performance statistics, but it is less likely to be successful in the future.

A strategy's trend cycle and trading dynamics

Generally, systematic trading strategies differ from one another along two key characteristics:

- **Trend cycle** – whether the trend is defined as a long-term, short-term, or medium-term event.
- **Time in the market** – the proportion of time that a strategy spends in trading positions. A strategy might be in the market most of the time, or might enter and exit trading positions very selectively, passing more time waiting for the right triggers.

Over the years I have evaluated millions of backtest simulations, and this experience has shown that in most markets, strategies that (1) use longer-term trends and that (2) spend the most time in trading positions, tend to perform best over the long term. At the same time however, such strategies experience the heaviest losses when major trends reverse because they will recognize trend reversals only when the prices have moved in the opposite direction for some time. Strategies that switch trend direction more quickly perform better when major trends reverse, but fall behind during long periods of price consolidation or range-bound trading, because they interpret larger price corrections as trend reversals and repeatedly take positions on the wrong side of the subsequent price move.

In summary, to formulate robust and reliable trading strategies, we must make sure that (1) our trading signals are *systemic* to the market in question and occur frequently and regularly in that market; that (2) our strategies generate profits as evenly as possible in all market environments and behave reasonably even during periods that are difficult to trade, and that (3) they follow longer-cycle trends and spend the bulk of time in trading positions, whether *long* or *short*.

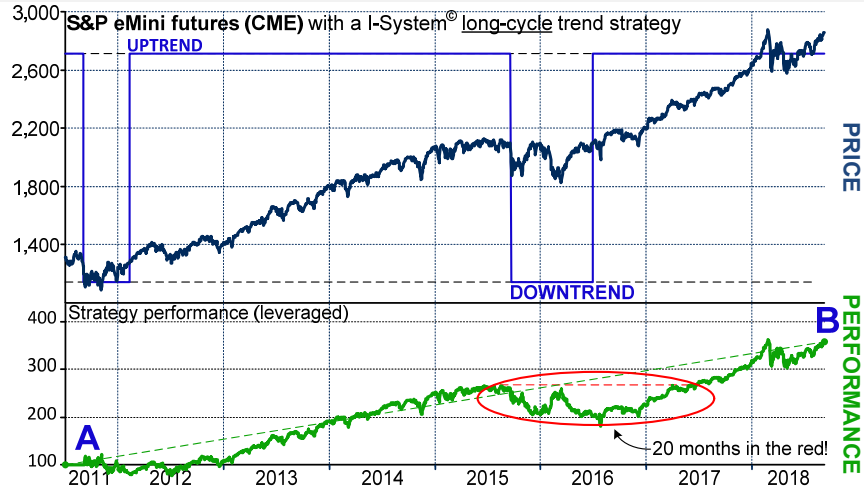
Ultimately, it all hinges on your confidence

Above and beyond all the technical and methodological considerations in formulating trading strategies, over the long term psychology still plays the pivotal role in any speculator's success. Ultimately, it all hinges on our confidence in the models and strategies we implement. Robust, reliable strategies afford us a high degree of confidence in using them. This confidence will determine how we cope with adverse market conditions and with the *experience* of sustaining losses over extended periods when – not if – they happen. This is related to the question of expectancy.

Expectancy is the answer to the question, "*what happens if I continue doing this*?" This deceptively simple question is critical in investment speculation, where "*doing this*" hopefully implies using some trading strategy. In systematic trend following, we strive to use strategies that have a positive expectancy, which we determine based on their past performance or through backtesting, which measures how a given set of rules would have performed in the past. Strategies that appear to generate the best trading gains with the lowest volatility of returns (the smoothest growth of profits over time) are the ones we prefer to implement in the face of an unknowable future.

However, the limitation of backtesting is that it compresses time into a snapshot of history. Examining a strategy's performance over a long period of time (as between points A and B in exhibit 14.13) cannot convey the day-to-day *experience* of making and losing money. That experience has powerful psychological effects that can influence the results of an investment management process. Chart on the following page shows a typical trend following strategy: over the long run it's proven successful at capturing profits from major trend moves, but it's also sustained substantial drawdowns along the way. If you were unlucky to implement this strategy around mid-2015, you'd have to persevere through a nearly full year of draw-downs and sit out 20 months of negative performance.

Exhibit 14.13: Performance of a typical systematic trend following strategy



This trading strategy seems superb between points A and B. However, if we implemented it in mid-2015, we'd endure over a year of drawdowns and fully 20 months in the red.

Watching your losses mount for that long can make the urge to change something almost irresistible. You might consider abandoning the strategy

or replacing it with one that looked better at that time. However, in succumbing to this urge you could abandon a strategy that's near the end of its losing streak, depriving yourself of the gains that would follow. Even worse, in replacing the strategy, you might start using one whose losing streak was only about to begin.

As we already discussed, we are all psychologically hardwired with the loss aversion bias. We are also hardwired to expect that the future will resemble the recent past. A few months of losses could lead us to believe that "doing this" leads straight to ruin. To persevere with a trading strategy through a losing streak, the trader must have full confidence in it, as well as a high degree of conviction in the correctness of his model. Otherwise, he's liable to alter course, tinker with the strategy or replace it. Worse yet, he might abandon his risk management discipline and start gambling in attempts to recover his losses.

The corollary of this lesson is that even with well-formulated, positive expectancy strategies, achieving high investment returns over time requires being able to tolerate extended losing streaks without losing composure and altering course. This may well be the hardest and the most important lesson to master in investment management, even more important than the questions of technical aspects of market analysis and the correct quantitative methods.

Part 4

RISK, PHILOSOPHY, FAITH

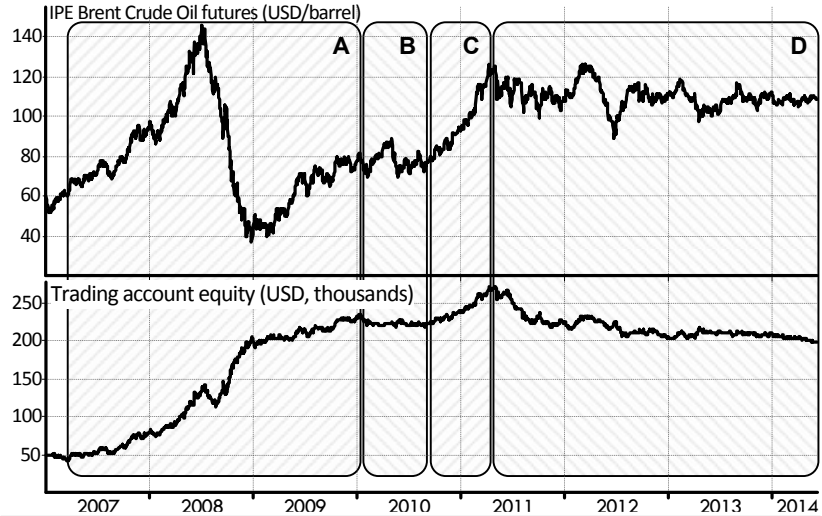
Chapter 15: Risk and Diversification

Nature has ... some sort of arithmetical-geometrical coordinate system, because nature has all kinds of models. What we experience of nature is in models, and all of nature's models are so beautiful.

R. Buckminster Fuller

If done well, trend following is probably the most effective and most reliable way to master uncertainty in speculation and navigate the markets profitably over the long term. Trend following works because markets move in trends. However, they don't always move in trends and consequently trend following doesn't always work. This presents a significant challenge for trend followers. The next exhibit shows the Brent Crude Oil price history from 2007 to mid-2014 with the performance of a typical trend following strategy in the sub-chart.

Exhibit 15.1: Markets move in trends – but not always...



This chart shows the performance of a trend following strategy trading Brent crude oil futures. The strategy begins with an initial risk budget of $50,000 and trades a single 1,000-barrel contract on the IPE (International Petroleum Exchange). From 2007 through mid-2008, oil rallied to about $146/bbl. Over the following six months, it collapsed to $40/bbl. In 2009, the trend reversed again and the price doubled from $40 to $80/bbl. These were very favorable winds for trend sailors. Panels A, B, C, and D show four distinct phases in this period.

A: strongly trending price offered very high returns on trend following. The above strategy generated a return of over 300% from January 2007 through December of 2009, with only one major drawdown in the wake of the trend's reversal in mid-2008. This draw-down may appear small, but it amounted to about 60% of the strategy's risk budget.

B: price consolidates around the $80/bbl level. When prices fluctuate in a sideways range, trend-following strategies tend to generate losses.

C: In late 2010, the price broke out of its range and advanced another 50% from the $80/bbl level, enabling further trading gains.

D: The period from April 2011 through June 2014 represents an exceptionally unfavorable environment for trend following. If you used a trend following strategy in crude oil markets at that time, you would have experienced more than three years of negative performance. Although these losses appear minor compared to the preceding returns, in the case of the above strategy they amount to almost $80 per barrel of Brent crude oil, or $80,000 per contract – more than 150% of the strategy's risk budget. Accordingly, an undiversified trend follower – even with the world's finest trend following model – was liable to sustain a total loss.

The above exhibit shows an unusually volatile, but otherwise typical sequence of events in the markets: periods of large-scale price readjustments followed by longer periods of trendless consolidation. Some analysts estimate that markets trend about 30%-35% of the time and then consolidate for twice as long. I believe that this estimate is broadly correct. This poses certain risk management challenges for trend followers. Namely, if you start with a given risk budget, say $50,000 as in the above

example and you use this budget to trade a certain number of contracts, what should you do if you deplete your risk budget by 50%? What if you double it to $100,000?

The typical answers – that if you halve your risk budget you should halve your positions, and if you double it you should double your positions – are not correct. With futures, so long as your risk budget covers your margin requirement, you can continue to trade the same position size even with a significantly reduced budget. If you automatically reduce your position sizes, you also reduce your profit potential. On the other hand if you automatically increase your position size with profits, you'll also enhance your future drawdowns. Thus, the correct solution to this problem isn't at all obvious and even though I studied several methods of 'optimal' risk management, I didn't find many of them convincing. Ultimately, I found some inspiration in the natural world.

Speculation in the wild

One evening while enjoying a wildlife documentary program, it occurred to me that if there were a sustainable solution to the problem of uncertainty and risk, it would have been worked out in some form in nature. Upon reflection, I realized that every form of life on Earth is in essence an embodiment of a strategy of survival. In natural life, species compete for energy and resources. Every individual animal is endowed with a physical body (a repository of internal resources) and a set of behaviors whose primary objective is to enable that animal's survival and procreation. To produce offspring, the animal must take in more resources than it expends in the course of living: its activities have to be profitable in terms of sustenance, else it would perish. Therefore, the existence of each species is proof positive that its survival strategies are successful. Take spiders for instance. Their strategy is to build webs. A spider's body is designed to do this. She may not know that food will get caught in her net, but this is how she secures her nourishment which must be sufficiently abundant to recover the resources that went into the building and maintenance of her web and also to bring forth her offspring.

I further realized that nature faces uncertainty in a similar way that we do when we formulate our trading strategies. Namely, nature generates her models without knowing how long they would be viable for. The design of a species is based on the environment experienced through its evolutionary past and every life form tends to be adapted to its present habitat. However, habitats eventually change and species must adapt or go extinct. When we consider that over 90% of all species that have inhabited the Earth

ultimately went extinct, it becomes clear that all of nature's models are fallible and that their fallibility is part of life's design. In this sense, nature's designs are speculative and every model is a guess based on the known environment. From there on, nature does not sustain life through permanent, immutable models, but by making its models nimble, constantly generating new adaptations and new species that can thrive for a time even as others go extinct.

The survival strategies in nature that bear the most similarities to the activities of market speculators are those of predators. To live, predators must hunt – an activity that includes elements of speculation. Like trading, predation requires knowledge, skills, judgment and decision-making. It also entails risk and uncertainty: a predator can't be sure where its next meal is coming from. Each hunt is an investment of resources; it involves the risk of injury and loss of energy expended in failed hunts, which tend to be more frequent than successful ones. To survive and procreate, predators must consistently generate a positive return on this investment. Too much of a losing streak could turn out to be fatal.

