

A Practical Guide to ETF Trading Systems

Anthony Garner

HARRIMAN HOUSE LTD
3A Penns Road
Petersfield
Hampshire
GU32 2EW
GREAT BRITAIN

Tel: +44 (0)1730 233870
Fax: +44 (0)1730 233880
Email: enquiries@harriman-house.com
Website: www.harriman-house.com

First published in Great Britain in 2009 by Harriman House.

Copyright © Harriman House Ltd

The right of Anthony Garner to be identified as the author has been asserted in accordance with the Copyright, Design and Patents Act 1988.

ISBN 978-1-906659-27-1

British Library Cataloguing in Publication Data
A CIP catalogue record for this book can be obtained from the British Library.

All rights reserved; no part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise without the prior written permission of the Publisher. This book may not be lent, resold, hired out or otherwise disposed of by way of trade in any form of binding or cover other than that in which it is published without the prior written consent of the Publisher.

Printed in the UK by the MPG Books Group

No responsibility for loss occasioned to any person or corporate body acting or refraining to act as a result of reading material in this book can be accepted by the Publisher, by the Author, or by the employer of the Author.

Disclaimer

The test results contained in this book represent hypothetical performance based on the use of computerised system logic.

Hypothetical performance results have many inherent limitations, some of which are described below. No representation is being made that any investor will or is likely to achieve profits or losses similar to those shown. There are frequently sharp differences between hypothetical performance results and the actual results subsequently achieved by any particular trading program. One of the limitations of hypothetical performance results is that they are generally prepared with the benefit of hindsight. In addition, hypothetical trading does not involve financial risk, and no hypothetical trading record can completely account for the impact of financial risk in actual trading. For example, the ability to withstand losses or to adhere to a particular trading program in spite of trading losses are material points which can also adversely affect actual trading results. There are numerous other factors related to the markets in general or to the implementation of any specific trading program which cannot be fully accounted for in the preparation of hypothetical performance results all of which can adversely affect actual trading results.

Readers are strongly advised to conduct their own rigorous testing and research before putting any of the ideas or systems described in this book into practice (if at all) and before taking any financial risk.

Contents

Preface	vii
Introduction	ix
Part 1: Rule-based Trading	1
A Simple Mechanical System	3
Does Rule-based Trading Work in the Real World?	13
Back-testing: Data	21
Back-testing: Software	41
Back-testing: Strategy and System Design	45
Part 2: Developing a Rule-based System	55
Establishing Benchmarks	57
The Bollinger Band Breakout System	83
Increasing the Returns on the Bollinger Band Breakout System	125
A Momentum System	137
Conclusion	167
Where to go from here	171
Appendix	173

Preface

What this book is about

This book is about developing simple, robust, rule-based trading systems of a trend-following nature. It covers the back-testing of rule-based systems and the application of rule-based trading systems to portfolios of index tracking Exchange Traded Funds (ETFs) and Exchange Traded Commodities (ETCs).

Who this book is for

This book has been written for the intelligent investor who has the time and the inclination to investigate rule-based trading and who may wish to pursue the topic further through his own back-testing and system design.

How this book is structured

The book is composed of two parts–

Part 1

- Introduces the concept of rule-based trading by setting out rules and brief test results for a very basic system.
- Gives numerous examples of fund managers who have demonstrated that rule-based trading works in the real world (and not just in theory).
- Describes the tools you need to conduct your own research before putting rule-based trading into practice for your own account.

Part 2

- Establishes a benchmark by which to judge the performance of the systems described in this book, using a buy-and-hold approach on the various different portfolios used in the system back-tests.
- Sets out the rules for two very effective rule-based trading systems: the Bollinger Band Breakout and the Momentum system.
- Contains detailed test results for each system using a number of different portfolios, showing what the application of such rules to past market data would have achieved by way of investment performance.

Introduction

There has never been a better time to demonstrate the advantages of rule-based investing.

At a time when long only traditionalists are fully invested in stocks and nursing huge losses, the long term systematic trader has exited many markets entirely and waits patiently for a signal to re-enter. The losses he has suffered are likely to be far less severe.

