SOCIETY OF ACTUARIES

Article from:

Risks and Rewards Newsletter

August 2006 – Issue No. 48

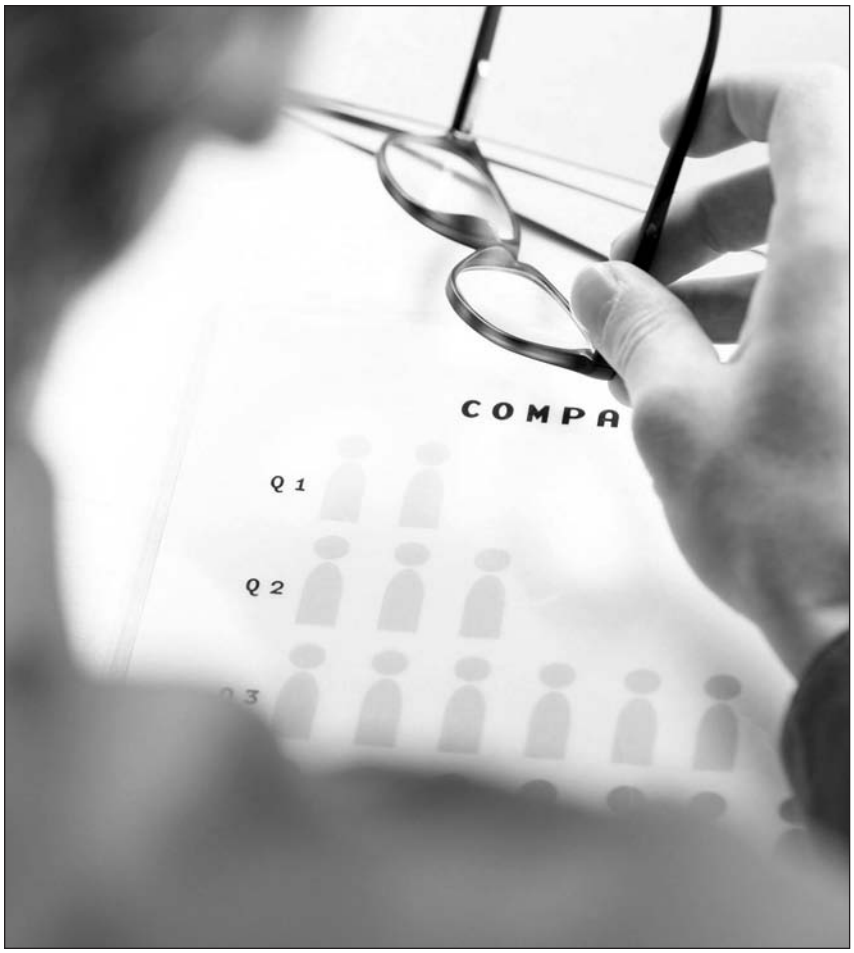
Bull and Bear or Simply All Bull?

by Shane Whelan

The historical development of a science often follows a very natural path. In the endless sequence of hypothesis-test-amended hypothesis, the ordering of the hypotheses is far from arbitrary—history tends to order them by decreasing plausibility.

This is certainly true when it comes to studying the capital markets. No sooner had Charles Dow collected data and constructed perhaps the first stock market index than he hit on 'Dow theory.' The hypothesis underlying Dow theory is that market prices tend to trend, either upwards (a bull trend) or downwards (a bear trend). All that an investor must do to make their fortune is to figure out the start and end of a trend. But is this bull and bear idea really all bull?

Being one of the first hypotheses, Dow theory (and more broadly the other supposedly predictive price patterns favored by technical analysts) has been extensively tested. Two landmarks in this literature are Cowles (1934) and Kendall (1953), which concluded that such rules do not identify profit opportunities outside of those due to chance. Later, it was reasoned that even if there were profit opportunities they would, at best, be fleeting—the infamous efficient market hypothesis (EMH).



Dow theory, and technical analysis generally, did not wither away when they failed the academics tests. Using more powerful techniques and considerably more data, academics have once again revisited this persistent hypothesis. And, albeit in a guarded way, they have reversed their earlier conclusions. Taking a glance at the Journal of Finance in recent years, Lo, Mamaysky & Wang (2000) report that head-and-shoulders, double-bottoms and other classic price patterns beloved by chartists "do provide incremental information and may have some practical value."