When pondering these issues, I tended to envisage the large cats hunting in the African savannahs and got quite excited when one day I came across a book titled, "The Serengeti Lion: A Study of Predator-Prey Relations" by George B. Schaller. Schaller spent several years in the Serengeti National Park in Tanzania during the 1970s, observing the activities of lions and other predators and fastidiously recording the details of hundreds of hunts. We have all seen wildlife television programs showing lions and cheetahs hunting, but Schaller's work offers a much richer account of the life of predatory cats including their hunting behavior, which I condensed in the following section.

The anatomy of a hunt

Lions prefer to hunt at night, especially when the moon is not bright. Because most of the animals they hunt can easily outrun them, lions must take every advantage of external factors like darkness, dense vegetation or the vicinity of water. While hunting, they rely on sight, hearing, and smell in the order of decreasing importance. Lions see much potential prey in the course of a day and evaluate the likelihood of catching any that appear vulnerable. "Most are given a glance," writes Schaller, "some merit a closer look, a few elicit hunting movements, and only a very few are actually pursued."

Lions use several distinct methods of hunting, which include ambushes, drives, runs and stalks. On occasion, lions make unexpected kills when a sick or injured animal stumbles upon them. The most common strategy is

stalking, where lions attempt to approach their prey undetected. To conserve energy, lions are extremely selective about engaging in the actual chase and generally don't charge unless they've been able to approach their prey undetected to within about 30 meters or less. The decision to attack also depends on the lion's judgment of her own fitness as well as that of the prey: chases after young animals are generally longer than those in pursuit of adults. If a chase is failing, the lion is quick to abandon the attempt and only seldom pursues the prey for more than 200 meters.

The risk of injury is another important concern. To avoid violent impact, prey is almost never attacked from the front, and when making a kill, a lion is careful to position her body where its victim's horns or thrashing hooves cannot reach her. Still, accidents do happen and Schaller reports seeing lions with broken jaws on several occasions. Such an injury is usually fatal for the predator. A lions' success at hunting depends on a variety of environmental factors and the method of hunting. Overall, running by a single lion is successful only about 8% of the time. When stalking or ambushing, a single lion kills on about one in six attempts, but if two lions hunt together they succeed once in about three hunts. Clearly, even though most of lions' hunts will fail, their success rates are sufficient for them to survive and procreate.

Decision-making in predators and speculators

One component of a predator's hunting that we cannot observe, but which is clearly operative in every healthy animal's brain, is the decision-making process that directs her predatory behavior. This is a sophisticated and highly complex mechanism, but for our present interest, I'll only discuss those elements that parallel the speculative activities of traders. As we have seen, lions spend a lot of time watching their environment for an opportunity to catch prey.

When actively hunting, a lion keeps track of a variety of factors to determine when to launch an attack. The size of her prey must be large enough to justify the expenditure of energy, but must also not be too large for her to tackle safely. She must also make a judgment about an animal's state of fitness and focus on the most vulnerable individuals.

She must also take her own fitness, speed and endurance into account, as well as a myriad of environmental factors. She may only charge when she is highly confident that her hunt can be successful. At that point the decision to launch the attack is made and she charges with full force. Her decision-making doesn't stop there however; the lion must conserve energy and abort her hunt as soon as her confidence in making a successful kill drops below some threshold. Then the process starts over.

In terms of decision-making, a lion's predatory behavior is similar to a trader's speculative behavior. The speculator spends much of his day scanning news, analyses and commentary about securities markets in order to identify attractive investment opportunities. Some opportunities or trade ideas may catch his attention and he then studies them more closely. When he is very confident that he can make a profitable trade of it, he buys or sells some quantity of the asset in question and assumes the risk in holding it. From that point on, he monitors his position to make sure it's unfolding as expected. But at this stage, the behavior of speculative traders differs sharply from the hunting behavior of predators in nature. Predators are masters of conserving resources and cutting their losses. They can always afford to abandon failed attempts because their survival depends on the cumulative result of the total of their hunts rather than on the outcome of any individual attempt. By contrast, speculators tend to treat each transaction as a departure from the status quo and are handicapped with a hardwired loss aversion bias. If markets go against them, rather than cutting their losses, traders tend to gamble with them and escalate risk hoping that things will turn in their favor. This doesn't always happen, and most speculators end up losing. As we saw in Chapter 7, many of them squander all of the resources at their disposal and eliminate themselves from the pool of market participants.

Nature's risk management

Natural world also gave us the solution to the problem of risk. Risk is not the same thing as uncertainty. Uncertainty means that we simply cannot predict the future. Uncertainty also can't be quantified in a meaningful way. By contrast, risk can be quantified and measured. In simplest terms, risk tells us how much we can lose if we bet the wrong way. If we make small bets, we risk small losses and if we make large bets, we can lose big. Nature has resolved the problem of risk to life on Earth through fragmentation of risk and diversification of species and individual agents.

This principle is appropriately encapsulated in the maxim, "no tree grows to the sky." While every species strives to grow, this is not done by infinite growth of individuals but by their multiplication at a certain – probably optimal – size. Thus, lions grow to about 115 kg for females and about 180 kg for males. If they are successful as predators, they will raise many litters of cubs. When fully grown, younger lions will establish new prides and spread as widely across the Earth's surface as they can. Competition for habitat and resources is the main business of every species on Earth and their action has spread life throughout the biosphere.

This diversification of life and its constant renewal as mature generations beget young generations has also enabled life to be perpetually adaptable. As conditions in a habitat change, life adapts by varying the genetic expression of species in their successive generations. Thus, even with perishable individuals and extinguishable species, nature has been able to sustain life for over three billion years and will probably continue to do so indefinitely as long as the conditions on the planet allow it.

The challenges encountered by natural life seem compatible to those we must address in investment trading. For me, this realization made the idea of emulating nature to build a sustainable solution to the problem of speculation irresistibly compelling as it gave us coherent answers to the problems of uncertainty, risk, growth and adaptability. In this sense, we could tackle the problem of uncertainty at the level of individual autonomous agents, which for our purposes would consist of systematic trend following strategies. Each strategy would come equipped with a risk budget with which to take a predetermined quantity of risk.

Nature's lessons for speculators

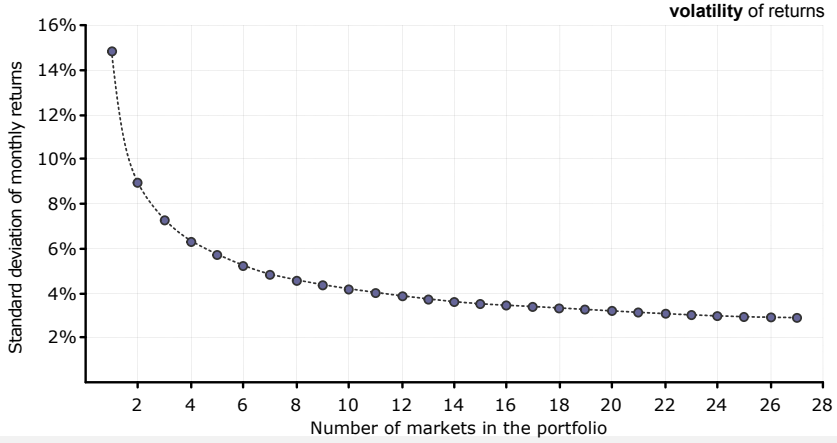
Returning to the dilemma about increasing or decreasing our bets along with drawdowns or profits, nature's models would suggest that we should always allow ourselves enough of a risk budget to accommodate for a few losing trades and probably continue taking similar-sized risks even after a losing streak. When we generate significant profits, we should probably use these profits to diversify and add more trading strategies in more markets rather than adding positions to the strategies that have been profitable in the past. Risk could be controlled by dividing the investment portfolio among a large number of such strategies, each in charge of a small fragment of the total portfolio risk. With a multitude of strategies we should ultimately be able to supplant the uncertainty of market events with a more predictable risk class: a swarm of focused, emotionless agents with positive trading expectancy. If any one strategy failed, overall performance could still be sustained by other strategies. The growth of an investment portfolio would be based on continuous addition of new strategies which would also introduce a degree of adaptability to the portfolios as new strategies would always be "educated" with the most recent changes in market environment.

Designing a diversified investment portfolio

Clearly, the most effective way to diversify risk is by fragmenting it across different, uncorrelated markets so that we are more likely to enjoy a favorable trending environment in some markets at all times. Indeed, for

this very reason, systematic trend followers normally seek the greatest and most balanced achievable diversification for their portfolios. In 2006, I calculated a curve showing the volatility-reducing effect of diversification. Trading in individual markets can produce strong, but volatile returns. Fragmenting risk among multiple uncorrelated markets significantly reduces risk.

Exhibit 15.2: Diversification lowers risk



Trading in individual markets can produce strong, but volatile returns. Dispersing risk among many uncorrelated markets increases the likelihood that at least some will generate gains at all times, resulting in lower overall volatility of returns and lower risk.

Futures markets offer trend followers more than 100 viable markets in six groups: energy, metals, agricultural commodities, equities, treasuries (interest rates), and currencies. Normally, all these markets fluctuate according to their own dynamics and trend at their own times. But when we seek diversification among them, we must weigh carefully the relative risk exposure in each since they all differ in terms of contract sizes and in terms of price volatility. Consider for example, the contrast between one of the most volatile markets (coffee) and one of the least volatile ones (2-year U.S. Treasury Note).

Over the ten year period from 2004 to 2014 (encompassing the most recent commodity bull market), the average and largest daily price changes in coffee futures were 1.49% and 13.85%, respectively. Over the same period, the average and largest daily price changes for 2-year Notes were 0.06% and 1.05%. Most of the other viable futures would fall somewhere between these two extremes. Thus, to take similar-size risk in each market we trade, we would want to size our bets appropriately and make relatively smaller bets in volatile markets like coffee futures and

much larger bets in less volatile ones like the 2-year T-note futures. To work out a balanced risk exposure for a given portfolio and determine the commensurate position limits for each market traded we need a meaningful way of measuring risk. One of the most useful methods to do this is the Value-at-Risk model, or VaR.

VaR uses statistical analysis of historical price fluctuations to estimate the extent of likely losses from exposure in some market. There are several ways of calculating the VaR, but the most common one looks at the statistical distribution of 1, 3, or 5-day price changes over some time interval. Assuming normal frequency distribution, it calculates the potential losses at a 95% or 99% interval of statistical confidence. In plain English, for a given exposure size, the 5-day, 99% confidence VaR quantifies the risk of loss associated with the largest 1% of 5-day price moves, which is a useful way to quantify the volatility of market price fluctuations. Some versions of VaR can get a bit complicated to calculate, but for our purposes with futures markets, it is dead easy to calculate thanks to modern spreadsheet programs like Excel.

Value-at-Risk parameters for commodity futures	
Δp	Absolute price change (close-to-close) between two successive periods (Δt days, we usually observe 1-day, 3-day or 5-day VaR). In some markets, like coffee and the grains, prices are quoted in cents, not in dollars. For these markets, to get the correct VaR figure, we have to divide Δp by 100.
Δt	Time period for which we measure the price change Δp. This period should reflect the time we need to liquidate some investment. In liquid securities markets, observing 1-day, 3-day, or 5-day VaRs is adequate. Generally, the larger the Δt, the greater the VaR.
k	The coefficient k defines how many standard deviations from the mean of price changes we observe. We normally use 1.65σ, which encompasses 95% of observed price changes or 2.3σ (encompasses 99% of price changes).
T	Lookback period determines how far back we analyze price data to calculate VaR. This period shouldn't be unduly long – it should reflect the most recent price conditions in the markets, going back perhaps only one or two years.
U	Contract size – how many pricing units there are in a futures contract (for exapmle, COMEX Gold contract has 100 tr. Oz.; CSCE Coffee futures calls for exchange of 37,500 lbs or coffee per contract, etc.)
C	The size of our trading position in terms of the number of contracts.

