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Price and Momentum as Robust Tactical Approaches to Global Equity Investing

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Abstract

We investigate the performance of momentum and timing approaches for investing across 32 international equity markets, adding to a growing body of literature including Siegel [2002] and Faber [2007, 2009], using data back to 1971. Momentum strategies are found to be profitable using a global portfolio although the outperformance has diminished somewhat in the last two decades. We find that a trend following method significantly reduces the volatility of international equities and provides superior risk-adjusted returns compared to a conventional buy-and-hold method. Finally, we observe that the performance of a portfolio momentum "winners" can be improved still further by the addition of a trend following filter.

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A large number of papers document the predictability of individual stock returns based solely on previous returns. Jegadeesh and Titman [1993] find in the United States that for holding periods of around 1-year winners outperform losers by approximately 1% per month. Explanations for this momentum effect have included "herding" (see Grinblatt et al [1995]) and underreaction to news (Barberis et al [1998] and Hong and Stein [1999]). Moskowitz and Grinblatt [1999] propose that individual stock momentum is a function of momentum within industry returns. The evidence of a momentum effect is not just confined to the US. Rouwenhorst [1998] reports that a strategy of buying medium-term winners and selling medium-term losers across 12 European countries also generates an excess return of around 1% per month. Results presented by Rouwenhorst [1999] also document the existence of momentum effects in individual equities in emerging markets.

Momentum investing can also be related to past price movements. George and Hwang [2004] report that the nearness to the 52-week high price can largely explain momentum profits in the US. In particular, they observe that the price level is a more important determinant of momentum effects than past price changes. They attribute this to investors being reluctant to bid stock prices higher when prices are near their 52-week high even though the information warrants it, until eventually the news prevails. This is also consistent with the findings presented by Grinblatt and Keloharju [2001].

Evidence of momentum is not just confined to individual equities. Chan et al [2000] observe that momentum effects exist based on the past returns of individual country equity indices. King et al [2002] report that momentum can be used to generate positive excess returns between growth and value, size and domestic and international equity groups using no-load mutual funds. Whilst Blitz and van Vliet [2007] find that momentum is an important factor in global tactical asset allocation. This encompasses both domestic and international stocks and bonds.

An alternative approach to global tactical asset allocation using price information is the trend following method utilized by Faber [2007, 2009] and Siegel [2002]. A simple rule is employed whereby assets are only held if they are above their 10-month moving average with cash being the alternative when the price is trending lower. This method is demonstrated as producing considerably improved risk-adjusted returns across a variety of asset classes. Fung and Hseih [1997] observe that trend-following is the major style factor of commodity trading advisor funds. Wilcox and Crittenden [2005] use this approach to formulate a trading strategy for individual US

equities. Stocks are purchased when a new all-time high is made (an unequivocal uptrend) and sold when they breach a prescribed stop loss. It is reported that this methodology materially outperforms the S&P 500 after accounting for trading slippages.

This paper seeks to extend the existing literature by examining momentum and price strategies as a method of tactical allocation for a large number of international equity markets. We examine both developed and emerging countries. In recent years a proliferation of exchange traded funds (ETFs) have been introduced that makes tactical international investing both more practical and affordable. Rather than in the majority of previous studies, we focus our attention purely on entire country markets rather than individual equities.

We find that:

(i)   Momentum profits exist across international equity markets; however, these have diminished over the past two decades, though the inclusion of emerging markets improves the performance of a momentum strategy.

(ii)   A trend following strategy improves the risk-adjusted returns of an international portfolio of equities compared to a conventional buy-and-hold approach, building on work already well established by Siegel [2002] and Faber [2007, 2009].

(iii)   Trend following and momentum systems are not mutually exclusive. The addition of a trend-following filter to a momentum portfolio materially reduces the volatility without sacrificing any return or increasing the portfolio turnover.

Data

For this study we use a sample of 32 individual country equity markets with a data period of 1970-2008. All observations are collected on a monthly basis. We use MSCI indices with values available for both price and total (gross) return. To represent the investment decisions faced by a US investor, all values used for the indices are expressed in US dollars. This also provides a more reasonable comparison internationally between countries where some have experienced signification inflation and thus equity markets have risen substantially in nominal local currency but failed to create real increases in wealth.

Our sample is divided into two distinct time periods. Firstly, 18 countries that we will refer to as "developed" markets and have data available for the full 1970-2008 time period, namely Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hong Kong, Italy, Japan, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland, United Kingdom and United States. Another 14 countries have data available from 1988 onwards and contain many emerging markets along with some smaller developed countries. Specifically these markets are Argentina, Brazil, Chile, Finland, Indonesia, Ireland, Jordan, Malaysia, Mexico, New Zealand, Philippines, Portugal, Thailand and Turkey. Where a risk-free asset is required we use short-term US Treasury bills, this is also our proxy for cash.