This book reflects my informed belief that successful investing is not complex and that the investor should spurn traditional, actively managed funds run by professionals (which are by and large an expensive waste of time) in favour of managing his own investments.

This book will demonstrate that using a rule-based trading system is likely to provide far better risk-adjusted returns than conventional approaches.

Part 1

Rule-based Trading

A Simple Mechanical System

The aims of this chapter are–

- To introduce rule-based trading with an example of a very simple mechanical system, which sets out exact rules as to when to buy and when to sell a security. (More complex systems will be introduced in Part 2 of this book.)
- To test the efficacy of the system as measured against the benchmark of a buy-and-hold approach.

A basic rule-based system

The rules

Let us take a rule-based trading system of extreme simplicity. Here are the rules:

1. **Entry:** When the closing price of a stock crosses above a *double smoothed* 200-day moving average of the closing price of that same stock, buy the stock at the open the next morning.
2. **Exit:** When the price of the stock closes below the 200-day moving average, sell the stock and remain in cash until another buy signal is given.

Let's look quickly at a few concepts–

- *Double smoothing:* Means taking the 200-day moving average of the closing price and averaging that average over 200 days. Double smoothing makes for a less jagged

moving average, which follows the price less closely and helps to remove short-term market noise.

- *Trend following*: This is a classically simple, pure trend following system: the theory is that when prices start to move significantly in one direction, they tend to continue in that direction for a while. All the trader has to do, is to hop on the trend and enjoy the ride while it is going his way and to hop off when his system tells him the trend is over.
- *Cutting your losses*: On many occasions, the trend won't go your way and you have to cut your losses in accordance with your system's rules. The "hopping off" bit is vital: few long term mechanical systems produce more winners than losers. They rely on big winners to overcome the many small losses, so as to come out with an eventual overall profit. This can only happen if losses are cut short while winners are allowed to run.
- *Capturing the middle of the trend*: Trend followers do not expect to be able to buy at the bottom and sell at the top. The lagging nature of their indicators means that they will only benefit from the middle portion of a trend. They buy some time after the market has started to move up and sell some time after the market has started to go down again. This is a fact of life for trend followers.

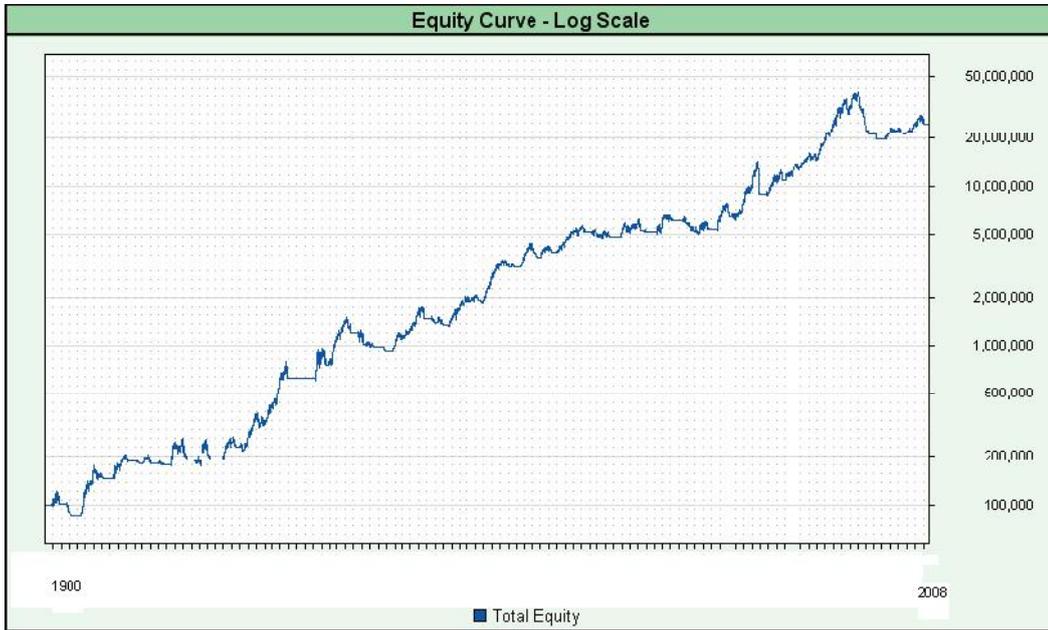
Does it work?