Basically we create a time series of absolute price changes over a given time period. This period should reflect the time needed to trade out of any individual position which, for most practical purposes should be a single day. To be conservative, we can 'inflate' this measure of risk a bit by

using a 3-day, or 5-day price changes. We then calculate the standard deviation (σ) of this series and further multiply it by the desired confidence coefficient (1.65 for 95% confidence or 2.33 for 99% confidence). The table above summarizes the parameters that determine the VaR for each individual futures market. Adjusting these parameters allows us to determine the position sizes in each market to achieve similar risk.

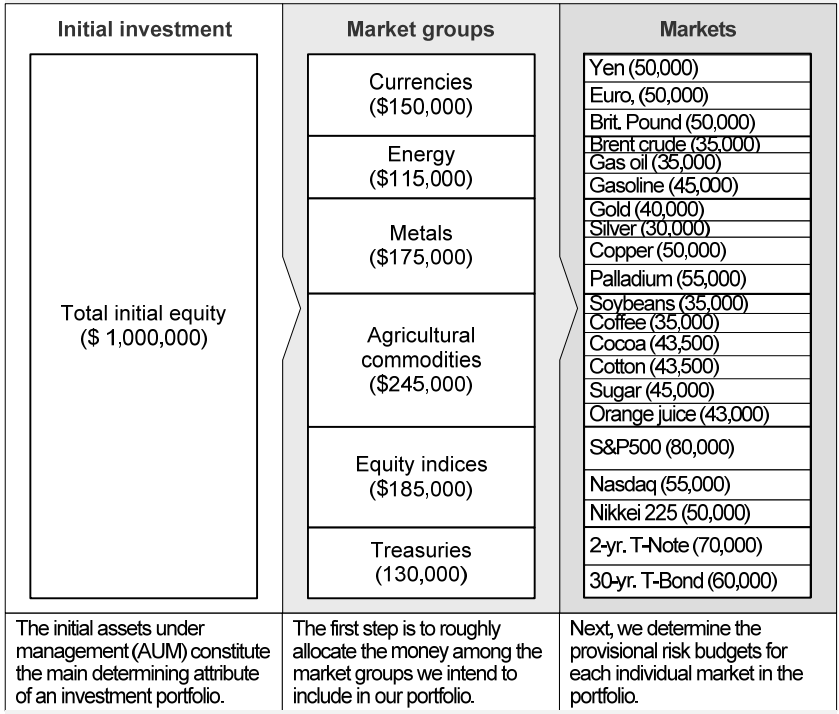
One of the weaknesses of VaR is that it doesn't tell you what happens beyond the 1, 3, or 5-day periods. Namely, the price in a certain market might move strongly against your position, but if you keep it unchanged and the price continues moving against it, your losses could end up much larger than your VaR estimate. For this reason, we should also consider each trading strategy's draw-down history.

Example: designing a model $1 million diversified portfolio

The process of designing a diversified futures portfolio is perhaps best explained with the example of an actual $1 million portfolio I had designed in late 2006 and implemented the following year. The $1 million was a sufficient risk cushion to trade in 21 futures markets: its purpose is not only to fund the futures margin requirement but also to absorb the likely cash drawdowns on the account.

The process is straightforward: first, we roughly allocate our risk budgets across six market groups and then divide it among the individual markets, as in the above example. This step of the process gives us the first rough idea about how much risk we can allocate to trading in each market. In our example, you'll note that we have relatively smaller allocations to energy and treasury futures, but a much larger risk allocation to agricultural commodities. The reason for that is that energy markets are mutually very highly correlated. The same is true for the treasuries. By contrast, among the agricultural futures, there are many individual markets that have very low correlations among themselves.

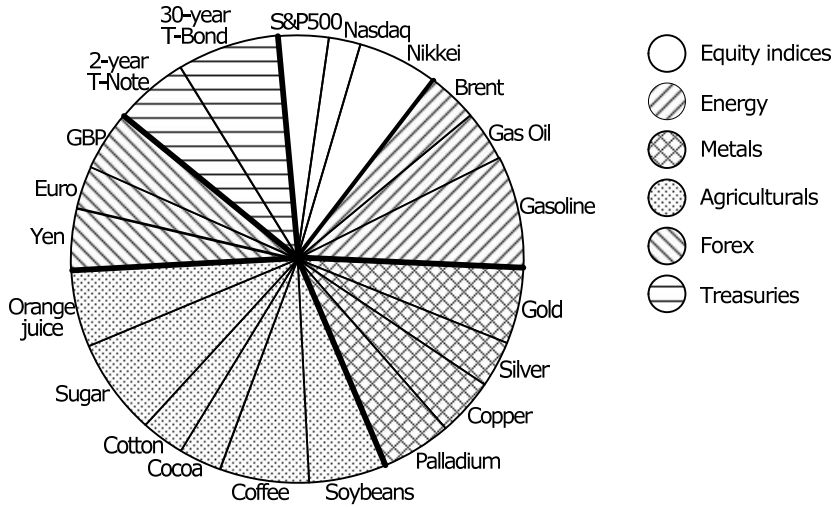
Exhibit 15.3: Designing a diversified futures portfolio



The first step in portfolio construction is to allocate a risk budget to each selected market

To achieve approximately equal risk weighting and set position limits for each market, we should observe three measures of risk: VaR, worst loss scenario and the drawdowns history for every trading strategy. The next exhibit shows the figures for our model portfolio:

Exhibit 15.3a: Balancing the risk exposure



Market	Risk budget	Value-at-Risk		Worst loss		Largest drawdown		Position limit
	USD	USD	% of AUM	USD	% of risk budget	USD	% of risk budget	Contracts
Yen/USD	50,000	3,733	0.37	30,325	61	37,500	75	2
Eur/USD	50,000	2,702	0.27	11,438	23	37,500	75	1
GBP/USD	50,000	3,800	0.38	8,900	18	20,000	40	2
Brent	30,000	3,023	0.30	7,240	24	12,900	43	1
Gas oil	37,500	3,126	0.31	7,275	19	17,625	47	1
Nat. gas	47,500	6,972	0.70	22,306	47	32,300	68	1
Gold	40,000	4,724	0.47	13,580	34	24,800	62	2
Silver	30,000	2,798	0.28	9,610	32	27,000	90	1
Copper	50,000	3,611	0.36	9,225	18	23,000	46	2
Palladium	55,000	4,282	0.43	42,260	77	20,350	37	2
Soybeans	35,000	4,583	0.46	15,000	43	22,400	64	2
Coffee	35,000	5,679	0.57	63,225	181	24,150	69	2
Cocoa	42,500	2,615	0.26	12,450	29	13,175	31	3
Cotton	45,000	2,590	0.26	31,720	70	13,950	31	2
Sugar	45,000	5,748	0.57	16,330	36	18,900	42	6
Org. juice	42,500	4,786	0.48	21,938	52	14,875	35	5
S&P 500	80,000	3,195	0.32	24,225	30	28,800	36	3
Nasdaq	55,000	1,747	0.17	44,780	81	28,050	51	2
Nikkei	50,000	5,003	0.50	20,950	42	23,000	46	2
2yr Note	70,000	4,615	0.46	28,969	41	39,200	56	9
30yr Bond	60,000	6,157	0.62	23,375	39	28,200	47	4
		A		B		C		
Totals	1,000,000	86,489	8.65%	465,120	46.51%	486,675	48.67%	

Observing the three different scenarios we determine the portfolio position sizes for each market: the maximum position limit for this portfolio; such limits should be periodically revised, taking into account meaningful changes in the size of the portfolio and changes in price volatility in each market.

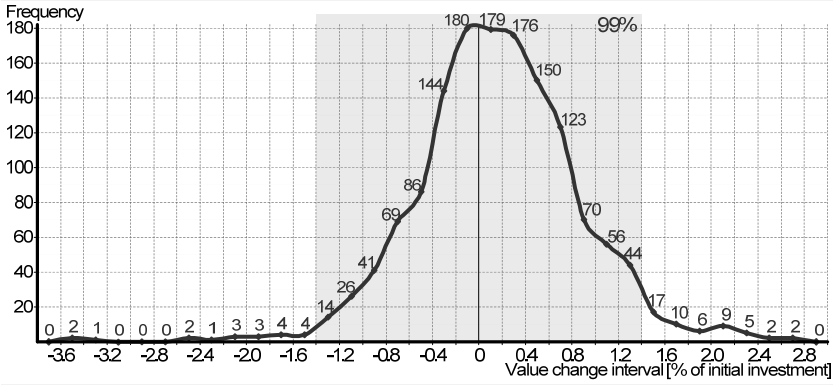
The following table summarizes what these numbers mean:

The three risk scenarios: what do the figures mean?

A	**8.56%**	**Value at Risk**: If the largest 1% of 5-day price moves occurred at the same time, and we were fully exposed on the wrong side in each market, the portfolio would lose 8.65% in such a 5-day period.
B	**46.51%**	**Catastrophic loss**: If a price swing equal to the single largest historical 5-day price change exactly coincided in each of the 21 markets traded and our strategies held the "wrong" exposure in every one of them, we could expect to lose about 46.5%.
C	**48.67%**	**Largest drawdown**: If each of the 21 strategies experienced a draw-down equal to its most severe losing streak (in its simulated behavior since 1992), and such draw-downs bottomed out on the same day for every strategy, the portfolio would lose about $490,000 (49%).

The above values, which represent plausible, but improbable events, give us a framework of what to expect in case of an unusually disruptive adverse dislocation in the markets. More importantly however, once we've precisely defined the whole portfolio, we can backtest it and derive a fairly comprehensive set of statistics about its speculative performance. For example, measuring the portfolio's daily profits and losses gives us a fairly realistic idea about its risk profile.

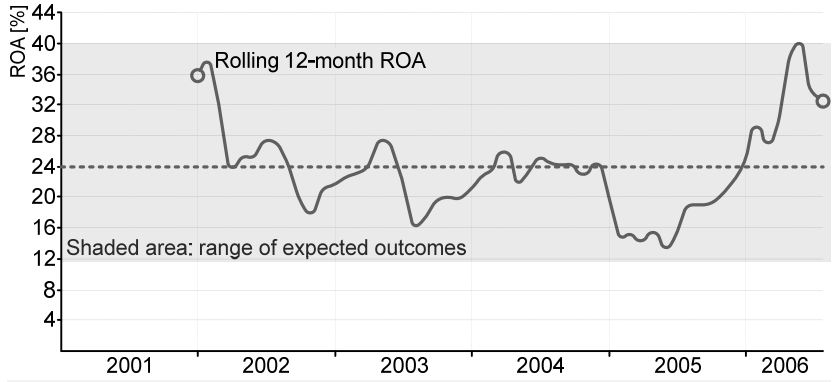
Exhibit 15.4: Distribution of daily fluctuations in portfolio value



99% of observations fall in the +/- 1.4% ($14,000 per $1,000,000 investment).

For a total of 1,429 simulated observations between January 2001 and July 2006, the largest recorded daily loss was just under $36,000 while the largest daily gain was $27,500. The average daily value change was $1,590 with 99% of observations falling within the +/- $14,000 interval. Backtesting the portfolio also provides an estimate of its rolling 12-month returns as a range of probable outcomes:

Exhibit 15.5: Rolling 12-month net return on assets (ROA)



Based on 2001 through mid-2006 performance simulation, the portfolio detailed in this example might have been expected to generate a return of between 13% and 40%, provided that the markets included in the portfolio continued to fluctuate similarly as they have done in the past.

The above curve represents a series of snapshots of 12-month performance relative to the initial investment simulated from 2001 through mid-2006. These projections gave us a way to form our expectations for the first 12 months' results once the portfolio went live. Remarkably, once we launched this same portfolio in live trading, its risk profile was a very close match with the profit and loss distribution depicted in exhibit 15.4, and its performance during those first 12 months was almost exactly 24% net of fees – very close to the mean value of our performance projections.