Momentum

Momentum is calculated on the basis of past performance for entire markets during either the previous 1, 6 and 12 months. Quartiles are formed with Q1 being the lowest momentum and Q4 being the highest. The holding period is initially set at 1 month with rebalancing also taking place monthly. When quartiles are formed using the 18 country sample, 4 countries are allocated to Q1 and Q4, and five countries each to Q2 and Q3. The large sample of 32 countries is divisible by 4 and hence an equal number of countries are in each portfolio.

Exhibit 1 shows the findings of the initial momentum approach. Panel A reports the results for the 18 developed countries during 1971-2008 (in all cases the first year of data available is used for the calculation period). Firstly it can be seen across all ranking periods that a positive relationship exists between momentum and the subsequent average (mean) monthly return and the compound annual growth rate (CAGR). In all cases the difference in average return between Q4 and Q1 is statistically significant. The highest momentum portfolios also have some of the highest volatilities; however, this is more than compensated for by the additional return as evidenced by the Sharpe ratios. Maximum drawdowns are found to be largest for the lowest momentum quartiles.

Panel B reports the results of the developed markets between 1989 and 2008. Initially, it is noticeable that the returns during this time frame are lower than whole 1971-2008 data period; however, the positive relationship between momentum and returns remains largely intact. The excess returns of Q4-Q1 are around 0.3%-0.4% lower though compared to the full data period

and are only statistically significant for the 12-month ranking period. Momentum profits have thus contracted in recent years, possibly as a result of the greater amount of information on the methodology along with the increased ability of more market participants to access the strategy. Finally, Panel C shows the results of the full sample of 32 countries between 1989 and 2008. The overall level of return increases as a result of including the emerging and smaller developed markets. In addition, the returns to Q4-Q1 also increase, consistent with the observations of Chan et al [2000]. Despite this, the excess returns to this zero-cost portfolio continue to only be significant for the 12-month calculation period. The volatility of the momentum quartiles increases with the inclusion of the emerging markets despite the now larger, and possibly better diversified, portfolios. In spite of this, the Sharpe ratios are also higher than the equivalent developed market quartiles shown in Panel B.

To further examine the returns of these strategies we consider the volatility-adjusted performance, i.e. whether they generate any alpha. The benchmark for the calculations is the equally-weighted portfolio of all countries included in the sample. Exhibit 2 reports the alphas of the various portfolios. For the period 1971-2008 we find that Q4 quartiles generate statistically significant alpha for all lengths of calculation period. The underperformance of Q1 is also significant for the 6 and 12-month calculation periods. Q4-Q1 generated alpha of nearly 1% per month when a 12-month ranking was used which is also statistically significant. The other zero-cost momentum portfolios of 1 and 6-month calculation periods are also significant but the amount of alpha generated is lower.

When just the shorter 1989-2008 period is used for developed markets the level of alpha declines quite considerably. The 12-month Q4 portfolio is now the only quartile where returns are statistically significant. Q4-Q1 for the same calculation period is the only significant zero-cost portfolio. This decline in recent years of the performance of momentum is consistent with the evidence in Exhibit 1. Panel C reports the results of the full sample of countries during 1989-2008. Once again the inclusion of the emerging markets improves the performance of the momentum portfolios. Significant alpha is only generated though for 12-month ranking portfolios for Q4 and Q4-Q1. International momentum profits thus appear robust to volatility adjustment, although a 12-month ranking period has proved an important criteria.

King et al [2002] present an approach to investment strategy called passive momentum asset allocation (PMAA) whereby 8 equity styles are ranked over 1 year according to momentum and

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are then held for 12 months before rebalancing. Rather than adopting the usual decile/quintile/quartile approach they observe that the risk-adjusted results improve when 50% of the highest momentum styles are held. We investigate whether this can be applied to international equity markets, using a 12-month ranking period and holding periods of 1, 3, 6 and 12 months with rebalancing taking place at the end of the these time frames. We observe in Exhibit 3 that across all time periods there is a tendency for lower returns as the holding period increases. As the number of countries held in a portfolio is raised so the level of return declines although this is also accompanied by a decline in volatility. In the majority of cases the Sharpe ratio for the portfolios with the fewest number of countries is lower than the equivalent portfolios with more markets included. In addition, the annual round-trip turnover of the portfolios with larger numbers countries is lower than when just 4 countries are adopted.

Trend Following

The concept of trend following, whereby one uses a price signal alone for market timing investment decisions, clearly stands at odds with the efficient market hypothesis in all its forms. Studies such as Grinblatt and Titman [1994] have found no evidence that investment managers have any ability to time markets whilst studies such as Tezel and McManus [2001] provide results to the contrary. Faber [2007, 2009] demonstrates however, that a simple trend following rule when applied to the S&P 500 would have produced a similar return over the past 100 years but with much lower volatility and also lower drawdowns. This approach also delivered similar results across other asset classes including bonds and commodities. It proved particularly effective during 2008 at preserving investors' capital when the majority of asset markets declined precipitously.

