Detection of momentum effects using an index out-performance strategy

J E Beasley

CARISMA
Centre for the **A**nalysis of **Ris**k and Optimisation **M**odelling **A**pplications

http://people.brunel.ac.uk/~mastjjb/jeb/jeb.html

Joint work with N. Meade, Centre for Quantitative Finance, Tanaka Business School, Imperial College, London

A full technical paper describing this work is available on request from john.beasley@brunel.ac.uk

---

ABSTRACT

Concentrating on liquid long-only investments, we investigate momentum using index out-performance portfolio selection (via a modified Sortino ratio) for eleven S&P international equity indices.

The probability a stock out-performed its index for a number of weeks, conditional on out-performance during the preceding year, successfully predicts momentum effects.

We find evidence of significant momentum profits (including reasonable transaction costs) in seven indices. Comparable conventional momentum analysis found significant profits for one index.

MOMENTUM

Momentum, as we deal with it in our work, is the tendency of high performing stocks to continue to exhibit high performance for a "long" period, i.e. of the order of a month or more.

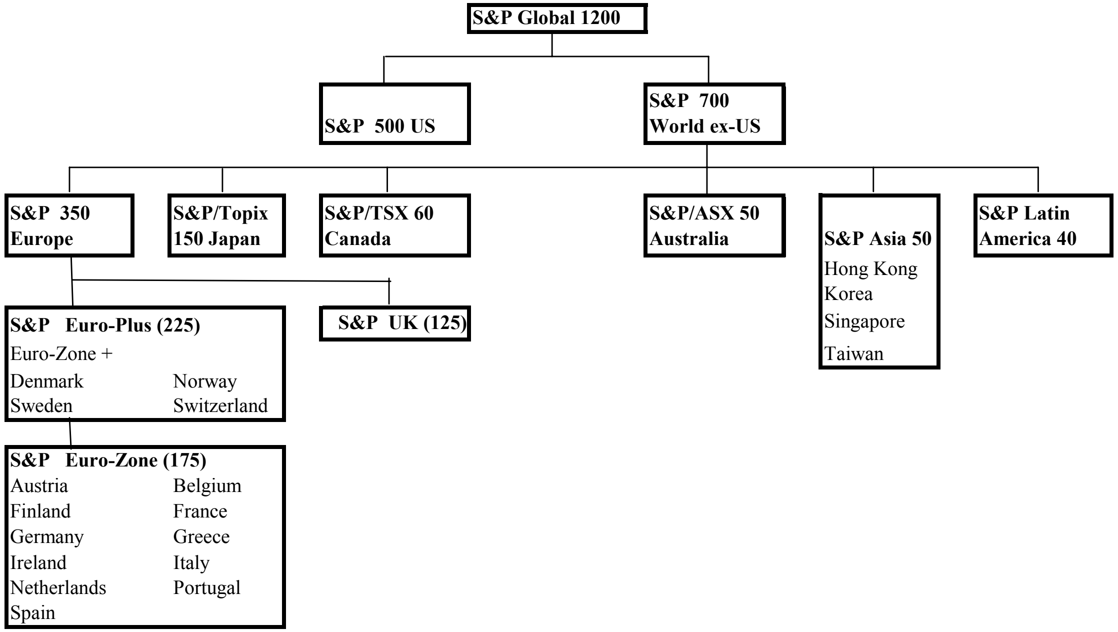
Evidence for momentum exists in the literature. However momentum is regarded as an unexplained anomaly because it is not explained either by the capital asset pricing model or its multi-factor successors.

In this work we offer an approach:

- to identifying whether, or not, momentum exists
- constructing a portfolio to exploit such momentum

DATA

We investigate the universe of stocks defined by the S&P (Standard and Poor's) Global 1200 index and the indices subsumed within it.



Data for (weekly) equity prices, index values and foreign exchange rates was obtained from Datastream for January 1999 to September 2006 (396 weeks). Dividends were not included. We exclude the S&P 700 World ex-US here as it only started in April 2004.

PROBABILITIES

Our portfolio approach is based on stock returns relative to the relevant market index. We denote the index value at time t as I_t and the value of one unit of stock i at time t as v_{it}. Consider:

- the conditional probabilities of continuous out-performance for a randomly selected stock i for the next H weeks starting from a randomly selected week t, given out-performance in the previous year, i.e.
  $\text{Prob}[\log_e(v_{i,t+h}/v_{it})>\log_e(I_{t+h}/I_t) \text{ for } h=1,\ldots,H \mid \log_e(v_{it}/v_{i,t-52})>\log_e(I_t/I_{t-52})]$

The table below shows this probability data for one of our indices, the S&P 500

Conditional probability of continuous out-performance for:	1 wk	0.52
	2 wk	0.40
	4 wk	0.29
	8 wk	0.22
	13 wk	0.17
	26 wk	0.12
	39 wk	0.10
	52 wk	0.09

CLASSIFICATION

Based on this probability analysis we were able to classify our indices into three sets:

Set A, with clear evidence of momentum, comprising S&P Global 1200; S&P 500 (US); S&P Europe 350; S&P/ASX 50 (Australia); S&P/TSX 60 (Canada)