Thus, it pays to be thorough with your portfolio design and performance simulations. That exercise serves a very important purpose. It will enable you to ascertain whether the actual results of your trading activities conform to the expected values. If they do, this is an important confirmation that your model and your investment management process is functioning as intended. If not, they signal that something needs to be adjusted. In this way, applying these simple quantitative tools provides a solid foundation for a high confidence management of your investments.

Clearly, most people can't set aside $1 million to trade a diversified futures portfolio. However, even with lesser amounts investors can diversify among 4, 5 or more futures, mini-futures and FX pairs. For example you can combine one equity index CFD, an energy mini-futures contract, one metal like silver or copper, and one 10-year T-Note contract. This combination should provide significant diversification and reduce your risk. Your VaR calculations will be essentially the same as what we covered here, only multiplied by smaller position limits.

Chapter 16: Adaptability of Trading Strategies

Change is the only constant in life

Heraclitus

Most trend followers use systematic trading strategies and have done so for decades now. One would therefore expect to find a fairly strong consensus about *what* makes a good trading strategy. However, this is not the case. In addition to quantitative methods employed, trend following also entails a philosophical system of thought that shapes trend followers' convictions. Beyond the fundamental belief that markets move in trends, philosophies and convictions vary considerably.

With regard to the question about what makes trading strategies effective, one school of thought among trend followers holds that strategies should be simple and ultra-robust: they should not only perform in most time-frames and trading environments, they should also perform well in any market. In other words, a strategy that's successful in Soybean futures should also work on Gold, Natural Gas, and Yen futures. As a trend follower I happen to strongly disagree with this idea: each market manifests different price fluctuation dynamics and I find it hard to conceive that any one strategy could perform well in many different markets. Furthermore, as we discussed in the last chapter, each market's fluctuation dynamics may change over time, so we should expect some strategies to lose their edge. But then again, I've discussed this with a number of trend followers who vehemently disagree.

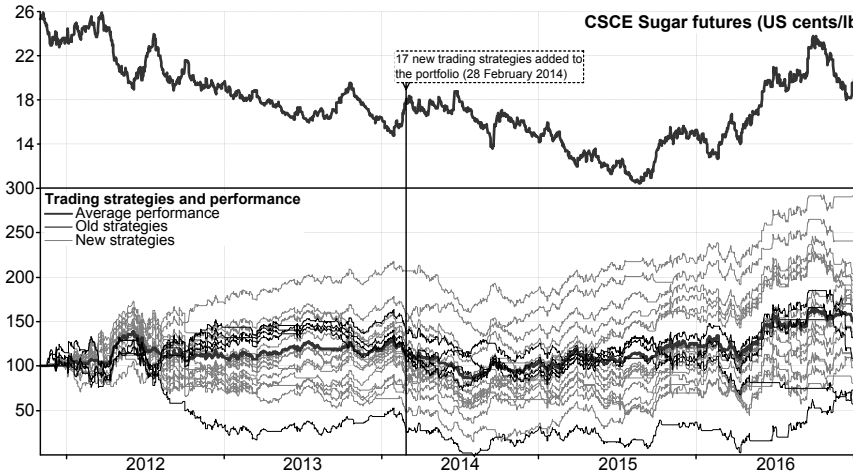
The reason why such questions remain contentious and why opinions about them still differ among trend followers is because the issue is extremely difficult to settle scientifically. It would take a fairly long time forward-testing a set of trading strategies, periodically formulating new ones and running them in parallel along with the old ones to establish whether new trading strategies actually added value. Such strategies should also be qualitatively similar so that we can be sure that we are comparing apples with apples. This in itself is hard to achieve since there is much turnover among trend followers as older ones with their legacy models fail, quit, or simply retire and new ones enter the fray with new, different models.

For this reason, what we are about to explore might be a rather unique and hard-won piece of knowledge that I was able to extract thanks to the I-System, which I have used in live trading continuously for over 15 years. I-System is not so much a trading strategy as a tool for generating strategies in different markets and different time frames, but always within the same framework of knowledge. That knowledge framework has been fixed in a set of algorithms which have never been altered since 2003. Thus, even though the trading strategies I formulate with the I-System vary widely in performance and in the way they generate *buy* and *sell* decisions, they are always based on the same identical set of algorithms, so we can be sure that here we truly *are* comparing apples with apples.

In the example below, the *apples* are strategies I had formulated to trade CSCE Sugar futures for Altana Inflation Trends Fund (AITF) which I managed from November 2011 to April 2019. The fund's position limit in Sugar was 20 contracts, subsequently increased to 22. At first I used five strategies, which I formulated in 2006 and which had performed fairly well over the years. Thus, each strategy was in charge of trading four CSCE Sugar contracts. In 2014 however, as I increased our Sugar position

limit to 22 contracts, I added 17 new strategies to the portfolio so that I could use one strategy for each contract traded. I began using the new strategies on 28 February 2014. A subsequent review of their performance revealed a striking difference between the old and the new strategies. The chart below illustrates the performance of the 22 strategies over the full period since the fund's launch.

Exhibit 16.1: 22 I-System strategies for CSCE Sugar futures



The performance of 22 I-System strategies for CSCE Sugar is shown below the Sugar price chart, with 100 corresponding with each strategy's initial risk budget.

Of the five old strategies formulated in 2006, one was a clear underperformer, but which nevertheless performed quite decently from mid-2014 onwards. What's clear is that there was significant variability in performance among all the strategies. The chart in exhibit 16.2 lumps together the average performance of the five old strategies vs. the 17 new ones to highlight their difference. Keep in mind, the comparison was not a theoretical exercise with backtest simulations – it reflects the results of real, live trading in CSCE Sugar futures. As the chart reveals, the new strategies performed significantly better since they were implemented, in spite of the fact that their 2014 draw-down was considerably worse than that of the old strategies.

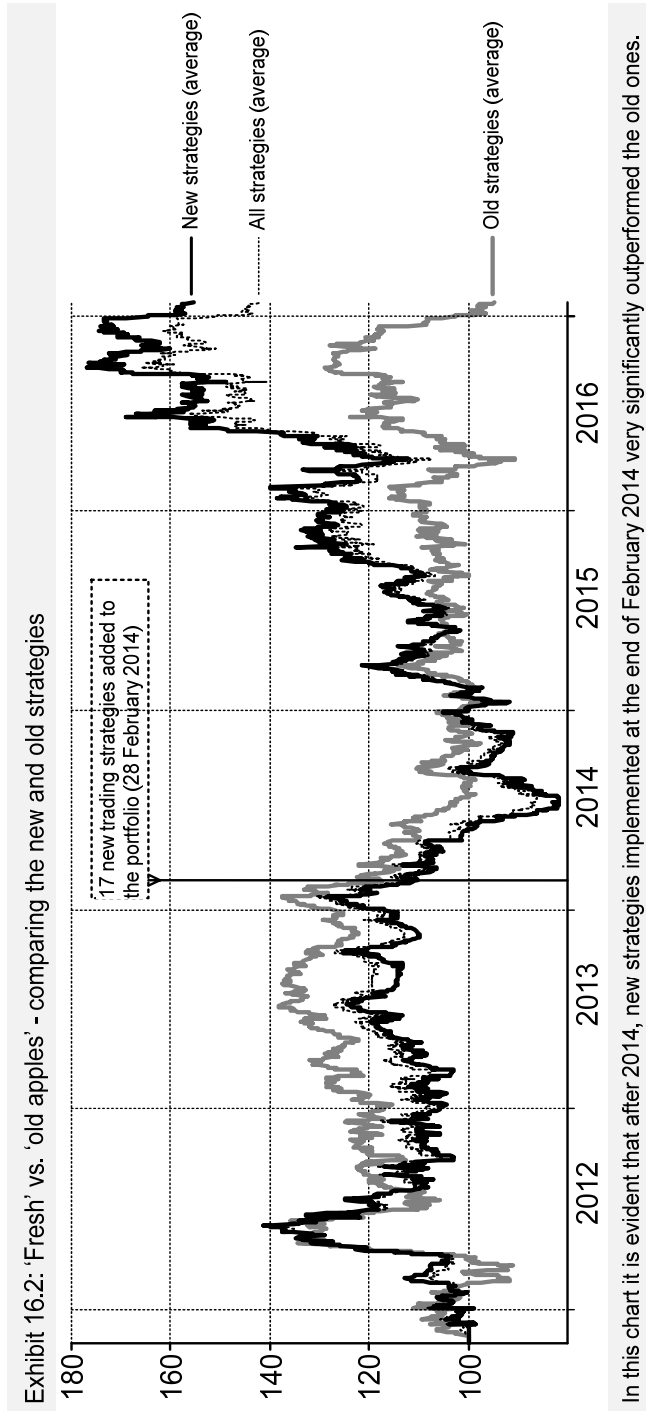
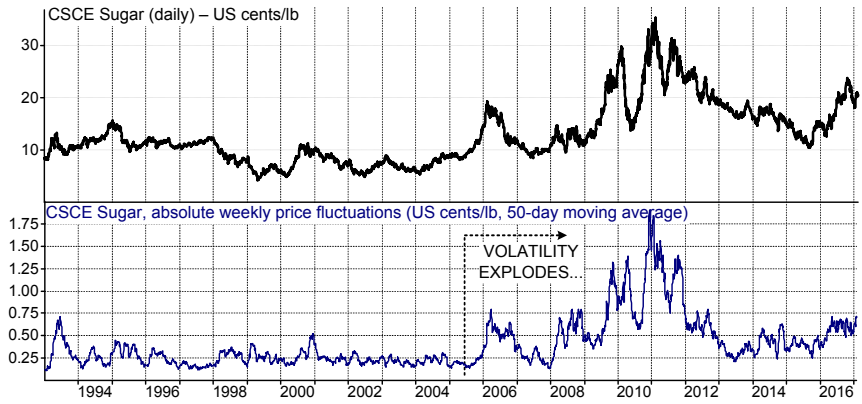


Exhibit 16.2: 'Fresh' vs. 'old apples' - comparing the new and old strategies
180
160
140
120
100
2012
2013
2014
2015
2016
17 new trading strategies added to the portfolio (28 February 2014)
New strategies (average)
All strategies (average)
Old strategies (average)
In this chart it is evident that after 2014, new strategies implemented at the end of February 2014 very significantly outperformed the old ones.

This was not because the I-System had improved (it did not, since we never made any alterations to its algorithms), but because over the years, the price fluctuation dynamics in Sugar futures changed and the new strategies, formulated in early 2014 were a much better fit with the new market environment than were the old ones, formulated in late 2006. The chart below illustrates how much these fluctuation dynamics have changed:

Exhibit 16.3: Changing price fluctuation dynamics in CSCE Sugar futures



Sugar price in cents/lb vs. the 50-day moving average of absolute weekly price changes (right axis).

Between 1992 and 2005, Sugar futures fluctuated rather evenly with average weekly price change hovering between 0.15 and 0.30 ct/lb. After 2005, price changes became much more volatile with the average weekly changes more than doubling from 0.26 ct/lb to 0.54 ct/lb! It should be clear that strategies that were designed to perform in one environment can't negotiate a different one equally well. We should thus not be surprised that new strategies, formulated in 2014 performed so much better since then.

Perhaps we can now lay to rest the idea that trading strategies can be ultra-robust and equally effective across all markets and all time frames. Change may really be the only thing that's constant in life and this is also true about the markets. Accordingly, to make our portfolios adaptable, we should constantly bring new varieties into the 'genetic pool' of our strategies, eliminating the ones that become obsolete. The change we may observe in markets is gradual and we can only ascertain it with hindsight. For this reason, the process of adaptation is slow, but it's a process we must take into account. The first step in that direction is dispensing with the idea that we should ignore change and continue to use a rigid and unvarying range of responses in a changing world.