We extend the work of Siegel [2002] and Faber [2007, 2009] by examining whether a trend following methodology can be used as an allocation tool for international equity markets. For ease of comparison we use the same rule as Faber, namely that when an asset is trading above its 10-month simple moving average (10MA), which is approximately equivalent to the widely used 200-day moving average, the asset is purchased and when it falls below the 10MA it is sold and the proceeds invested in cash (US T-bills). This test is made on a monthly basis. All moving average signals are estimated using index price signals and all returns are calculated using index total return series. No account is made for taxation or slippages.

Exhibit 4 reports how trend following methods have worked in international equity markets versus a buy-and-hold approach. Panel A examines the 1971-2008 period for developed markets. Firstly, we study how trend following performed in just the MSCI World index, i.e. the trend following method either owned 100% of MSCI World each month or else 100% cash. Consistent with the evidence of Faber [2007, 2009] we find a small improvement in the CAGR of the trend following model but more importantly a substantial reduction in the volatility. This leads to a Sharpe ratio of 0.50 versus 0.25 for buy-and-hold. There is also a commensurate reduction in the maximum drawdown experienced by trend following investors. During the shorter 1989-2008 period the outperformance of trend following returns was more pronounced at in excess of 2% per annum. Again, both volatility and drawdown were considerably lower than buy-and-hold and the Sharpe ratio superior. A caveat is that the trend following method would attract some additional costs but annual turnover is not excessive at 60-70%.

The centre columns of Exhibit 4 show the performance of an equal-weight portfolio of the 18 developed equity markets. It is noticeable that the buy-and-hold portfolio for this outperforms the MSCI World index alone, presumably as a result of some of the smaller markets delivering higher returns compared to the larger markets that have the greatest index weighting. The comparable trend following portfolio takes an equally-weighted long position in all the individual markets that are above their 10MA and a cash position for the remainder of the portfolio. For example, suppose that 12 markets are trending higher and 6 markets trending lower, this would mean that the trend following portfolio is 66.7% in equities and 33.3% in cash. Once again, it can be observed that there is not a great deal of difference in the CAGR of the two methods during 1971-2008 but the trend following portfolio delivers a much lower volatility. The Sharpe ratio is 0.75 compared to 0.41 for buy-and-hold. A major difference is also the maximum level of drawdown experienced as evidenced by Exhibit 5. It can be observed bow the trend following method experienced much smaller losses during the major bear markets of 1973-74 and 2000-02. The biggest loss a trend follower faced was 19.4% compared to 53.8% for a buy-and-hold investor. This makes trend following an appealing strategy for investors who hold serious concerns over capital preservation, for instance those approaching retirement who may be looking to purchase an annuity in the near future. Similar observations can be made for the period 1989-2008 although the trend following outperformance is generally more pronounced during this time frame. Annualized turnover is around 85% regardless of the time frame chosen.

Finally, the far-right hand columns of Exhibit 4 demonstrate the results when all 32 countries are included during 1989-2008. As evidenced previously, the overall level of return increases with the inclusion of emerging markets but the earlier observations remain largely unaltered. This is a small improvement in CAGR to the trend following approach, much lower volatility and a higher Sharpe ratio.

Exhibit 6 reports the trend following performance of each individual country versus a conventional buy-and-hold approach. Across all markets we find that the proportion of countries where a trend following method outperformed on an average monthly return basis was about 60-40 but this was higher on a CAGR basis. When the other metrics, standard deviation, Sharpe ratio and maximum drawdown, are examined the results are unequivocal. In 100% of the cases for developed markets, and in all but 1 of the entire sample of 32 countries, the trend following method produced superior results. We find this corroborates the evidence presented by Faber [2007, 2009] that a simple market timing strategy can be a substantial improvement on buy-and-hold.

Combination Strategy

Thus far we have observed that both momentum and trend following have been able to deliver outperformance compared to an average index holding. We now investigate whether these two tactical approaches can be combined to deliver any further improvements. The trend following results have indicated that owning an equity index when it is trending lower leads to disappointing results. There are some periods in time though when every country equity market is trending lower. Under a standard momentum strategy, an investor would still own long positions in some of these markets as there will always be a number of markets that qualify as "winners".

Exhibit 7 reports the results of a strategy whereby long-only momentum portfolios are formed (12 month calculation period, 1-month holding period) using the same principles as Exhibit 3 but now for a market to be owned it has to also be trending higher as defined by the 10MA rule. If it is below then the money is invested in cash instead. Thus, in a 6 country winner portfolio if only 3 of the markets are trending higher the allocation will be 50% to equities (equally split amongst the upward trending markets) and 50% in cash. Firstly looking at the 1971-2008 period, the CAGR range between 17.4% (9 country portfolio) and 18.7% (4 country portfolio). These are

around 1% higher than the equivalent momentum-only portfolios (see Exhibit 3). Once again, we find that trend following reduces the volatility of the investment experience. Standard deviations are lower across all portfolios by around 2-3% along with substantial reductions in the largest drawdowns. Sharpe ratios show an improvement in every case. Exhibit 8 provides a visual description of the relative performance of the standard 18 country trend-following portfolio (as shown in Exhibit 4), the 9 country, 12-month ranking period, 1-month holding period momentum portfolio and the same portfolio with the trend following filter applied. It can be seen that the trend following filter removes a good deal of the drawdown of the standard momentum portfolio in a similar way to that shown in Exhibit 5. The momentum with trend following filter visually appears like a high beta version of the standard trend following portfolio.