Technical analysts have developed many trading rules based on diverse patterns in the price series since the time of Dow at the end of the nineteenth century. Trend-exploiting techniques, such as filter rules and moving-average cross-over rules, remain popular, but they are now augmented by more sophisticated precursor patterns, such as head-and-shoulders, broadening tops, triangle tops, rectangle tops, double tops and their inverses. Still, though, the original filter rule remains the most easily motivated trading technique. Here, it is assumed that prices trend, that is, follow the same direction upwards or downwards for a time. The trend is caused by a lagged or staged response of the market to the underlying development in fundamentals or from the propagation of a fashion in the investment community.

To detect the establishing of a trend, it is necessary to filter out the random background noise of the market. Filter rules are designed to do this, waiting for a rise (or fall) of f percent from a recent low (or high) before declaring a trend established. One then buys into a rising trend or sells out of a declining one only reversing the trade when the filter rule detects the beginning of the opposite trend. Small filters will occasionally misdiagnose the background noise of the market for the early beginnings of a trend, leading to excessive trading. However, small filters have the advantage that they will detect such trends as are present and exploit them earlier than coarser filter

rules. Trial-and-error helps identify the size of the filter that works best.

Previous Studies of Filter Rules

Alexander (1961) was one of the first to report success in applying the simple trend-exploiting rule. He reported that trending in prices seems to be a feature of the U.S. equity market:

> *In particular, if the stock market has moved up x percent, it is more likely to move more than x percent further before it moves down x percent. This proposition seems to be valid for x ranging from 5 percent through 30 percent.*
>
> Alexander (1961).

Alexander (1961) investigated the profitability of filter rules between 5 percent and 50 percent on the U.S. stock market between 1897 and 1959 using monthly index values and compared them to the returns of the passive buy-and-hold strategy. The results were remarkable: "medium filters uniformly yield profits, and the smallest filters yield the highest profits, and very high they are." Over the 30 difficult years, 1929-1959, the 5 percent filter rule gave an annualised return of 36.8 percent (before trading expenses) against the buy-and-hold's paltry 3.0 percent; from 1897 to 1914 the results were 20.5 percent p.a. versus 3.2 percent p.a. from the buy-and-hold; and in the period 1914 to 1929 the returns were 15.8 percent p.a. versus 14.1 percent p.a.

However, Alexander's study made an innocent looking assumption. He assumed the continuity of prices. That is, if the price is 200 one day and 100 the next, then he supposes it must have been possible to trade at 150. However, this property does not hold for security prices, and his filter rules were trading at prices that may not have been available on the market. He revisited his work without this continuity assumption in Alexander (1964) and reports considerably less remarkable results. As he says himself: "The big bold profits of Paper 1 must be replaced with rather puny ones. The question remains whether even these profits could plausibly be the result of a random walk. But I must admit that the fun has gone out of it somehow." From this revised work, and subsequent studies,[1] trending in equity markets is generally found to be significant statistically for filters of the order of 1 percent. However, a trading rule that is based solely on such technical rules is not economically viable because of trading costs. Such rules can only complement buy-and-sell decisions made from other considerations, and simply help to finesse the timing of the trade.

Filter rules have, however, been found to yield significant profits in currency markets. Levich & Thomas (1993a,b&c) conclude from their analysis of trend following technical rules: "Our analysis of daily currency futures prices over the 1976-90 period shows that exchange rates have not evolved randomly. Simple trend-following trading rules have historically earned economically and statistically significant profits."

However, a trading rule that is based solely on such technical rules is not economically viable because of trading costs.

At first sight it appears odd that the currency markets should appear less efficient than equity markets. Currency markets tend to most closely approximate the conditions of the perfect market—market frictions such as dealing costs and information asymmetries are low and the turnover in currency markets, at over U.S.$1.8 trillion a day in value, is considerably greater than that of equity markets. Yet, as was first shown in Meese & Rogoff (1983), fundamental factors such as inflation, interest rates, monetary aggregates and economic growth provide, at best, only a loose anchor to the value of a currency. That is, the fundamental determinants of currency values are, as yet, poorly understood and hence fundamental analysis is not especially rewarding in this market. Accordingly, currency traders tend to rely on technical rules more than their equity counterparts as is borne out by numerous surveys. Finally, in currency markets, there is a type of trader who is not primarily motivated by profit, the central banks.