Chapter 17: Past, Present, and Future of Trend Following

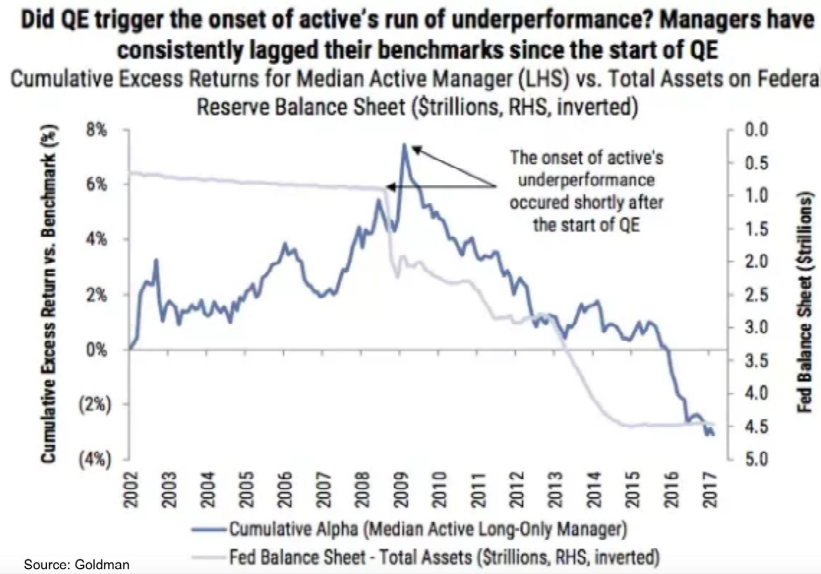
Spending time looking at economic data releases or focusing on corporate earnings is a colossal waste of time.

David Zervos

As with most things in life, fashions change and popular ideas become forgotten while others come into vogue. The same is true about trend following. While the strategy has been remarkably successful for many decades, it has fallen into disfavor after the Great Financial Crisis of 2008/09. The aftermath of that crisis ushered in an era of unprecedented fiscal and monetary interventions by governments and central banks aimed at stimulating the ailing global economies. While these measures had limited effect on the economic activity, producing the slowest and weakest recovery on record, they were very successful at inflating a massive new asset bubble. In many countries, most asset classes saw prices soar to new all-time highs. In this environment, investors with passive allocations in long-only stock index funds, fixed income (bonds) and real estate have done extraordinarily well. At the same time, the fiscal and monetary interventions created significant market distortions that led to a dramatic decline in performance by active asset managers. At sea in the uncharted

territory of centrally planned economies, many managers lost their edge. The remarkable chart below, produced by Goldman Sachs research summarized what took place.

Exhibit 17.1: Active traders lost way in the centrally planned economy



Source: Goldman

Central bank quantitative easing created market distortions that active investment managers did not manage to navigate to their investors' advantage.

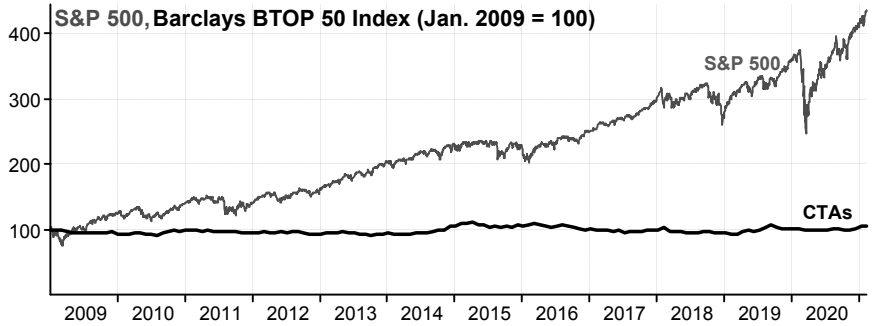
What the chart shows us is that shortly after the onset of Quantitative Easing, active investment managers began to lose their edge. As a result, many among the world's most successful hedge funds with decades of outstanding performance saw their businesses fade. According to Hedge Fund Research, just in the five years from 2015 to 2020 there were more than 4,000 hedge fund liquidations – the process that included some of the most respected names in the industry.

The 'death' and resurrection of trend following

In this environment, trend followers haven't done well either. As we already discussed, most trend followers tend to rely strongly on commodities for trading performance. However, one of the peculiar market distortions during the decade of 2010s has been an unusual absence of trends in commodity markets. With few exceptions, most commodities spent many long years fluctuating in horizontal ranges, only here and there broken with sharp rallies or crashes that often reversed as

quickly as they emerged. This caused most Commodity Trading Advisors (CTAs) to struggle and already in 2014 the Financial Times reported that, "after years of poor performance," 156 CTAs shut down as investor outflows took heavy toll.[91]

Exhibit 17.2: During the age of central bank Quantitative Easing, Commodity Trading Advisors lost their shine.



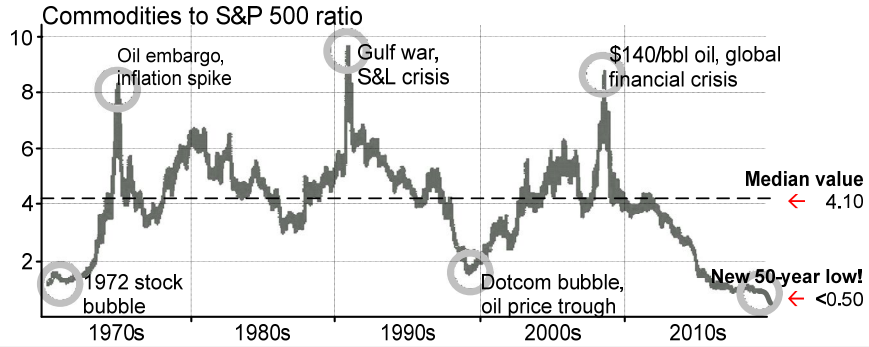
A decade of flat performance put many CTAs out of business. The above CTA curve is based on Barclays BTOP 50 index.

In the years that followed, many more of them shut down, including some of the largest funds and best respected names. Not surprisingly, trend following lost the popularity that it had gained through previous business cycles, including the 2008 financial crisis. Much of the financial media commentariat declared the strategy dead and buried.

However, I believe that this view is mistaken. I can confidently predict that trend following will soon experience a veritable renaissance and once more prove to be the top performing strategy for the near future. As I write these lines in February of 2021, global markets are beset by extremely precarious imbalances: monetary inflation has reached astronomical proportions; levels of debt and fiscal deficits in virtually all industrialized nations are unsustainable; interest rates are near zero (and in many cases below zero) and stocks are at record high valuations – what many analysts have called *the everything bubble*. At the same time commodities remained relatively depressed, creating an anomalous imbalance between the prices of commodities relative to other asset classes.

[91] Marriage, Madison: "Trend-following hedge funds' future in doubt" – Financial Times, 07 September 2014. https://www.ft.com/content/c9b78c5a-350e-11e4-aa47-00144feabdc0

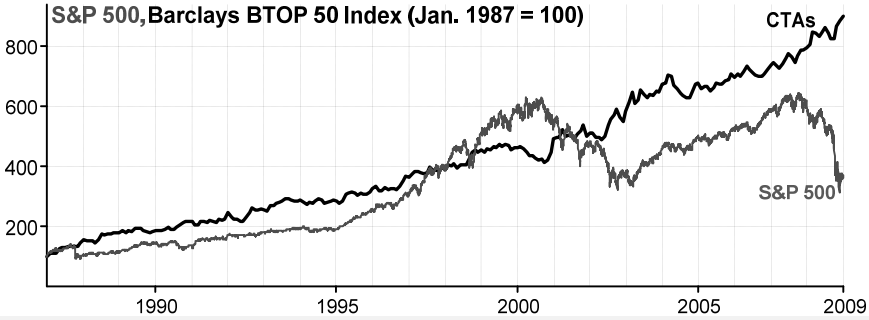
Exhibit 17.3: Commodities reach an all-time low relative to equity prices



For the last 50 years, the ratio of commodity prices to the S&P 500 fluctuated around the median value of 4.1. With central bank Quantitative Easing and financial repression, they have remained depressed and unusually flat, ultimately falling to an all-time low in 2020.

The market pendulum is likely to swing back in the opposite direction, and unleash a cycle of significant price readjustments. The timing and magnitude of such large price events tend to be entirely unpredictable.

Exhibit 17.4: For over 30 years, the Commodity Trading Advisors performed as well as the S&P 500 but with far lower risk and volatility.



Systematic trend following is probably the best strategy of active investing.

What we can predict however, is that they will almost certainly unfold as trends and shape up over many years. When these trends begin to emerge in earnest, trend following will prove to be the winning strategy for those who adopt them as it has been for over 30 years before government and central bank interventions.

Chapter 18: Keeping the Faith

If the highest aim of a captain was to preserve his ship, he would keep it in port forever.

Thomas Aquinas

I'm not afraid of storms, for I am learning to sail my ship.

Aeschylus

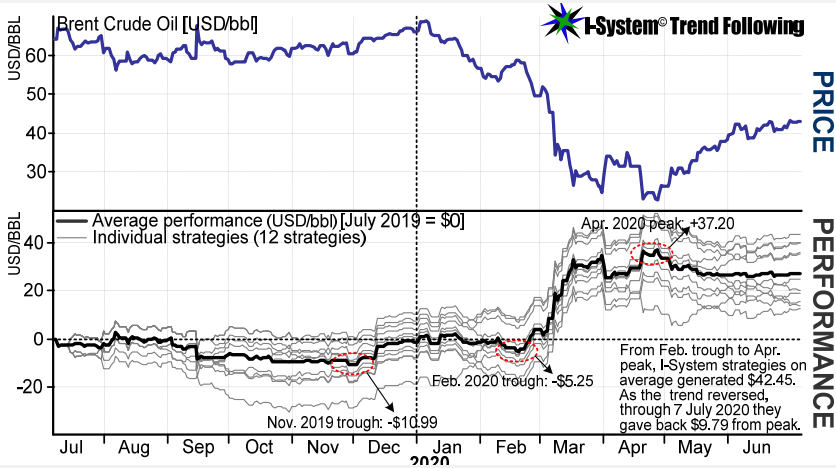
Conceptually, trend following is not complicated – the idea is simply to profit from price trends in securities markets: if you think that the price of some asset will trend higher, you buy it, and if you think it'll fall, you sell. However, converting this simple concept into a successful practice is not so easy. To catch a trending move at the right time and then exit before the

trend reverses requires good judgment and a well-formulated strategy. More importantly, it requires a great deal of patience and discipline.

It is a bit like fishing…

You can think of trend following as fishing: imagine that you have a small fishing boat and you specialize in catching tuna. You know that during certain seasons, large schools of tuna may pass nearby and during those seasons you can land a large catch. The problem is that you don't know when that might be and so, to catch the tuna you must go out to sea and cast your lines every day. This costs you some effort and expense – the costs you expect to recover when you land the next big catch. Likewise, to capture profits from large price moves in securities markets, you need to continually position your bets in the direction of anticipated trends. I-System strategies offered a good illustration of this process through the 2020 crude oil price collapse:

Exhibit 18.1: Profiting from a big price move with trend following

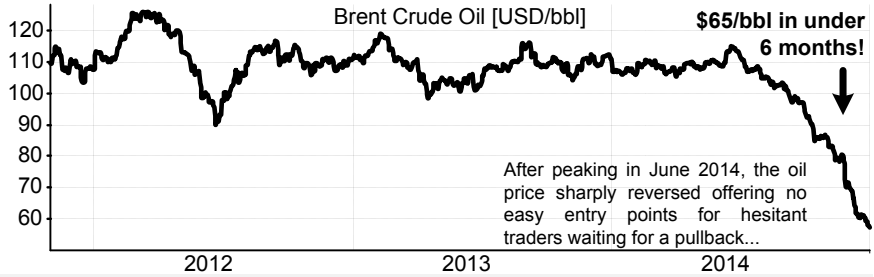


A set of systematic trend following strategies captured very significant profits from the oil price collapse in 2020.