Similar results are observed when the 1989-2008 period is used for the 18 developed markets, i.e. slightly improved returns, lower volatility and higher Sharpe ratios. It is also noticeable that the annualized turnover of the combination strategy is very similar to that of just the momentum portfolio alone. It is therefore unlikely that the combination strategy would attract any additional costs that would impair the findings. When the combination results are compared to the equally-weighted trend following strategy, the combination approach delivers substantially higher returns although volatility is markedly higher too. In general, the combination strategy does deliver slightly better risk-adjusted returns.

Finally, looking at the 1989-2008 period for all 32 countries, the CAGR for the combination strategy is higher than both the comparable momentum and trend following portfolios. Volatility is lower than the momentum portfolio and higher than the trend following method. Once again, the Sharpe ratios are generally superior, although less so compared to the equally-weighted trend following portfolio.

As a final robustness check of the results of the combination strategy, we again calculate the alpha that each portfolio generates. Panel A of Exhibit 9 reports the alpha values for the portfolios benchmarked against the equally-weighted portfolio of all countries included in the sample. It can be witnessed that all portfolios generate alpha that is both positive and statistically significant. As additional checks, we also benchmarked against MSCI World and MSCI Emerging Markets indices in Panels B and C respectively. Again, positive and statistically significant alpha is generated across all portfolios. If anything, the equally-weighted portfolio proves to be the most challenging benchmark to outperform.

Conclusion

We have investigated the performance of momentum and trend following strategies in the context of a wide number of international equity markets. It was observed that momentum profits were available during 1971-2008 to a strategy of buying the best performing global indices and selling the worst. This approach generated the most favourable results when a 12-month calculation period was used and the investments rebalanced monthly. Furthermore, it was also found that momentum profits became smaller, but still statistically significant, in the more recent period of 1989-2008. We speculate that this may have been the result of a greater amount of information available on momentum strategies during this time along with increased ease of transaction available to many market participants. The inclusion of emerging and smaller developed markets improved the profits available to momentum strategies consistent with the evidence of Chan et al [2002].

A simple trend following method was demonstrated as having similar returns to a conventional buy-and-hold investment philosophy but with considerably lower volatility and drawdowns. The risk-adjusted performance of this strategy was clearly superior to buy-and-hold. This was true irrespective of the inclusion of emerging markets. It was also true regardless of whether one considered each country individually or formed an equally-weighted trend following portfolio. These results support the evidence of Faber [2007, 2009].

Finally, we examine whether a trend following filter could add additional value to a portfolio of momentum winners. We observed that, similar to earlier results, the level of return after the application of the filter was similar to the base case but the variation in returns was considerably reduced and led to a better risk-adjusted performance. When the combination strategy was related to the original trend following results it was found that returns were markedly higher but so was volatility. There was some small improvement in the risk-adjusted performance but in many respects the combination strategy represents a higher beta version of the equally-weighted trend following portfolio. This supports the view of Faber [2007, 2009] that trend following is an effective risk reduction tool.

References

Barberis, N., Shleifer, A. and Vishny, R. (1998). "A Model of Investor Sentiment", *Journal of Financial Economics*, vol. 49, 307-343.

Blitz, D. and van Vliet, P. (2007). "Global Tactical Cross-Asset Allocation: Applying Value and Momentum Across Asset Classes", Robeco Asset Management.

Chan, K., Hameed, A. and Tong, W. (2000). "Profitability of Momentum Strategies in the International Equity Markets", *Journal of Financial and Quantitative Analysis*, vol. 35, 153-172.

Faber, M. (2007). "A Quantitative Approach to Tactical Asset Allocation", *Journal of Investing*, vol. 16, 69-79.

Faber, M. (2009). "A Quantitative Approach to Tactical Asset Allocation – An Update", Cambria Investment Management.

Fung, W. and Hsieh, D. (2001). "The Risk in Hedge Fund Strategies: Theory and Evidence from Trend Followers", *Review of Financial Studies*, vol. 14, 313-341.

George, T. and Hwang, C-Y. (2004). "The 52-Week High and Momentum Investing", *Journal of Investing*, vol. 59, 2145-2176.

Grinblatt, M. and Titman, S. (1994). "A Study of Mutual Fund Returns and Performance Evaluation Techniques", *Journal of Financial and Quantitative Analysis*, vol. 29, 419-444.

Grinblatt, M., Titman, S. and Wermers, R. (1995). "Momentum Strategies, Portfolio Performance, and Herding: A Study of Mutual Fund Behaviour", *American Economic Review*, vol. 85, 1088-1105.

Grinblatt, M. and Keloharju, M. (2001). "What Makes Investors Trade?", *Journal of Finance*, vol. 51, 589-616.

Hong, H. and Stein, J. (1999). "A Unified Theory of Underreaction, Momentum Trading and Overreaction in Asset Markets", *Journal of Finance*, vol. 54, 2143-2184.