You will now legitimately ask: does it work? The question can be answered by applying the rules to historical data and by then comparing the results to a buy-and-hold approach applied to the same data.

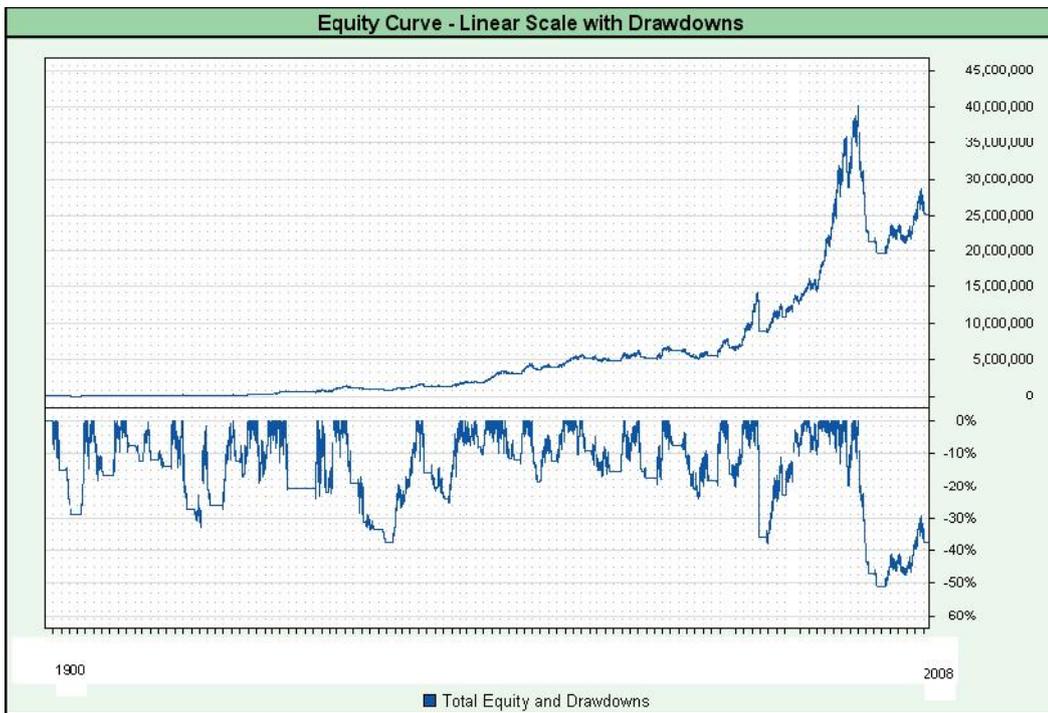
Rule-based trading test 1: the system applied to the Dow

The following charts and tables represent the growth of starting capital of USD100,000 obtained by applying this simple trend following system to the Dow Jones Industrial Average for the period 1st January 1900 to 4th November 2008.

Ending Balance	CAGR%	MAR	Max total equity DD	Longest drawdown	Trades
24,668,244	5.19%	0.1	50.8%	105.8	295



Source: Trading Blox LLC



Source: Trading Blox LLC

Trading performance		Win/loss statistics		
Average max drawdown %	37.45%	Wins	50	16.90%
Average max drawdown length	86.22	Losses	245	83.10%
Standard deviation %	12.22%			
		Total	295	100.00%
Total win dollars	45,659,686			
Total loss dollars	21,090,153	Winning months	903	69.10%
Total profit	24,569,532	Losing months	404	30.90%
		Total	1307	100.00%
		Average win dollars	913,193	
		Average loss dollars	86,082	
		Profit factor	2.16	

Points to note

A few notes on the preceding analysis–

- **CAGR**

The test shows that the system as applied to the Dow Jones Industrial Index over the period of 108 years would have turned initial capital of \$100,000 into \$24.7m, representing a modest compound annual growth rate of 5.19%.

- **Number of trades**

The system produced a total of 295 trades. Just under three trades a year, so a reasonably long-term system.