Set B, where the evidence for momentum was mixed, comprising S&P Euro Plus (225); S&P Euro Zone (175); S&P UK (125) S&P/TOPIX 150 (Japan)

Set C, the remainder, where there was no evidence for momentum

---

EXPLOITING MOMENTUM

The above analysis tells you where you might find momentum, not how to construct a portfolio to exploit it. Let:

T be the number of time periods for which we have observed data (the in-sample period)

K be the number of distinct stocks we choose to hold in our portfolio out of the universe of N stocks available

R_t be the single period index return, i.e. $R_t=\log_e(I_t/I_{t-1})$ where I_t is the value of the index at time t

r_t be the single period portfolio return, i.e. $r_t= \log_e(\sum_{i=1}^{N} v_{it}x_i/\sum_{i=1}^{N} v_{i,t-1}x_i)$ where v_{it} is the value of one unit of stock i at time t and x_i is the number of units of stock i that we choose to hold in our portfolio (where $x_i=0$ if i is not one of our chosen K stocks)

Our out-performance objective is based on the Sortino ratio as defined by Sortino and Price (1994). This ratio is the average excess return divided by the root mean square downside deviation, where excess and downside are measured from a required minimum return.

Here we replace the required minimum return by the mean return on the index, $R^{mean}=(\sum_{t=1}^{T} R_t/T)$. Hence we choose a portfolio containing K stocks so as to maximise the modified Sortino ratio:

$$(\sum_{t=1}^{T} r_t/T - R^{mean})/\sqrt{[\sum_{t=1}^{T} (\min(0, r_t - R^{mean}))^2/T]}$$

Choosing K distinct stocks, and their associated quantities $[x_i]$, so as to maximise this expression (which is nonlinear) is accomplished by making use of a genetic algorithm.

RESULTS

The approach adopted was:
repeat

- Decide a portfolio looking one year into the past (the in-sample period)
- Hold that portfolio unchanged into the future for a fixed time period of H weeks (the out-of-sample period) and then rebalance

In the table below we show, for the S&P 500 with K=50 stocks in the portfolio and a variety of holding periods:

- the mean and standard deviation for out-of-sample excess return (**return over and above index return**), expressed as per cent per annum
- the mean percentage turnover of the portfolio at each rebalance
- a 95% break-even transaction cost

Holding period in weeks (H)	Out-of-sample excess return % p.a		Mean % turnover	95% Break-even transaction cost (%)
	mean	sd		
4	10.5	13.5	30	0.49
12	12.4	12.8	51	1.87
24	12.0	14.5	69	1.73
36	13.5	15.6	79	2.83
48	9.6	15.4	87	-0.37

The 95% break-even transaction cost is that level of transaction cost such that we are 95% sure of making a net positive excess return.

For example with a twelve week holding period if we can trade $1m of stocks in the S&P 500 such that the transaction (round trip, sell and then buy) cost is 1.87%($1m) = $18700 then we have a probability of 95% of a net positive excess return (**return over and above index return after accounting for transaction cost**).

For:

- all five indices in set A, and
- two of the four indices in set B, the S&P Euro Plus (225) and S&P Euro Zone (175)

a holding period of twelve weeks offers a 95% probability of net positive excess returns in the face of transaction costs of 1.75%.

CONVENTIONAL MOMENTUM ANALYSIS

As a basis for comparison, a conventional momentum analysis was made of the same data sets.

We used the approach of Jegadeesh and Titman (1993) and that of George and Hwang (2004). In the former case, the returns over an in-sample period are ranked, the out-of-sample investment is to buy the top decile and sell (go short) the bottom decile; this is the long-short strategy. Alternatively, only the long half of the strategy need be implemented; the long-only strategy

The George and Hwang approach ranks the in-sample data using maximum price over the preceding 52 weeks.

Our results here were:

- the Jegadeesh and Titman long-only strategies produce significant returns for the S&P/ASX 50 (Australia) only
- the George and Hwang long-only strategy is significant for both the S&P/ASX 50 (Australia) and the S&P/TSX 60 (Canada)

In our approach we have focused on long-only strategies, so we report the results of the long-short strategy for completeness:

- the Jegadeesh and Titman strategy (with 26 weeks in-sample and 26 weeks out-of-sample) is the only long-short strategy to produce substantial evidence of momentum profits, giving significant profits for six indices

This result, with six month in-sample and out-of-sample periods, echoes the findings of Jegadeesh and Titman (1993) for different universes of stocks and for a different time period.

CONCLUSIONS

- our portfolio selection approach of maximising the modified Sortino ratio produces excess profits significant in the face of a comparatively conservative representation of the cost of practical implementation, the 95% break-even transaction cost

- the partitioning into three sets has predictive value in the sense that the stocks for all five indices in set A, two of the four indices in set B and none of the indices in set C, exhibited significant profits for the Sortino ratio portfolio strategy

- conventional momentum analysis applied to the same data set produced evidence of significant profits for the stocks of only one or two indices (using a long-only strategy and depending on the ranking criterion used)