Jegadeesh, N. and Titman, S. (1993). "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency", *Journal of Finance*, vol. 48, 65-91.

King, M., Silver, O. and Guo, B. (2002). "Passive Momentum Asset Allocation", *Journal of Wealth Management*, 34-41.

Moskowitz, T. and Grinblatt, M. (1999). "Do Industries Explain Momentum?", *Journal of Finance*, vol. 54, 1249-1290.

Rouwenhorst, G. (1998). "International Momentum Strategies", *Journal of Finance*, vol. 53, 267-284.

Rouwenhorst, G. (1999). "Local Return Factors and Turnover in Emerging Stock Markets", *Journal of Finance*, vol. 54, 1439-1464.

Siegel, J. (2002). *Stocks for the Long Run*. McGraw Hill.

Tezel, A. and McManus, G. (2001). "Evaluating a Stock Market Timing Strategy: The Case of RTE Asset Management", *Financial Services Review*, vol. 10, 173-186.

Wilcox, C. and Crittenden, E. (2005). "Does Trend-Following Work on Stocks?", BlackStar Funds.

Exhibit 1

Momentum Portfolios With 1-Month Holding Periods 1971-2008

	Momentum Calculation Period														
	1-month					6-months					12-months				
	Q1	Q2	Q3	Q4	Q4-Q1	Q1	Q2	Q3	Q4	Q4-Q1	Q1	Q2	Q3	Q4	Q4-Q1
A. 1971-2008 – Developed Markets															
Average Monthly Return (%)	0.92	0.94	1.06	1.46	0.54	0.79	0.91	1.18	1.47	0.68	0.56	0.96	1.25	1.54	0.98
CAGR (%)	9.69	10.22	11.82	16.85	-	7.63	9.91	13.58	16.81	-	4.81	10.71	14.52	17.68	-
Standard Deviation (%)	18.30	17.21	17.09	18.84	-	20.32	16.65	16.58	19.65	-	19.91	16.08	16.69	20.24	-
Sharpe Ratio	0.22	0.26	0.35	0.59	-	0.09	0.25	0.47	0.56	-	-0.05	0.31	0.53	0.59	-
Maximum Drawdown (%)	60.27	52.61	51.47	52.12	-	60.17	50.10	51.70	54.98	-	64.68	48.42	48.87	54.71	-
t-stat	-	-	-	-	2.56	-	-	-	-	2.65	-	-	-	-	3.83
B. 1989-2008 – Developed Markets															
Average Monthly Return (%)	0.66	0.76	0.85	0.91	0.24	0.69	0.69	0.90	0.90	0.21	0.52	0.71	0.87	1.08	0.55
CAGR (%)	6.22	7.84	9.04	9.65	-	6.32	7.00	9.74	9.65	-	4.18	7.33	9.48	11.85	-
Standard Deviation (%)	19.04	17.02	17.12	17.92	-	20.25	16.98	16.88	17.48	-	20.36	16.64	16.38	18.06	-
Sharpe Ratio	0.12	0.23	0.30	0.32	-	0.12	0.18	0.34	0.32	-	0.01	0.20	0.34	0.44	-
Maximum Drawdown (%)	60.27	52.61	51.47	52.12	-	60.17	50.10	51.70	54.98	-	64.68	48.42	48.87	54.71	-
t-stat	-	-	-	-	0.98	-	-	-	-	0.70	-	-	-	-	1.97
C. 1989-2008 – All Markets															
Average Monthly Return (%)	0.91	0.77	1.01	1.29	0.37	0.85	0.88	0.91	1.31	0.46	0.67	0.66	1.11	1.54	0.88
CAGR (%)	8.91	7.99	10.96	14.08	-	7.77	9.21	9.71	14.42	-	5.40	6.39	12.46	17.57	-
Standard Deviation (%)	21.50	16.99	18.23	21.00	-	22.79	18.07	17.82	20.87	-	23.16	18.08	17.45	20.97	-
Sharpe Ratio	0.23	0.24	0.38	0.48	-	0.17	0.29	0.32	0.50	-	0.06	0.13	0.49	0.65	-
Maximum Drawdown (%)	61.60	52.48	54.78	47.69	-	59.52	51.63	50.95	52.80	-	62.28	49.41	53.51	56.07	-
t-stat	-	-	-	-	1.19	-	-	-	-	1.22	-	-	-	-	2.26