This chart highlights two very important aspects of trend following: it shows the gain, but also the pain involved in the process. To profit from a price trend, you need to be in the right position at the right time. This positioning involves risk-taking and incurring some losses until a price trend takes off. Of course, trend following strategies did not and could not have predicted any of the events that unfolded in 2020. Instead, they simply navigated the trend moves and provided the timing of *buy* and *sell* signals in accordance with a predefined set of rules. The outcome was

ultimately a success, but it is important to recognize that this success – the big catch – followed a period of eight months of taking positions and sustaining losses. Psychologically, this can be difficult for even the most disciplined of traders, especially as we never know when a trend might emerge and redeem our losses. At the same time, failing to take positions would be the equivalent of failing to cast your nets the day a large school of tuna passes under your boat. Such events usually happen suddenly and seemingly out of nowhere…

Exhibit 18.2: Big price moves – suddenly and out of nowhere…



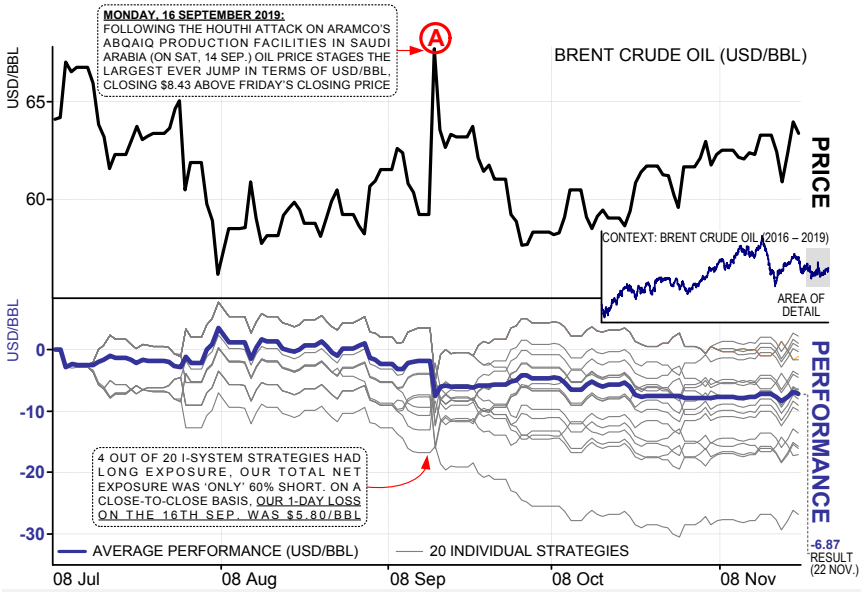
After nearly three years of directionless drift, the price of crude oil crashed by over $65/bbl in under six months. Either you had your 'nets' out or you didn't. The only reliable way to do this is to stick with systematic trend following.

Yes, but how can a trading model 'know' if XYZ happens?

Many investors distrust systematic trading strategies on the grounds that such strategies can't *know* if some event XYZ might unexpectedly happen and cause a large jolt in the markets. In that case, you risk getting caught on the wrong side of that event before your systematic strategies can 'react' and evade the damage. This is perhaps the most commonly voiced doubt about quantitative strategies. At first blush, this would seem like a legitimate objection. But it may not be. Let's have a look at an actual case of a market event catching trend following strategies wrong-footed.

A good example of an unforeseen, "XYZ" event occurred on Saturday, 14 September 2019 when a missile attack in Saudi Arabia caused substantial damage to Aramco's Abqaiq oil production facilities. The following Monday, Brent crude oil sustained the largest-ever one-day price jump and closed $8.42/bbl above previous Friday's price. At that time I was using a set of 20 I-System trend following strategies to track Brent futures. Of course, the strategies didn't 'know' that the rocket attack would happen and held a 60% short exposure to crude oil price. As a result, our energy portfolio sustained a $5.80/bbl average loss (4 out of 20 strategies had long exposure).

Exhibit 18.3: Slammed by the largest-ever oil price jump - the performance of I-System trend following strategies on Brent crude oil, 09 July – 22 November 2019



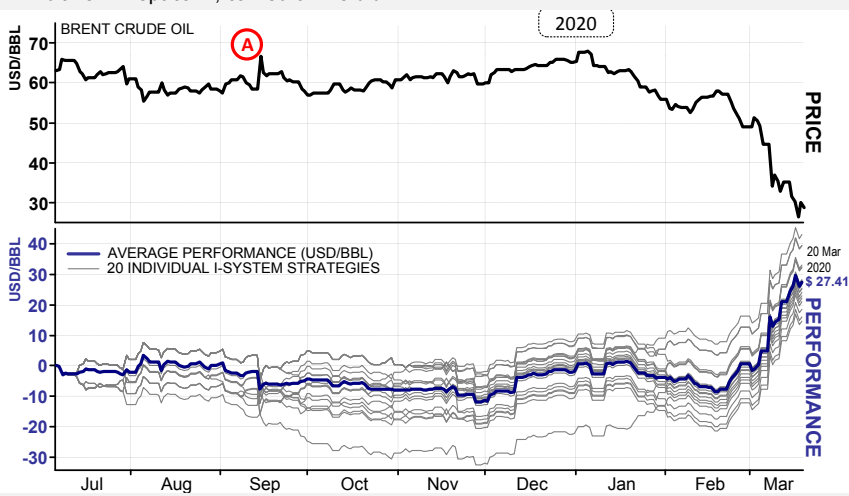
Through the trendless period above, I-System strategies generated a loss of $6.87/bbl, more than 84% of which occurred on the 16th Sep. Event A in the above chart marks the largest-ever oil price jump in terms of USD/barrel.

Such an experience can easily induce traders to react emotionally to try and avoid the losses or recover them quickly. But such maneuvering doesn't always improve things; impulsive trading around on-going events can easily make things worse.

By contrast, disciplined adherence to a set of predefined and tested decision-making rules can help traders to resist getting caught up in the commotion of the moment.[92] In this sense, sticking with the predetermined trading strategies is not a weakness but an important strength. Over longer time-horizons, the consistency of systematic strategies will tend to pay off, as it did with the Brent crude oil strategies we just saw:

[92] This example also highlights the crucial importance of robust risk management: to be able to sit out a large loss without losing composure or diverging from your strategy requires maintaining adequate loss-absorbing capital.

Exhibit 18.4: Kept calm, carried on we did...



Our large loss sustained on 16 September 2019 looked like a relatively small blip as it receded in the past. With trends, from 09 July 2019 through 20 March 2020 I-System strategies generated a profit of $27.41/bbl. Please note, some of the strategy curves overlap so not all 20 are visible.

The September 2019 Abqaiq attacks in Saudi Arabia had a massive impact on the price of oil. But seen from a longer-term perspective the impact of individual events is dwarfed by trends. As they recede in time, the losses (and gains) related with any single event will look like minor blips in the performance history of systematic trend following strategies.

Trend following vs. quant gimmicks

The requisite patience, iron discipline and keeping the faith may seem off-putting to some. Many traders like the idea of discovering some gimmick that could provide instant gratification and predictable profits without much risk of loss. This desire is met with a flood of offers promising very large returns on investment, risk-free trading, 80% accurate forecasts, and all kinds of other varieties of trading snake oil. As a rule, such claims will prove false. We know this because in jurisdictions where brokers are obliged to disclose the proportion of their clients who lose money, the figures are soberingly high. Here are a few examples:

- IG Group: 74% lose money
- Saxo Bank: 71% lose money
- Ava Trade: 79% lose money
- Plus 500: 76% lose money
- FxPro: 80.6% lose money

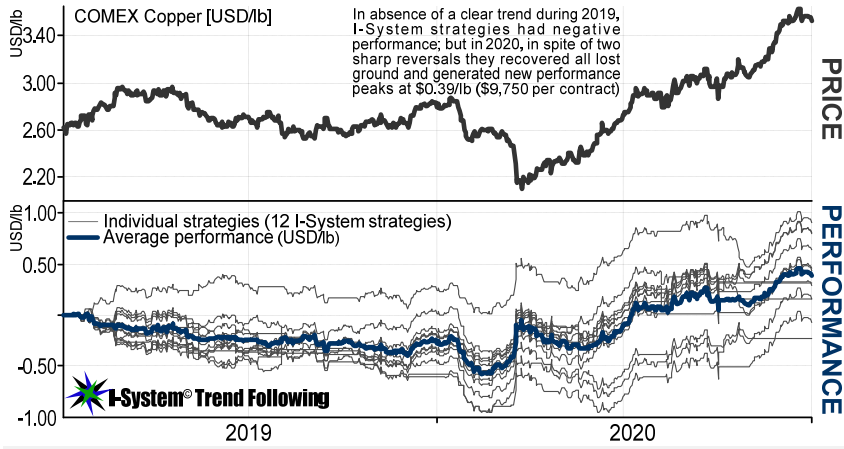
As we already discussed in chapter 5, among algorithmic traders, the group that is the most inclined to searching for special profit-making gimmicks, close to 80% lose money. These facts speak to the unrealistic claims of many providers of quantitative systems: they may all look great on paper but they usually prove less effective in reality.

Of course, this all begs the question: why should trend following be any better? The answer is that trends arise from the collective psychology and action of market participants. Human psychology is the one constant in all markets. That constant has not fundamentally changed over centuries in spite of the extraordinary evolution we have experienced in global securities markets over the last few decades. We may therefore be justified in assuming that human psychology will continue to shape the price discovery process in a similar way in the future as well. If this assumption proves correct, price trends will continue to emerge in various markets worldwide and trend following will help investors to generate substantial profits from them.

It all boils down to faith

Another good illustration of the pain-to-gain nature of trend following was the performance of I-System strategies with COMEX Copper futures over the two-year period from 2019 through 2020:

Exhibit 18.5: Trend following "fishing expeditions" can take time and try your patience



Long in the making, but very positive performance.

Again, over the longer term, the exercise proved successful in spite of the difficult trajectory of Copper prices: through the whole year 2019, the price mostly drifted in a horizontal range, then staged two sharp reversals,

first turning down from the incipient trend at the end of 2019 and then rebounding sharply from the sudden collapse during the first quarter of 2020. Not only did this result in more than a year of negative performance, it also caused a painful loss through the opening weeks of 2020. Sustaining a trading strategy through such adverse circumstances can be psychologically very difficult. It really does require patience, iron discipline and keeping the faith. As any experienced practitioner will tell you, trend following is a sequence of *feasts* and *famines*. Sitting tight through periods of losses is a part of the game and the inevitable aspect of risk taking.

But in this sense, trend following is not so different from other long-term investment approaches. As I write these lines in mid-February 2021, the price of Bitcoin has just broken above $50,000. Less than six months ago it was at $10,000 and in March of 2020 it was just over $5,000. Bitcoin investors who sat through this trend have done remarkably well. However, Bitcoin had already gained the attention of mainstream investing public in 2017 when it rose sharply from below $1,000 to $19,300. From that last peak, investors had to sit, wait patiently and keep the faith for nearly three years during which they would see an 83% draw-down (from the December 2017 peak at $19,345 to the $3,229 in December 2018). Similarly, that 2009 'correct' value call on Japanese stocks we discussed in chapter 8 (see exhibit 8.2) also entailed two years of waiting, weathering losses and keeping the faith.

Indeed, speculation inevitably involves the risk of loss and it is the ability to cope with the losses perhaps that separates those who can play the game successfully from the majority who fail. This process and the uncertainty it involves clearly poses considerable psychological and emotional challenges for the investor, so it is fair to ask: why should we even bother with risk taking, losses and iron discipline at all? This is actually an important question and most everyone intuitively knows the answer: ultimately, the justification in any risk-taking endeavor rests on *belief*. For the fisherman, his efforts are warranted by his belief that schools of tuna or other fish will periodically pass within the reach of his nets. For the trend follower, the belief is that markets move in trends and that with good judgment, well formulated strategy and discipline he'll be able to profit from them. For both the fisherman and the investor, the *willingness* to take risks is ultimately motivated by necessities of life. Fishing is necessary as a source of sustenance for the fisherman's family and his customers. Investing is predicated on the need to generate return on one's capital, including cash. If cash lays idle, it predictably loses purchasing power over time. The need to keep capital working productively was perhaps best captured by St. Thomas Aquinas when he

said that, "*If the highest aim of a captain were to preserve his ship, he would keep it in port forever*." Of course, people do not build ships in order to preserve them, but to put them to work in profitable enterprise. The same is true for all other forms of capital.