Equity Markets Studied

We shall investigate the profitability or otherwise of filter rules, covering largely the 1990s, one of the most pronounced equity bull markets of the twentieth century. The number of prices analyzed on the next page is in excess of one and a half million as we attempt to analyze the major stock markets in the world using daily closing prices. The datasets studied are described briefly on page 24.

turn to page 24

[1] Fama (1965), Fama & Blume (1996), and any number of Masters' theses since that time.

From Page 23

Table 1: Datasets Studied Using Daily Closing Prices

Equity Market	Description of Price Series	Period Studied (inclusive)	No. of Price Series	Data Points per Series	Data Points Analysed
U.S.	Stock Prices	Each Calendar Year, 1990-1999	c. 4,500	c. 254	1,143,000
U.S.	Sector Indices in S&P 500	Jan 1990 – Jul 2000	7	2,675	18,725
U.K.	Stock Prices	Jan 1990 – Aug 2000	71	2,782	197,522
German	Stock Prices	Jan 1990 – Aug 2000	21	2,782	58,422
French	Stock Prices	Jan 1990 – Aug 2000	28	2,782	77,896
Dutch	Stock Prices	Jan 1990 – Aug 2000	15	2,782	41,730
Swiss	Stock Prices	Jan 1990 – Aug 2000	17	2,782	47,294
Irish	Stock Prices	Jan 1991- mid-Aug 2000	29	2,409	69,861

The filter rule we investigate is defined below:

Definition: A filter rule of *f* percent gives a buy signal when the price rises by *f* percent from its most recent trough and, conversely, gives a sell signal when the price declines by *f* percent from its most recent peak.

We examine our stock price and sector indices with six filters, 1 percent, 2 percent, 3 percent, 5 percent, 7 percent and 10 percent. Trading is at end of day quoted prices.

It is assumed that the passive or default strategy is an exposure to the underlying stock. The initial state of the portfolio is therefore a holding of one unit of the stock. If the stock subsequently falls *f* percent from its most recent peak then it is sold and the proceeds are held in non-interest bearing cash until the next buy signal, and so on. The value of the portfolio, thus actively managed, is compared with that of the passive buy-and-hold strategy and the profit or loss readily determined.

First, we studied over 400 large capitalisation stocks each year over the 1990s on the U.S. equity market. The selection rule for stocks was that they had to be a member of the S&P 500 Index over the entire calendar year. The results, in summary form, are given below where the success rate gives the percentage of times the filter rule outperforms the buy-and-hold strategy over the period.

The table on page 25 is saying, quite simply, that filter rules generally do not outperform a buy-and-hold strategy, even before trading costs. We do the same analysis on the seven equity sector indices of the S&P 500 over the decade.

Table 2: Profitability of Filter Rules, U.S. Large Capitalisation Stocks, Annually, 1990-1999.

Filter Size	1%	2%	3%	1%	2%	3%
		Year 1990			*Year 1991*	
No. of Stocks Studied	423			424		
Average No. of Trades	71	45	32	72	47	33
Success Rate	80%	74%	70%	40%	30%	23%
		Year 1992			*Year 1993*	
No. of Stocks Studied	433			438		
Average No. of Trades	71	44	30	70	43	29
Success Rate	39%	27%	26%	39%	31%	27%
		Year 1994			*Year 1995*	
No. of Stocks Studied	443			450		
Average No. of Trades	69	41	27	67	38	25
Success Rate	51%	44%	41%	20%	17%	18%
		Year 1996			*Year 1997*	
No. of Stocks Studied	472					
Average No. of Trades	67	40	27	75	47	31
Success Rate	35%	28%	26%	25%	23%	21%
		Year 1998			*Year 1999*	
No. of Stocks Studied	474			472		
Average No. of Trades	79	53	37	85	58	42
Success Rate	51%	47%	43%	48%	47%	47%

turn to page 26

From Page 25

Table 3: Profitability of Filter Rules, U.S. Equity Sector Indices, 1991-2000.