Exhibit 2

Volatility Adjusted Momentum Portfolios With 1-Month Holding Periods 1971-2008

	Momentum Calculation Period														
	1-month					6-months					12-months				
	Q1	Q2	Q3	Q4	Q4-Q1	Q1	Q2	Q3	Q4	Q4-Q1	Q1	Q2	Q3	Q4	Q4-Q1
A. 1971-2008 – Developed Markets															
Alpha (%)	-0.16	-0.14	-0.02	0.36	0.52	-0.34	-0.15	0.13	0.37	0.71	-0.55	-0.08	0.19	0.41	0.96
t-stat	-1.33	-1.55	-0.23	2.85	2.46	-2.36	-1.65	1.49	2.54	2.76	-3.74	-1.04	2.29	2.88	3.71
Tracking Error (%)	8.93	6.54	6.25	9.26	15.51	10.75	6.57	6.25	10.68	18.96	10.82	5.87	6.20	10.58	19.03
Information Ratio	-0.06	-0.08	-0.01	0.14	0.12	-0.09	-0.09	0.06	0.13	0.12	-0.17	-0.07	0.10	0.15	0.18
B. 1989-2008 – Developed Markets															
Alpha (%)	-0.16	-0.03	0.06	0.12	0.28	-0.15	-0.10	0.11	0.14	0.29	-0.32	-0.07	0.10	0.28	0.61
t-stat	-1.16	-0.31	0.59	0.82	1.15	-0.91	-1.01	1.29	0.86	0.98	-1.91	-0.75	1.10	1.98	2.16
Tracking Error (%)	7.52	5.33	5.45	8.04	13.33	9.07	5.17	4.57	8.49	15.88	9.20	4.95	4.89	7.67	15.11
Information Ratio	-0.06	-0.02	0.03	0.05	0.06	-0.04	-0.07	0.08	0.04	0.05	-0.10	-0.06	0.05	0.13	0.13
C. 1989-2008 – All Markets															
Alpha (%)	-0.15	-0.16	0.05	0.26	0.41	-0.24	-0.07	-0.03	0.32	0.56	-0.42	-0.31	0.19	0.54	0.96
t-stat	-0.88	-1.32	0.38	1.38	1.30	-1.14	-0.52	-0.21	1.48	1.47	-1.94	-2.42	1.34	2.57	2.48
Tracking Error (%)	9.32	6.68	7.44	9.99	16.68	11.29	7.61	7.66	11.50	20.25	11.85	6.77	7.65	11.20	20.81
Information Ratio	-0.03	-0.12	0.01	0.10	0.08	-0.05	-0.05	-0.04	0.09	0.08	-0.10	-0.17	0.05	0.17	0.15

Exhibit 3

Exhibit 3

Long-Only High Momentum Portfolios With 12-month Calculation Period 1971-2008

	Holding Period															
	1-month				3-months				6-months				12-months			
A. 1971-2008 – Developed Markets																
No. of Countries in Portfolio	4	6	9		4	6	9		4	6	9		4	6	9	
Ave. Monthly Return (%)	1.54	1.49	1.38		1.48	1.44	1.35		1.46	1.35	1.28		1.20	1.19	1.17	
CAGR (%)	17.68	17.39	16.18		16.85	16.64	15.75		16.50	15.37	14.76		13.08	13.32	13.29	
Standard Deviation (%)	20.24	18.30	17.08		20.21	18.55	17.04		20.44	18.67	17.23		19.81	18.21	17.14	
Sharpe Ratio	0.59	0.64	0.61		0.55	0.59	0.59		0.53	0.52	0.52		0.37	0.42	0.44	
Maximum Drawdown (%)	54.71	51.95	51.44		55.67	51.80	51.03		56.35	55.50	53.18		56.49	55.99	54.30	
Annualized Turnover (%)	247	193	158		147	114	89		96	82	62		71	60	47	
B. 1989-2008 – Developed Markets																
No. of Countries in Portfolio	4	6	9		4	6	9		4	6	9		4	6	9	
Ave. Monthly Return (%)	1.08	1.07	0.96		1.00	1.00	0.97		1.05	1.00	0.92		0.93	0.91	0.88	
CAGR (%)	11.85	11.95	10.64		10.80	10.93	10.68		11.23	10.83	10.06		9.77	9.71	9.48	
Standard Deviation (%)	18.06	17.07	16.53		18.49	17.56	16.57		18.92	17.75	16.79		18.76	17.89	16.83	
Sharpe Ratio	0.44	0.47	0.40		0.37	0.40	0.40		0.38	0.39	0.36		0.31	0.32	0.33	
Maximum Drawdown (%)	54.71	51.95	51.44		55.67	51.80	51.03		56.35	55.50	53.18		56.49	55.99	54.30	
Annualized Turnover (%)	271	210	163		163	121	93		98	83	64		70	58	46	
C. 1989-2008 – All Markets																
No. of Countries in Portfolio	4	6	8	16	4	6	8	16	4	6	8	16	4	6	8	16
Ave. Monthly Return (%)	1.69	1.62	1.54	1.33	1.74	1.57	1.47	1.28	1.70	1.52	1.38	1.24	1.54	1.27	1.27	1.09
CAGR (%)	18.16	18.21	17.57	15.26	18.25	17.19	16.45	14.51	17.47	16.32	15.16	13.89	15.83	13.52	13.98	12.04
Standard Deviation (%)	26.58	22.95	20.97	17.95	28.71	23.95	21.54	18.50	29.37	24.44	21.62	18.51	27.08	22.30	20.24	18.15
Sharpe Ratio	0.53	0.62	0.65	0.63	0.50	0.55	0.58	0.57	0.46	0.50	0.52	0.54	0.44	0.43	0.49	0.44
Maximum Drawdown (%)	56.63	55.55	56.07	54.66	62.98	60.58	59.36	56.10	66.63	65.70	65.58	57.79	61.42	58.66	57.54	55.80
Annualized Turnover (%)	319	255	232	149	158	141	132	88	109	98	88	58	73	66	63	42