Speculation is inevitable

Productive use of capital inevitably involves speculation, as do many ordinary decisions in life: do I buy a home, or do I rent? Do I get a job after school or do I go to university? Should I keep my job or start a business? Shall I save up to buy a tractor in cash, or do I lease it without delay? To the extent that such decisions deal in the present with uncertain future outcomes, they are speculative. More controversial aspects of speculation emerge when we engage in financial transactions for profit. The desire to gain in such transactions intensifies the emotional experiences like fear and greed which can lead to unfortunate outcomes. To avoid this, it is essential that we moderate our actions with judicious risk management and unwavering discipline.

Chapter 19: Twelve Do's and Don'ts

To invent an airplane is nothing. To build one is something. But to fly is everything.

Otto Lilienthal

Observing the following twelve simple *do's* and *don'ts* of investment speculation will go a long way in helping you to maintain that discipline and to significantly improve your chances of success over the long term.

1. Set the right objective

We'd all love to double our money every year, but this is an extremely unlikely fantasy. Instead, we must gauge our performance objectives around realistic, attainable goals. For reference, we can start with the stock markets: over the long term, they have tended to compound at about 9 to 10 percent per year. Outside of the decade of 2010s during which the

markets have been heavily distorted by central bank quantitative easing policies, the top-performing active investment managers could sustain annual returns ranging between 10% and 17% after fees, implying a maximum gross return in the low 20% range. That level should be your benchmark.

If you spend time reading financial press, sooner or later you are bound to come across the legend of the mysterious Medallion Fund managed by Jim Simmons' Renaissance Technologies (or RenTec as people in the know like to call it). The Medallion Fund, dubbed the most successful fund in history of the Milky Way galaxy, allegedly returned 66.1% annually from 1988 to 2018 before fees. Net of their ridiculously high fees (5% management + 44% performance fee), Medallion's returns stood at a still staggering 39.1%. During those 30 years, RenTec's profits supposedly amounted to $104.5 billion. For some odd reason, most people in the financial industry actually believe this story. But for a number of good reasons I strongly doubt the veracity of these self-reported figures. That discussion is outside our scope here, but the point is that if you *do* come across the legend of the Medallion Fund, please resist the idea that generating annual returns of 66% or even 39% is remotely realistic.

Firmly grounding your objectives on realistic, attainable objectives should also help you gauge your risk appetite. To be sure, you might have strong months in which you earn double-digit returns – say, if you were lucky to hold some asset that's on a tear like Tesla or Bitcoin were during the late 2020 and early 2021. You can gratefully accept that, but if the needle on your investment account strikes double digits too often, it may be time to take the pressure off the gas pedal. A few double-digit down months could be crippling and very difficult to reverse.

Finally, realistic performance objectives will also make you less likely to fall for offers of dubious and unrealistic gimmicks promising exorbitant returns. Such gimmicks might come with irresistible marketing and enticing buzzwords like artificial intelligence, genetic algorithms, machine learning and such, but keep in mind that exceptionally high profits also entail high risk. Your reality check should be that among the very best professional investment managers, very few have been able to sustain returns beyond mid- to high teens.

2. Keep your bets small

You must decide the size of your bets in advance. How much money you can risk on any particular bet should depend on how much you are prepared to lose if you turn out to be wrong. If you trade stocks, assume that you risk losing 50% on every stock you purchase. If you are prepared

to lose $100 on a trade, then only buy $200 worth of that particular stock. With commodities, or CFD contracts, you should observe Value-at-Risk measurements in each individual market and allow yourself an abundant cushion to absorb losses on any individual trade. For example, I advise customers to budget at least $25,000 to trade one 1,000 barrel contract of crude oil, or about $25 per barrel. Thus if you'll allocate $25,000 to trading crude oil, you should trade no more than a single 1,000 barrel contract. For smaller allocations, you should look to mini contracts or other instruments that offer exposure to oil prices. Whatever you decide, be sure that your bets are small enough not to keep you awake at night. If your trading puts too much strain on your emotions, you'll be more likely to make mistakes, overtrade and ultimately sustain irreversible losses.

3. Never chase after losses

Investment trading is a long-term pursuit where performance accrues through a long series of transactions. But instead of considering every decision as just one of many, we tend to treat each transaction as a departure from the status quo, where our fear of loss overpowers our desire for gain. We tend to be strongly risk averse when preserving a favorable status quo, but risk-seeking when we are faced with trading losses. This creates the disposition to close profitable trades too soon, and to "work" losing trades for too long, take more risk and overtrade in trying to recover the losses. Loss aversion is a hardwired human trait and in investment trading it can induce us to greatly escalate risk taking. This seldom leads to happy endings, and adds another reason to keep your bets small enough so that it doesn't weigh on your emotions.

One of the most common errors investors make is 'averaging down' the purchase price on their investments. When they become enamored of some stock and its price falls after they'd bought it, they succumb to the temptation to buy more of it to average down their purchase price. The logic of averaging down is that the more you buy as prices decline, the lower your purchase price, so the temptation can be considerable. If it were certain that the stock's price would go higher, this approach would make sense. But this is never certain and averaging down often leads to larger losses. More often than not, cutting your losses is the more sensible alternative.

4. Don't let a winning streak get to your head

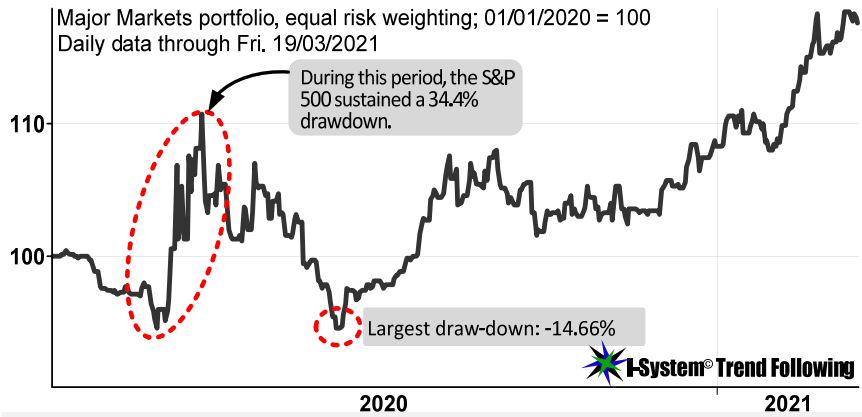
A winning streak in trading may give you the idea that you've mastered the game and the confidence to bet more frequently and more aggressively. Absolutely resist such temptations: no matter how well you may have

done in the recent past, believe me, *you have not mastered the game*. Do not get ahead of yourself. Think of it as driving your car: the harder you press on the gas pedal, the more likely you are to get hurt. Keep it steady within your emotional comfort zone.

5. Diversify as much as possible

Because we can't predict the onset of a trending move in any particular market, trend followers diversify their bets across as many uncorrelated markets as possible. Systematic trend followers normally seek to trade in as many as 30 markets or more. In this way their returns are typically driven by one or two markets at any one time while the rest of their positions tend to be a mix of smaller gains and losses. Being well diversified makes it that much easier to tolerate an extended losing streak in any individual market. To illustrate the idea, consider a model portfolio I'd tracked since 2019: our Major Markets portfolio is diversified across 15 key global financial and commodity futures markets. Exhibit 19.1 shows its gross performance over a 15-month period:

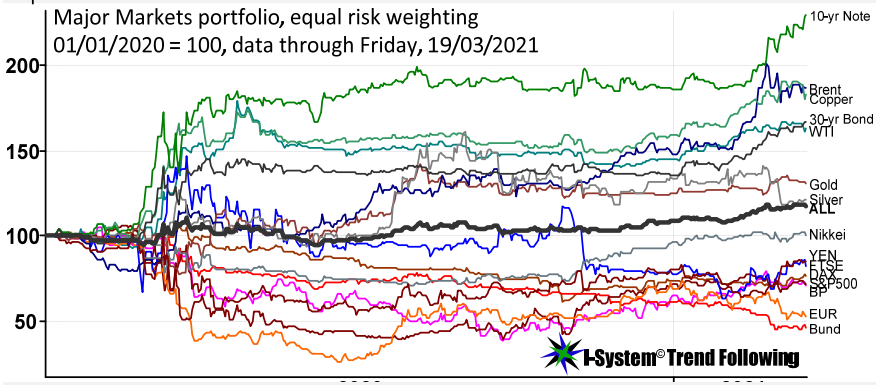
Exhibit 19.1: I-System Trend Following Major Markets portfolio performance (gross)



Major Markets portfolio consists of 15 key global financial and commodity markets.

Over this period, the portfolio has had very decent performance, benefiting from the crash in Crude Oil, Copper and Treasury futures prices in the first half of 2020 and from the sustained rise in commodity prices and further decline in U.S. Treasury prices in the latter part of 2020 and the opening months of 2021. But this performance was in fact a mix of very substantial profits in those markets and losses elsewhere, which is in fact typical for diversified trend following portfolios. The next chart reveals the individual components of the above performance:

Exhibit 19.2: The anatomy of a diversified portfolio's performance – almost invariably it is a blend of profits in some markets and losses in others...



For diversified trend following portfolios, this picture is rather typical.

Clearly, trading in 15, 30 or more futures markets requires a large capital base. With smaller amounts, you should seek to trade in at least 4 or 5 markets. For example, you may consider allocations to one equity index (FTSE 100 or Russell 2000), one or two currency pairs like USD/YEN, USD/EUR, or EUR/GBP), a precious metal like Silver or Gold, and an energy security (Brent crude oil or Gas Oil). While crude oil and metals can be too volatile and risky for some, markets like Corn, Oats or Treasury bond futures offer tamer venues for diversification.

Finally, you should seek to keep at least roughly equal risk exposure in each market. Traders usually have views about which market would do best in the immediate future and the obvious temptation is to overweight risk in that market. But oftentimes, markets surprise us and you'll achieve your best results in a market you didn't suspect. To avoid guesswork as much as possible I always recommend equal risk-weighting using Value-at-Risk (VaR) to measure the relative riskiness of positions in any given market as we already saw in chapter 15.

6. Stick with the plan

Many traders find it hard to trade against their convictions, and when events defy their convictions, they hesitate to act, or they decline to trade at all. Take the example of Tesla shares we discussed in chapter 11. You might have resolved to follow price trends, but then also become convinced that some stock is far overvalued. You might sell too soon or even get tempted to short-sell it. For best results, have clarity about what strategy you'll adhere to and stick with it. This is easier to do if you apply some kind of systematic strategy. When you use systematic strategies, it is best to execute every trade. You'll find that some of your best trades will

be the ones you least expected to make profits, and you'll also see the trades where you had highest expectations flop time and again. For best results, do not become emotionally invested in the outcome of any individual transaction – your performance will accrue over time as a cumulative result of a long series of trades.

7. Avoid gunning for best execution

Another hard-to-resist temptation is trying to get the best price for your trades. Investors may typically spend considerable time waiting for the best moment to place a trade or set up trigger points, but this is not always a good idea. Even if you are successful a few times, other times you'll miss favorable price moves and in the end the whole exercise could prove futile. To avoid this, it is best to execute all your trades at a fixed time during the day and use market orders, not limit orders. During the 15 years of my active hedge fund career I adopted the practice of always executing my trades between 4 and 6 PM (central European time), corresponding to mid-morning hours in the U.S. futures markets. Most trend followers do the same.