- **MAR ratio**

This ratio is an often used “pain to gain” ratio and was developed by the Managed Accounts Review for ranking Commodity Trading Advisors. It is calculated as follows:

$$\text{MAR Ratio} = \text{CAGR} / \text{Max Total Equity Drawdown}$$

In other words how much pain (how big a loss in your account) are you willing to put up with to achieve the gain (the theoretical compound annual rate of return).

- **Maximum total equity drawdown**

This is a one time event and represents the largest retracement relative to an equity high in the entire simulation: in this case the maximum loss of account equity after a previous

high was 51.1% and occurred during the market downturn earlier this decade (June 2003 to be exact).

- **Other drawdowns**

The “underwater” (or drawdown chart) indicates that the next worst drawdowns in terms of severity occurred in November 1988 (37.53%) and October 1941 (37.48%) while the Wall Street Crash of 1929 caused a mere 20.84% decline for this system. A closer inspection of the system’s trades reveals that in 1929 the system exited the market on 25th October 1929 and remained out of the market until April 1933. By contrast, during the worst drawdown for the system, which took place earlier this decade, the system faced the worst possible conditions for trend following: the price crossed and re-crossed the moving average losing money on each trade. In a later chapter we will discuss some possible methods for reducing damage in choppy markets.

- **Length of drawdown**

It is important to note the length of the longest drawdown: 105.8 months. This is the maximum length of time between succeeding equity highs. Many stock market investors at the moment will be wondering how long they will have to wait before they see the highs they reached on their investments in October 2007. As it happens, the longest drawdown for this system on this index began in early 2000 and is still in progress.

- **Additional statistics**

Spare a moment to look at the additional trading statistics and win/loss statistics. They serve to emphasise the nature of this system:

- **Volatility**

Note the volatility or annualised standard deviation of monthly returns of 12.22%; many use this as a proxy for risk – the lower the figure the lower the risk.

- **Win/loss ratio**

The vast majority of trades lose money (83%). However, as a result of running winners and cutting losers, the average winner is over 10 times the average loser in dollar terms and an overall profit ensues.

- **Dollars won/lost**

In overall terms, this makes for total dollars won of \$45.7m – more than twice the amount of total dollar losses (\$21m) and resulting in an overall profit for the period of \$24.6m and a profit factor of 2.16 (total dollar profits/total dollar losses).

- **Assumptions**

Note the following assumptions made for the purposes of this test:

- **Dividends**

The data used for this test was “price only” data which does not include the effect of re-invested dividends. This makes a considerable difference to index performance, since the dividend yield on the US market averaged almost 4% for much of the past century. Profits would have been a lot higher if a total return price series had been used.

- **Earned interest**

I did not include interest earned on capital while out of the market – this too makes a considerable difference.

- **Brokerage/slippage**

I made no allowances in this test for brokerage costs or for slippage – each entry was assumed to have been made at the exact opening price for the index on the relevant day and each exit was assumed to have been made at the moving average.

- **Management fees**

No deductions were made for management fees or other expenses. An ETF tracking the Dow would be subject to such expenses.