Sector		Filter Size					
		1%	2%	3%	5%	7%	10%
Capital Goods	Trades No.	482	256	161	89	46	20
	Gross Profit (%)	24	-38	-49	-71	-57	-38
Energy	Trades No.	570	320	188	95	57	19
	Gross Profit (%)	-41	-69	-66	-66	-67	-30
Financials	Trades No.	532	328	230	106	76	38
	Gross Profit (%)	149	-9	-57	-38	-61	-51
Health care	Trades No.	572	318	198	100	55	40
	Gross Profit (%)	-11	-49	-53	-47	-41	-63
Transport	Trades No.	536	284	192	104	56	32
	Gross Profit (%)	24	44	-17	-51	-33	-34
Technology	Trades No.	643	370	247	137	75	47
	Gross Profit (%)	-21	-45	-64	-76	-57	-69
Utilities	Trades No.	416	196	114	48	34	16
	Gross Profit (%)	-17	-26	-30	-21	-36	-22

Again, the results are disappointing. There are no gains to be made by a trend following strategy within different equity sectors, even before trading costs are taken into account. Finally, we apply the same analysis on individual European stocks.

Table 4: Success Rate of Filter Rules, European Stock Markets, 1990-2000.

Equity Market		Filter Rule					
		1%	2%	3%	5%	7%	10%
U.K.	No. Profitable	65	37	26	17	10	9
	Total	71	71	71	71	71	71
	Success Rate	92%	52%	37%	24%	14%	13%
German	No. Profitable	10	7	5	2	2	2
	Total	21	21	21	21	21	21
	Success Rate	48%	33%	24%	10%	10%	10%
French	No. Profitable	16	9	4	3	1	3
	Total	28	28	28	28	28	28
	Success Rate	57%	32%	14%	11%	4%	11%
Dutch	No. Profitable	8	5	1	2	2	2
	Total	15	15	15	15	15	15
	Success Rate	53%	33%	7%	13%	13%	13%
Swiss	No. Profitable	11	8	6	5	8	6
	Total	17	17	17	17	17	17
	Success Rate	65%	47%	35%	29%	47%	35%
Ireland	No. Profitable	6	6	6	4	8	8
	Total	29	29	29	29	29	29
	Success Rate	21%	21%	21%	14%	28%	28%
Overall	No. Profitable	116	72	48	33	31	30
	Total	181	181	181	181	181	181
	Success Rate	72%	43%	28%	19%	15%	14%

The overall conclusion from this survey of the efficiency of filter rule in bull equity market of the 1990s is that small filters perform better than large filters, with the 1 percent filter performing best of all. However, even the 1 percent filter rule gives unconvincing profits—it seems to outperform a buy-and-hold strategy roughly about half the time and that is before (very high) trading costs are taken into account. There seems little point in assessing the statistical significance of this result when the economic profit is, as Alexander put it, "puny."

turn to page 28

From Page 27

Currency Markets

As mentioned earlier, the literature indicates that currency markets have previously proven fertile ground for technical trading rules, and, in particular, filter rules. In investigating the profitability or otherwise of filter rules, we assume that no position is held at the start of the period but, on the first trigger of the filter rule, the portfolio goes either long or short the currency the currency, as dictated by the rule. From that time onwards, the portfolio is either long or short the currency. Finally, we report the profitability of the trading rule in percent per annum in USD.

Closing daily exchange rate futures prices on the Chicago Mercantile Exchange were used from January 1976 to December 2000 (but since January 1977 in the case of yen futures), for the five major currencies relative to the USD, giving over 6,000 prices per exchange rate. These currency pairs account for over 70 percent of foreign exchange transactions in the euro area according to the 2004 survey by the Bank of International Settlements. We split the period in two: up to the end of 1990 and from the start of 1991, the first period coinciding with that of Levich & Thomas (1993) study (the "in-sample period") and the second being out-of-sample. With the help of Niall Fitzgerald, a graduate student at University College Dublin, we reproduced the surprising results of Levich & Thomas to within four trades and can confirm their findings. The results for filter sizes of 0.5 percent, 1 percent, 2 percent, 3 percent, 4 percent, 5 percent and 10 percent as shown in Table 5.