	MSCI World		Equally Weighted Dev. Mkts Only		Equally Weighted All Markets	
Exhibit 4						
Comparison of Buy-and-Hold and Trend Following Approaches 1971-2008						
	B&H	TF	B&H	TF	B&H	TF
A. 1971-2008						
Ave. Monthly Return (%)	0.84	0.92	1.08	1.09	-	-
CAGR (%)	9.34	11.01	12.32	13.28	-	-
Standard Deviation (%)	14.60	10.55	16.02	10.09	-	-
Sharpe Ratio	0.25	0.50	0.41	0.75	-	-
Maximum Drawdown (%)	46.31	22.55	53.82	19.44	-	-
Annualized Turnover (%)	-	67	-	86	-	-
B. 1989-2008						
Ave. Monthly Return (%)	0.53	0.73	0.79	0.87	1.00	1.07
CAGR (%)	5.35	8.54	8.45	10.45	10.85	13.01
Standard Deviation (%)	14.79	10.24	16.45	9.76	17.59	10.16
Sharpe Ratio	0.09	0.45	0.27	0.66	0.39	0.89
Maximum Drawdown (%)	46.31	22.55	53.82	13.58	54.22	14.74
Annualized Turnover (%)	-	58	-	84	-	84

Exhibit 5: Comparison of 18 Country Equally-Weighted Portfolio versus Trend-Following Portfolio 1971-2008
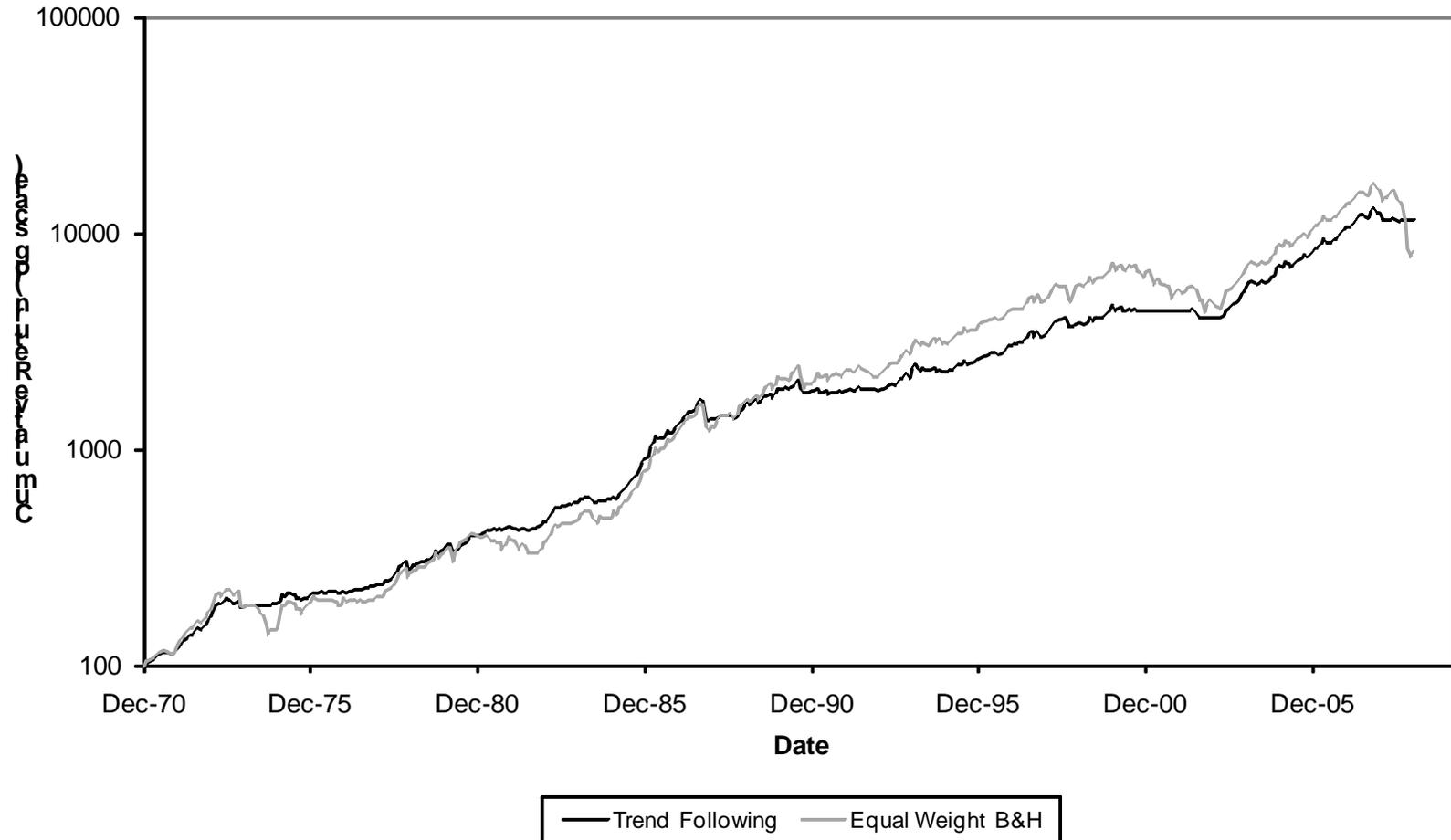
Exhibit 6