Establishing a performance benchmark

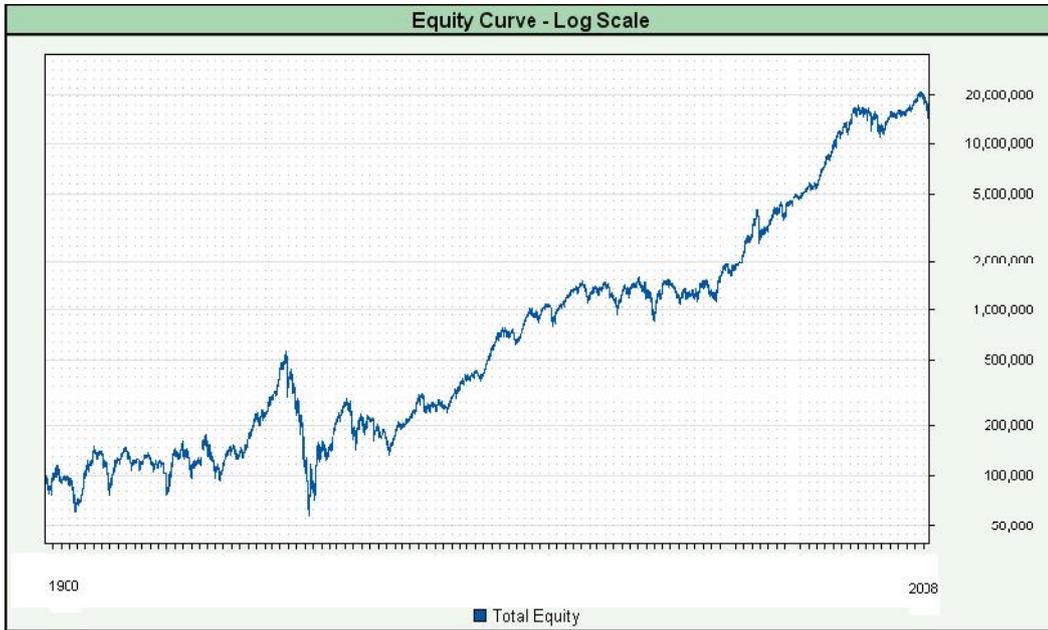
Buy and hold

In order to make a fair judgement on the performance of this basic system, it must be compared against what an investor might have expected to receive on a buy-and-hold basis. In other words, if an investor bought the DJI price index in January 1900 and held it until 4th November 2008 what return would he have made (excluding dividends) and what drawdown would he have suffered? The same assumptions are used as for Ruled Based Trading Test 1 above.

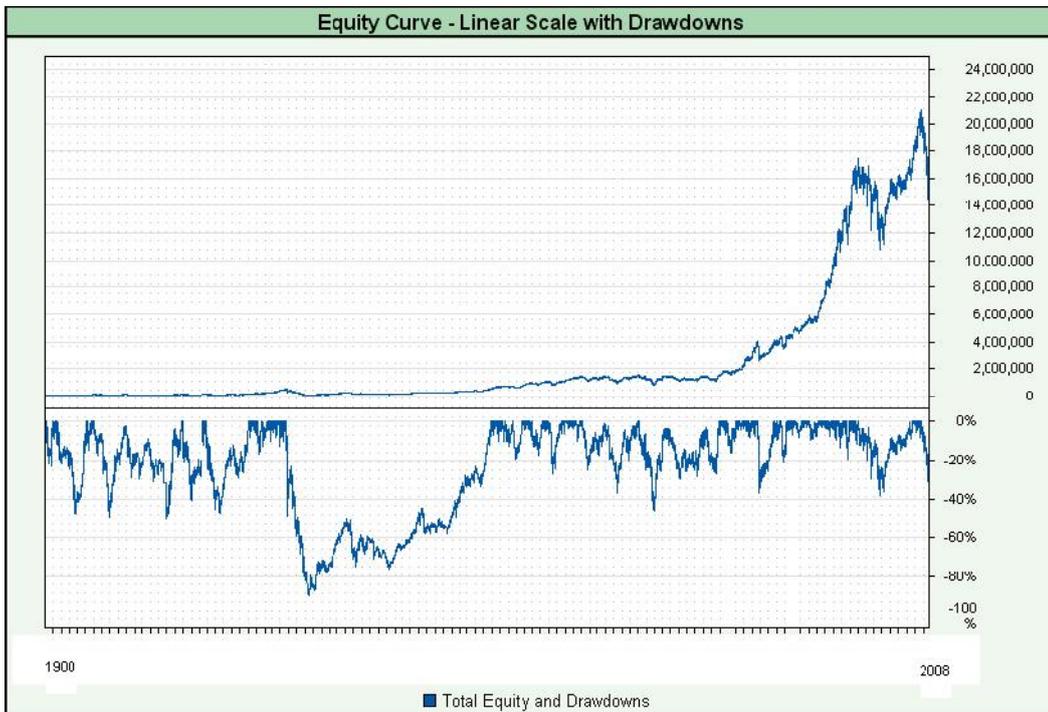
The charts and data tables below give us the answer.