Table 5: Success of Filter Rules, Exchange Rate Futures Market, 1973-1990 [In Sample]

Exchange Rate Futures		Filter Size						
		0.5%	1%	2%	3%	4%	5%	10%
Swiss Franc - US$	Trades No.	901	533	253	127	78	62	15
	Gross Profit (% p.a. US$)	8.1	6.8	3.7	7.2	10.1	6.7	6.0
	Statistical Significance (<)	1%	5%	-	5%	1%	5%	1%
DM- US$	Trades No.	825	409	195	97	62	41	15
	Gross Profit (% p.a. US$)	2.2	9.3	5.5	7.9	8.1	8.2	3.5
	Statistical Significance (<)	-	1%	5%	1%	1%	1%	5%
C$ -US$	Trades No.	305	121	51	28	15	11	2
	Gross Profit (% p.a. US$)	3.3	3.4	1.7	0.9	1.6	1.1	1.8
	Statistical Significance (<)	1%	1%	5%	-	5%	-	1%
UK£ - US$	Trades No.	791	424	188	106	65	55	14
	Gross Profit (% p.a. US$)	9.9	7.5	7.4	8.4	8.0	4.3	4.5
	Statistical Significance (<)	1%	1%	1%	1%	1%	10%	1%
J¥ - US$	Trades No.	784	410	174	98	60	44	15
	Gross Profit (% p.a. US$)	7.5	8.3	7.0	7.1	10.1	8.4	4.8
	Statistical Significance (<)	1%	1%	1%	1%	1%	1%	1%

From Levich & Thomas (1993), *Internally Diversified Bond Portfolios: The Merits of Active Currency Management.* NBER Working Paper Series No. 4340.

The rows indicating the statistical significance of the rules require elaboration. Levich & Thomas shuffle the daily returns on the futures to come up with, for each shuffle, a new series, which has the same distribution of the original returns. They then investigated how the filter rule performed on the price series with the resultant randomized returns. Redoing this 10,000 times or so, they could see whether the profit from applying the filter rule on the original series was unusually large—occurring in less than 100 cases (so with a p-value of less than 1 percent)—and hence calibrate its statistical significance. In re-estimating the statistical significance, we also estimated it using an alternative method of fixing the number of trades as given by the filter rule and then estimated the probability of a trading rule with that number of trades giving a profit as large as that of the filter rule. Both bootstrap-testing methods reported, surprisingly, almost identical results for the p-values which were, in turn, almost identical to those reported originally by Levich & Thomas.

The passage of time allows us to test the trading rules out of sample. We report the failure of the filter rules below.

turn to page 30

Table 6: Failure of Filter Rules, Exchange Rate Futures Market, 1991-2000 [Out-of-Sample]

Exchange Rate Futures		Filter Size						
		0.5%	1%	2%	3%	4%	5%	10%
Swiss Franc - US$	Trades No.	658	354	150	85	51	37	10
	Gross Profit (% p.a. US$)	1.1	2.7	-0.8	1.4	1.4	2.0	3.5
	Statistical Level							25%
ECU- US$	Trades No.	556	280	122	60	43	29	8
	Gross Profit (% p.a. US$)	1.9	2.9	1.2	4.2	2.7	1.4	3.3
	Statistical Significance (<)		20%		15%	25%		20%
C$ -US$	Trades No.	287	128	49	23	14	5	1
	Gross Profit (% p.a. US$)	0.9	-0.2	-2.3	-0.8	-1.2	1.6	1.7
	Statistical Significance (<)							
UK£ - US$	Trades No.	522	278	124	69	41	33	5
	Gross Profit (% p.a. US$)	-0.2	-1.2	-3.6	-4.4	-1.1	-4.0	1.6
	Statistical Significance (<)							
J¥ - US$	Trades No.	622	350	157	86	50	36	11
	Gross Profit (% p.a. US$)	-2.8	-4.0	-4.4	-1.4	3.0	2.1	3.6
	Statistical Significance (<)							

From Niall Fitzgerald (2004), *Assessing the Profitability of Technical Trading Rules in the Foreign Exchange Market.* Unpublished Minor MSc Dissertion in Statistics, University College Dublin. The moving average cross-over rules studied by Levich & Thomas were also explored out-of-sample, producing similarly disappointing results.