8. Don't spend too much time

Spending too much time analyzing markets and overthinking your trades isn't a good idea either. Fluctuating almost around the clock, modern markets generate a constant flow of news and information. This may seem like a good thing, but most traders would be better off staying away from the news flow altogether. As we discussed in chapter 8, evidence strongly suggests that even among experts, more information doesn't improve the quality of investment decisions and that traders who did not follow financial news at all earned double the returns of those who frequently checked the news.

9. Don't trade for entertainment

For any rational person, the objective of investing should be to protect the value of their assets and to grow them steadily over time. However, with the proliferation of online trading platforms and the growing numbers of people opting to manage their own investments, experience has shown that the actual conduct of the majority of individual investors is quite different. Whether consciously or unconsciously, most traders appear to strive for big profits fast. The cliché about day traders is that their guiding motivation is the dream of making a million bucks in their pajamas. This is unwise and very unrealistic. Most of these aspiring traders end up losing their money. We already saw that the percentage of retail brokerage clients

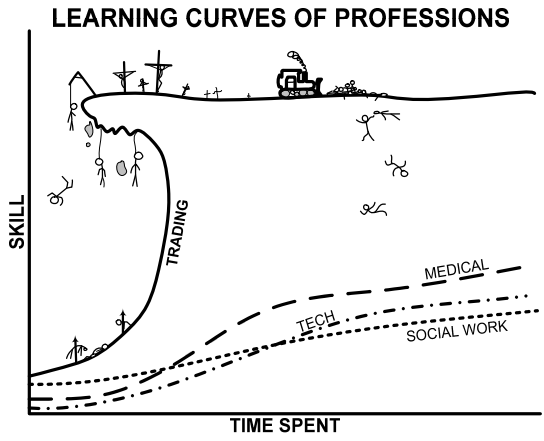
who lose money ranges between 70 to 76 percent. Among day-traders it is worse still: according to some estimates, as many as 95% of them lose money. Website TradeCity.com pulled together some staggering statistics about active day-traders[93]:

- of all day-traders, about 40% quit within one month
- 80% of them quit within two years
- only about 7% of day-traders remain active after five years
- in any given year, only about 1.6% of them are profitable
- active traders tend to sell their winning trades at a 50% higher rate than their losing trades (that's the loss-aversion, remember?)

These figures should be a sobering warning for the growing ranks of individuals who consider spending their time and money in pursuit of quick trading profits. To avoid the many pitfalls of active trading, every investor must start with a clear objective in mind, taking care to cultivate his discipline and not to allow himself to get drawn into a gambling behavior. Indeed, many people find the idea of gambling as an entertaining pastime, which is why casinos around the world draw such large crowds. But it is one thing to blow a bit of money on this kind of entertainment and then go back to your everyday life. It is quite different to embark on an open-ended adventure with a large chunk of your life's savings at stake.

If you feel that you are in danger of slipping into this trap, my strong advice would be: don't. But if you still wish to indulge yourself in the 'entertainment' of the game, then set aside an amount of money you are willing and able to lose. Make peace with the fact that you probably will lose a significant chunk of that money and try to make it last as long as possible while keeping your principal resources in a separate account. Entertainment aside, your adventures with day trading are very likely to turn into a colossal waste of your talents, time, and hard earned cash. Not so long ago, I came across an amusing looking chart, "The learning curve of professions," that even as a caricature fairly portrays what you might expect from a stint with trading. Indeed, you'll learn the ropes quickly and your learning curve will soon flatten, as will probably your bank account and a few other aspects of your life.

[93] Rolf: "Scientists discovered why most traders lose money – 24 surprising statistics." – TradeCity.com



The image of crucifixes and little stick-men falling to their deaths in the chart may look funny, but in reality, this situation is not amusing to those who actually trade themselves into a hole. Here's a glimpse of its seriousness from a personal appeal posted on a financial blog.[94]

Advice needed
Posted by [xyz] on Thursday 4 Jan 2007
I've traded for 7 years as a discretionary trader for myself full-time in equities and futures ... producing a total gain [of] over 700% on starting capital. I've made and lost money every way by experimenting. I just went bankrupt because a CTA I started and financed ran out of cash forcing me into bankruptcy. Now, totally broke does anyone have advice on how to bounce back to leverage my passion for trading and experience? ... I also have an MBA.

Ending up "totally broke" after seven years of trading with no clue how to proceed is desperately unfortunate. Over time I've come across many more of these similar stories. Keep in mind, this can happen to anyone and in some cases, the consequences can be distressing. One of the great men in the speculators' hall of fame that deserves mention here was Jesse Livermore. In 1929, he correctly predicted that the U.S. economy would experience a depression and that the stock market would collapse. Trading on his macro convictions, he became a star and hugely wealthy at the time when most investors took massive losses. However, by 1932 Livermore was declared bankrupt, and in 1940 he scribbled, "I'm a LOSER!" on the wall of his hotel room before putting a gun to his head. Jesse Livermore

[94] http://village.albourne.com/user/news.pcg?id=25838&f=d

was neither the first nor the last successful speculator who got trampled by markets and ultimately chose to end his life.

10. Always cultivate discipline

It is essential to make peace with the fact that your trading will not always be uniformly successful. When you're on a winning streak, you'll feel vindicated and enthusiastic and you'll regard your profits as proof that you have been right or that your approach works. Losses may lead you to doubt your understanding of the markets, second-guess your convictions and your strategy. Coupled with loss aversion, these doubts could make the urge to "do something" hard to resist. Be extra judicious about your actions at such times. When you are in a rut, doing nothing might be better than thrashing around trying to dig yourself out of the hole. Strategy drift is one of the terminal diseases of active asset managers. The cure to this disease is steadfast discipline and perseverance. If you catch yourself overtrading, it may be time to take a break – not for a day or two but for a few weeks or a few months. Have patience: disciplined, rational investment management is a marathon. You shouldn't regard taking time off as a waste of opportunities – markets will always offer new and unforeseen opportunities if you preserve your firepower.

11. Keep a journal

As you immerse yourself in trading, you will find yourself digesting an enormous amount of information, facts, stories, ideas, and theories. Many of them will intrigue you, but the day you encounter them you might not know how to use them or develop them further. Write down in a notebook whatever seems relevant, or just intrigues you. Use a paper notebook – do not type stuff or speak into your computer or smartphone. A great thing about writing things down is that it forces you to slow down your thinking, and focus on one thought at a time. That should help you distill important ideas from the jumble of thoughts in your mind and to articulate them with better clarity. As you'll discover, some of the thoughts you write down might encounter facts and ideas you will only uncover in the future and that encounter could spark something new and original to explore. You'll also come to discover that you will have forgotten many of the things you wrote down, and that without that reminder in your journal, the interesting and potentially life-changing gem might become inaccessible, lost in the mushrooming hay-stack of information you will have processed through your mind. Another important reason to keep a journal is that it will help you notice how your thinking has evolved over time and to alert you if you are veering away from your original plan.

12. Go systematic

If you can, definitely try to go systematic in managing your investments. It is one of the best ways to impose discipline on your decisions and keep from drifting between ideas and half-baked strategies. Discretionary decision making in speculation is a daunting challenge and the human mind – no matter how brilliant – may simply not be up to the task. For all the information and statistics we can digest about the markets, we can't hope to grasp their complexity in anything more than approximate terms. No matter how hard we try to be right it is unrealistic to expect that we can accurately navigate a process that eclipses our ability to comprehend it by orders of magnitude.

This is not to suggest that you can't invest successfully through discretionary trading; at any given time there will always be discretionary traders with the winning hand. Every season has its stars who, through a combination of smarts, ability and luck come up winners at any given time. But the story doesn't end there because speculators face an additional challenge: besides trying to understand markets, the manager must deal with himself. The burden of coping with two complex worlds – the external world of economics, finance, politics, assets, legal environments, quarterly results, and the internal world of knowledge, judgment, conviction, confidence and emotional states – is probably more than one man or woman can handle day in and day out and remain on a winning streak for very long. A systematic investment strategy can greatly unburden the decision maker.

A systematic strategy can help you focus on a limited set of parameters and impose critical discipline on your decision making and risk management. Importantly, you can backtest a systematic strategy and measure its past performance objectively. If a strategy's actual performance is meaningfully different from what was expected, you can analyze the discrepancy and refine the strategy with only limited losses. This valuable feedback loop is not realistically available to traders who process all the inputs in their heads before taking and executing speculative decisions. In fact, empirical evidence has shown that systematic hedge funds tend to be more resilient than those based on discretionary decision making. Analyzing a large sample of CTA funds between 1994 and 2009, Julia Arnold of the Imperial College in London found that systematic CTAs have a higher median survival horizon than discretionary CTAs: 12 years vs. 8 years.[95] In other words, going

[95] Arnold, Julia: "Survival of Commodity Trading Advisors: Systematic vs. Discretionary CTAs" Imperial College London, June 2012

systematic could extend the longevity of your investing strategy by 50%! So by all means, if you can, do go systematic.

Another reason to adopt systematic trading strategies is that they will help you profit from large scale price events more fully. Even those investors who do recognize promising new investments like Amazon, Google, Apple or Bitcoin seldom manage to take full advantage of such investments. The reality is that most of us cash out far too soon. Consider the story of Leo Melamed's mythical 1978 Silver trade. Melamed was the chairman emeritus and senior policy advisor to the Chicago Mercantile Exchange and one of the most eminent commodities traders in his time. In June of 1978, he bought Silver futures at about $5 an ounce. By October 1979, silver had rallied to $15 an ounce. Mr. Melamed made a small fortune on that trade and decided to cash out – only to see Silver more than triple to $50 an ounce over the following three months.

In his book, "*Escape to the Futures*" he wrote: "*why was this my worst trade when in fact it was the biggest profit I had ever made up to that time?*" It was for the same reason why I sold out of my 1998 investment into Amazon.com stock shares after they had appreciated about 15-fold. I was very happy with my gains, except that Amazon.com appreciated another 24-fold after I had sold my shares. Had I used a systematic trend following strategy to trade that stock, I might have taken fuller advantage of the powerful trend that propelled Amazon stock to heights that would have been inconceivable in 1998.

Thank you.

If you read my book through to the end, you have done me an honor and I thank you from the heart. I worked hard to make the material as readable, interesting and as free of errors, fluff and superfluous words as I could, so that it might be pleasant, profitable, and enlightening to the reader. I've also spent much effort in preparing the book for publishing.

So at the end of this volume I must request a small favor: if you enjoyed reading this book, please take a moment to give it an honest review on Amazon.com. Reader reviews are the most valuable currency for independent authors. Also, please recommend the book to your friends and acquaintances who might be interested in trend following. Thank you again.

About me

What qualified me to write this book was my 25+ years' career as a market analyst, researcher, trader and hedge fund manager. During that time I've conducted deep and extensive research into the problem of market speculation, investing, risk management, decision-making psychology, portfolio construction, and other related domains including history, resource economics, monetary policy and inflation. I've also managed several hedge funds and managed accounts conducting tens of thousands of trades billions of dollars' worth. I have extensively tested the ideas, theories and solutions I advocate in this text and elsewhere in the most rigorous way possible, fully with my own skin in the game. In this endeavour I've had some success: my hypotheses have generally proven sound and as a money manager I've consistently outperformed my relevant strategy benchmarks between 2007 and 2019 including the world's top CTAs as tracked by the Dow Jones Credit Suisse index of Blue Chip managed futures funds. In 2019 I hung up my money manager hat to step away from active trading and focus instead on pursuing the new horizons that had opened up with the ongoing *fintech* revolution, which promises new challenges for the daring and new potential conquests for adventurers endowed with capability and good fortune.

In addition to this book I generate content as a contributing editor on ZeroHedge and also on my web-site, ISystem-TF.com, TheNaked Hedgie.com and SeekingAlpha. Most recently I have launched a YouTube channel "Markets, Trends and Profits." I can be reached by e-mail at xela.reniark@gmail.com.