Rule-based trading test 2: buy and hold on the Dow

Ending Balance	CAGR%	MAR	Modified Sharpe	Annual Sharpe	Max total equity DD	Longest drawdown	Trades
14,120,339	4.65%	0.05	0.34	0.08	89.20%	302.8	1



Source: Trading Blox LLC



Source: Trading Blox LLC

Trading performance		Win/loss statistics		
Average max drawdown %	55.09%	Wins	1	100%
Average max drawdown length	142.14	Losses	0	0%
Standard deviation %	15.04%			
		Total	1	100.00%
Total win dollars	14,020,339			
Total loss dollars	0	Winning months	750	57.74%
		Losing months	557	42.60%
		Total	1307	100.00%

The comparison table set out below enables a clear view to be taken as to whether the system manages to improve upon the performance of the buy-and-hold benchmark.

Comparison Table

	System	Buy and hold
CAGR	5.19%	4.65%
Risk adjusted CAGR	5.19%	3.06%
Max total equity drawdown	50.8%	89.20%
Average max drawdown	37.4%	55.09%
Longest drawdown	105.8 months	302.8 months
Average max drawdown length	86.22 months	142.14 months
Standard deviation %	12.22%	18.57%
Winning months	903	750
Losing months	404	557

Comparing absolute CAGR

That the system's absolute CAGR happens to be higher than that of buy-and-hold is incidental: research shows that a simple system such as this usually matches rather than betters the return of a buy-and-hold approach over time.

Comparing risk adjusted CAGR

It is customary when comparing investments to standardise returns at the same risk level. When two investments have the same returns, the rational investor will choose that with the lowest risk. Likewise when two systems have the same risk, the rational investor chooses that with the highest return. To reduce the risk (standard deviation) of buy-and-hold above to the level of that of the system, divide the higher risk of 18.57% by the lower risk of 12.22% giving 1.52. Now divide the CAGR of buy-and-hold by 1.52 giving a much lower risk adjusted return of 3.06%. The rational investor would choose to invest in the system rather than the buy-and-hold approach.

Comparing maximum drawdown

As the above table demonstrates, the system's maximum drawdown is almost half that of the buy-and-hold alternative. While a peak to valley loss of 50.8% is indeed steep, it is a great improvement on 89.20%.

Comparing longest drawdown

After the 1929 crash a buy and hold investor had to wait 25 years before he regained the pre-crash peak. The longest drawdown for the system during this test period is "only" just under 9 years.

Comparing risk

Since the system spends a lot of the time out of the market, its risk or volatility (annualised standard deviation of monthly returns) of 12.22% is 34% lower than that of the buy-and-hold investment (18.57%); that is a great improvement.

Comparing winning months

The system had a positive performance in 69% of the months of this long test while the buy-and-hold investment achieved a positive performance in only 58% of the months.

Summary

- A simple mechanical system provides far superior risk adjusted performance to that of the buy-and-hold alternative.
- A system provides more gain for less pain.
- A rational investor would choose (taxation aside) to invest using a mechanical system rather than a buy-and-hold approach.

Does Rule-based Trading Work in the Real World?

The aims of this chapter are–

- To reassure the reader that rule-based trading is a reality and not simply the theoretical output of computerised back-testing.
- To provide references to real world fund managers who have used mechanical strategies to generate impressive profits for many years.
- To provide references to academic research which supports the inescapable conclusion that rule-based trading works.

The background

Sceptics and practitioners

Most traditional fund managers, the long only stock pickers, scoff at the very idea of being able to profit from simple mechanical systems which exploit observed market phenomena such as momentum and trends. It is a fact however that many hedge funds and Commodity Trading Advisors have profited handsomely from such strategies over the past three decades, which seems reason enough to give credence to such systems, or at least not to write them off without serious investigation.

The academics

Many academics who point out the underperformance of the mutual fund industry are adherents of the efficient market hypothesis and claim that the only proper way to invest is passively – by tracking and remaining long an index. Broadly, the efficient market hypothesis claims that financial markets reflect in their prices all known information and that it is not possible therefore to outperform the market except by chance. Other academics however have produced interesting studies in support of the notion that timing *can* enhance the investment process.

Backtesting

My own extensive back-testing strongly suggests that market timing techniques can be usefully combined with index funds to produce risk adjusted returns which are superior to a buy-and-hold strategy. And certainly superior to the performance of most mutual funds.