From Page 29

The results are hardly economically significant and certainly not statistical significant. In the table, we just show results which are significant at the 25 percent level or under—a total of 5 out of 35—which is unremarkable.

All Bull

The extensive analysis presented here appears to justify the conclusion that trend-exploiting rules, strictly filter rules, do not lead to excess returns, but this will not settle the conjecture.

Going back to the *Journal of Finance*, Brown et al. (1998), for instance, already takes issue with this conclusion, pointing out that Dow theory gives high Sharpe ratios and positive alphas compared to a buy-and-hold strategy when due allowance is made lower risk of being out of the market. But, I would rejoin, this is testing an altogether different hypothesis and, in any event, Brown et al. did not allow for the well-documented seasonality in risk-adjusted returns, but that is another article.

The remarkable part of all this study is not whether markets trend or not: it is that we are still actively debating after a century one of the first conjectures of this science. The study of the price formation process has developed so little that we can question if it is a science at all. The pronounced and exploitable patterns identified by Levich & Thomas have disappeared or, maybe, were never really there. Despite the conscientiousness and thoroughness of that piece of research, a mixture of inadvertent data mining with the very limited data, coupled with a publication bias for unexpected results could have produced their findings. If so, then no researcher is immune.

Clever Hans, the horse of Wilhelm von Osten, fooled scientists in Berlin in 1904 by appearing to be able to count and do sums until it was discovered the horse was studying the scientists closer than the scientists where studying the horse. Maybe market traders have picked up the same trick. If so, then these studies are less about finding universal truths and more about monitoring the influence the observer has on observed. ∎

Shane Whelan, PhD, FFA, FSAI, FSA, is a lecturer in actuarial science in the School of Mathematical Sciences, University College in Dublin, Ireland. He can be reached at shane.whelan@ucd.ie.

References

Alexander, S.S. (1961)
Price Movements in Speculative Markets: Trends or Random Walks, Industrial Management Review, Vol. 2, no. 2. pp. 7-26 (also reproduced in Cootner, P.(1964) The Random Character of Stock Market Prices, MIT Press).

Alexander, S.S. (1964)
Price Movements in Speculative Markets: Trends or Random Walks, No. 2. in Cootner, P.(1964) The Random Character of Stock Market Prices, MIT Press.

Brown, S.J., Goetzmann, W.M. & Kumar, A. (1998)
The Dow Theory: William Peter Hamilton's Track Record Reconsidered. Journal of Finance, Vol. 53, 4, August 1998.

Cowles, A. (1934)
Can Stock Market Forecasters Forecast? Econometrica, Vol. 1, pp. 309-324.

Fama, E. (1965)
The Behavior of Stock Market Prices. Journal of Business, 38, pp.34-105.

Fama, E. & Blume, M. (1966)
Filter Rules and Stock Market Trading Profits. Journal of Business, 39, pp. 226-241.

Fitzgerald, N. (2004)
Assessing the Profitability of Technical Trading Rules in the Foreign Exchange Market. Unpublished Minor MSc Dissertion in Statistics, University College Dublin.

Kendall, M. G. (1953)
The Analysis of Economic Time Series – Part I: Prices. Journal of the Royal Statistical Society, Vol. 96, Part I, pp. 11-25.

Levich, R.M & Thomas, L.R. (1993a)
The Merits of Active Currency Risk Management: Evidence from International Bond Portfolios. Financial Analysts Journal, Sept-Oct 1993, pp63-70.

Levich, R.M & Thomas, L.R. (1993b)
The Significance of Technical Trading-Rule Profits in the Foreign Exchange Market: A Bootstrap Approach. Journal of International Money and Finance.

Levich & Thomas (1993c)
Internally Diversified Bond Portfolios: The Merits of Active Currency Management. NBER Working Paper Series No. 4340.

Lo, A.W., Mamaysky, H. & Wang, J. (2000)
Foundations of Technical Analysis: Computational Algorithms, Statistical Inference, and Empirical Implementation. Journal of Finance, Vol. 55, Issue 4, pp.1705-1770, August 2000.

Meese, R.A. & Rogoff, K. (1983)
Empirical Exchange Rate Models: Do They Fit Out of Sample? Journal of International Economics, Vol. 14, pp. 3-24.