Caveat

The reader should bear in mind that my conclusions are by definition based on interpreting past performance (covering, usually, a maximum period of around 30 years) and what has worked in the past may not necessarily hold good in the future. Emphasis on the word “necessarily”: I suspect that simple timing strategies will continue to perform well, especially if watched carefully and updated on a periodic basis in line with changing market conditions.

Rule-based fund managers

Evidence from the real world

The market place provides irrefutable evidence that rule-based trading strategies have been profitably employed over long periods of time by real life money managers. Many of the fund managers mentioned in this section apply rule-based systems to the futures markets rather than to cash equities or funds (ETFs or otherwise) but the broad principles are similar whichever instrument they are applied to.

Renaissance Technologies

Discarded the discretionary approach

Mathematician James Simons' Renaissance Technologies is an interesting place to start, although hard facts are difficult to come by unless you are an investor in his funds.

James Simons began his investment career as a discretionary investor, using his own judgement, as do the vast majority of traditional fund managers. By the end of the 1980s he had turned to quantitative models and lost interest in fundamental analysis. He is quoted as saying–

With old fashioned stock picking, one day you feel like a hero. The next day you feel like a goat. Either way, most of the time its just luck.

The Medallion Fund

According to their marketing material, they–

approach investing largely as a scientific problem that human acumen, advanced mathematical and statistical methods, and robust technology are well suited to address.

Simons' Medallion Fund has achieved 39% compound annualized returns net of huge fees from 1989 through to 30th June 2007 and according to press reports continued to perform at similar levels in the taxing environment of 2008. A report on Bloomberg at the end of November 2008 quoted Medallion as being up 58% for the year to date.

REIF

Medallion was closed to outside investors a while ago and a new fund, the Renaissance Institutional Equities Fund was launched, to invest in US equities on a long/short quantitative basis. It is generally understood that the fund uses different techniques from Medallion and trades longer term; certainly, its track record so far is a lot less glamorous. As of 30th June 2008 the retail tranche of a fund run by RIEF for Société Générale Asset Management, net of fees and in US dollar terms, had achieved an annualised return of 1.7% since inception (September 2006) with volatility of 7.99% and a maximum peak to valley drawdown of 18.42%. On all measures except volatility, thus far RIEF has slightly underperformed the S&P 500 but it is perhaps rather too early to draw much of a conclusion.

Tactical Investment Management Corporation

Background

Tactical Investment Management Corporation and its founder David Druz provide a useful lesson in the long term viability of trend following strategies. His website can be found at www.tacticalnet.com and it is highly recommended reading. Tactical is a registered Commodity Trading Advisor (CTA) and Commodity Pool Operator in the US with a track record in following trends in the futures markets stretching back to 1981.

Track record

From its inception on 1st July 1981 up to the end of August 2008, Tactical's Commodity Trading programme achieved a compound annual rate of return of 17.8% while the Institutional Programme which started in 1993 achieved 18.8%. In terms of risk, the institutional programme suffered a maximum peak to valley drawdown during this period of 30.75% and records an annualised standard deviation of monthly returns of 25.14%.

Purely systematic

Tactical's method of trading is purely systematic and all trading decisions are made by following computer driven algorithms which give buy and sell signals over the widely diversified portfolio of futures it trades.

Inefficient markets

In sharp contrast to the believers in an "efficient market", Dr Druz believes that his trading is profitable because of the exact opposite: he considers that the futures markets are not efficient and that trends in price can be distinguished and exploited. If a market is moving, his computer driven system will have him hop on the trend and follow it up (go long) or down (go short).

The Turtles

Trading places

Many will be familiar with the famous trading experiment where Richard Dennis and William Eckhardt successfully taught rule-based futures trading to a group of individuals who have become known as the "Turtles". Many of the original Turtles subsequently became successful systems based fund managers in their own right.

Track record

Eckhardt Trading Company's record for its standard programme goes back to 1987, with an annualised compound return of 26.4%, an annualised standard deviation of monthly returns of 39.82% and a maximum peak to valley drawdown of 29.08% as of the end of September 2008.

The IASG database

Further track records

The IASG database at www.iasg.com contains the track records of many other successful futures based systematic trend followers dating back as far as 1977 including the following (as of end September 2008):

Manager	Start date	CAGR%	Max DD%	Volatility
Millburn Ridgefield Corporation – Diversified Program	1977	13.96	33.47	21.07
Campbell & Company – Financial, Metal and Energy	1983	13.04	41.92	19.76
John W Henry – Financial and Metals	1984	21.65	43.60	37.70
Dunn Capital Management – World Monetary Assets	1984	14.02	57.66	35.86
EMC Capital Management Classic Program	1985	25.11	45.35	51.78
Mark J Walsh & Co – Standard Program	1985	23.57	43.04	40.82
Abraham Trading Company	1988	21.32	31.96	34.47
Chesapeake Capital	1988	14.74	23.36	21.25
Hawksbill Capital Management	1988	24.99	61.78	51.18
Saxon Investment Corporation – Diversified Program	1988	16.12	41.55	26.05
Rabar Market Research – Diversified Program	1988	13.90	29.84	23.02
S&P 500	1980	9.02	46.28	14.73

Academe

Theoretical background

You may think it redundant to look at academic research when an assessment of some of the real life fund managers out there tells us that momentum strategies work. Not so, I would argue. An additional bonus of digging into the research is that it gives us a theoretical background as to why such techniques work. The two papers referred to below are examples of the very extensive research available for free on the internet.

“Momentum” (Jegadeesh)

An article entitled “Momentum” written in October 2001 by Narasimhan Jegadeesh of the University of Illinois and Sheridan Titman of the University of Texas is freely available for download from the website of The Social Science Research Network (SSRN).

The paper cites substantial evidence that stocks that perform the best (worst) over a three to twelve month period continue to perform well (poorly) over the subsequent three to twelve months and that momentum trading strategies which exploit this phenomenon have been consistently profitable in the US and most developed markets. This conclusion is of particular relevance to the Momentum System set out in Part 2 of this book.

A number of possible reasons for the phenomena are discussed and while no firm conclusions are drawn, the paper makes interesting reading. Most explanations would seem to detract to a greater or lesser extent from the efficient market hypothesis. The possible (and largely unconfirmed) explanations include the theory that stocks initially under-react to information and continue to move as investors digest the implications over time.

“Market Timing Strategies That Worked” (Shen)

Pu Shen, an economist at the Federal Reserve Bank of Kansas City wrote an interesting paper in May 2002: “Market Timing Strategies That Worked”. He points out that *market timing* is a loose expression and that many commentators doubt that it is ever a viable investment strategy. By contrast, his back-testing of some simple strategies suggests that profit is to be had, and many different systems are out there to be tested.

Pu Shen concludes from the back-testing outlined in his paper that four out of the five strategies he proposes outperformed the market index (the S&P 500) in the sense that they provided higher returns at lower risk than the market, even allowing for transaction costs.

To quote–

Our research suggests that it may be possible to use a simple rule of thumb to avoid some of the market downturns and to improve upon the widely preached buy and hold strategy.

He uses data from 1970 to 2000 and his focus is on the spread between the earnings to price ratio of the S&P 500 and interest rates. The earnings to price ratio is the inverse of the more familiar price earnings ratio and the interest rates used were the three month Treasury Bill rate and the ten-year Treasury Note rate.

The theory tested was that there may be times when the stock market is so expensive in relation to bonds that it is better to get out altogether. The test portfolio switches between the stock market and cash using the spread between the earnings to price ratio of the stock market and the relevant interest rate for a signal. Put very simply, the signals tell you when the stock market looks too expensive against short-term bills or longer-term bonds: when it does, the system switches you out of the stock market and into cash. When better value is to be had, the system switches you back into the stock market.

As to why his system worked, Pu Shen came to the conclusion that it kept out of the stock market in periods where inflation was a major problem for the economy and thus the stock market.

Summary

- There are many successful and publicly available real life track records which demonstrate that rule-based trading is profitable and works in the real world.
- There are academic studies which provide theoretical support for the efficacy of rule-based trading.
- The diligent investor applying some simple rules of thumb on a systematic basis to financial instruments of his choice, can hope to achieve performance at least as good as, if not better than, the majority of products currently offered by investment professionals.