Proportion of Individual Countries Trend-Following Performance Statistics Relative to Buy-and-Hold 1971-2008
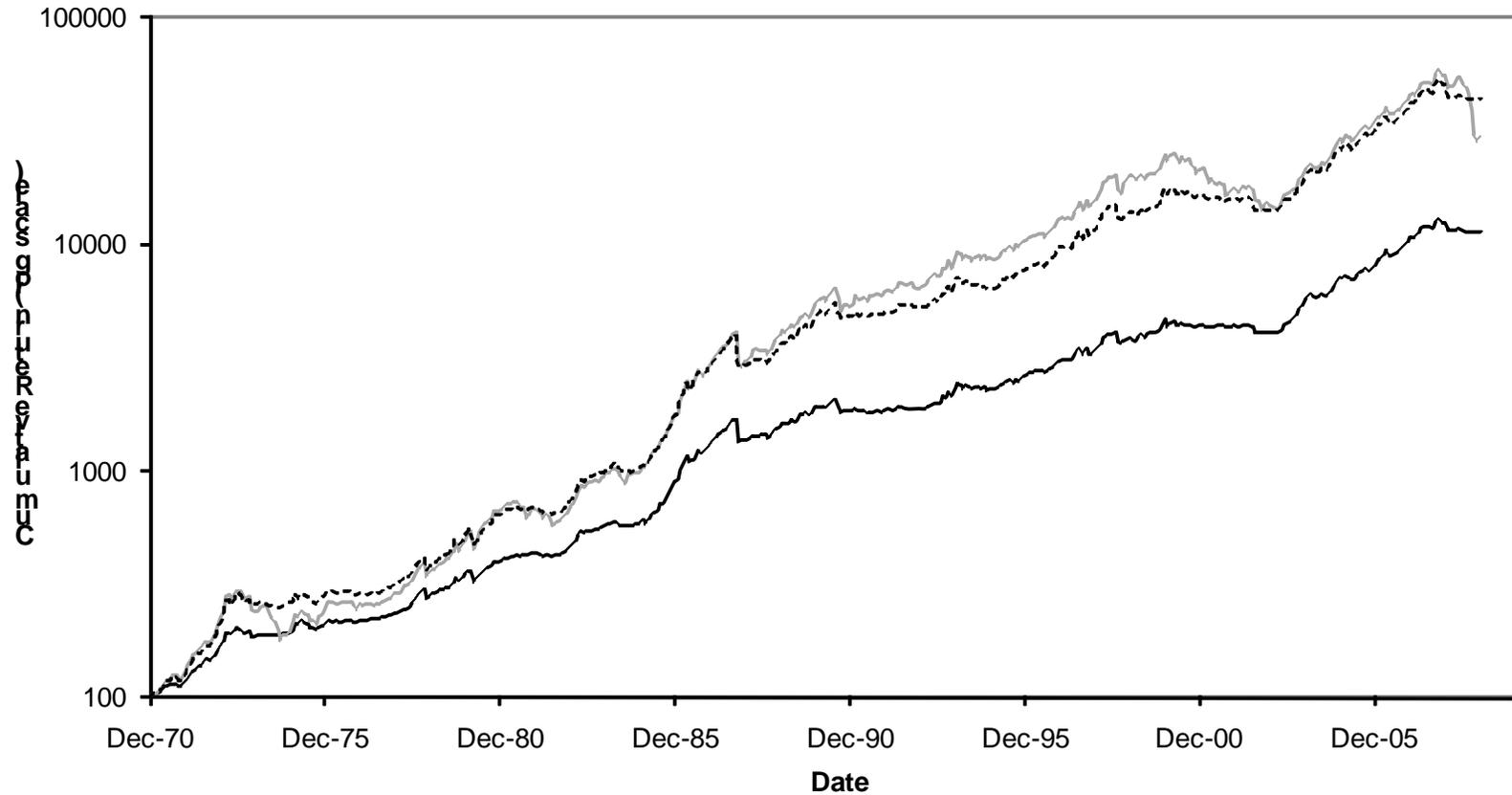
	1971-2008 – Dev. Markets Only		1989-2008 – Dev. Markets Only		1989-2008 – All Markets	
	Superior	Inferior	Superior	Inferior	Superior	Inferior
Ave. Monthly Return (%)	56%	44%	61%	39%	63%	37%
CAGR (%)	72%	28%	89%	11%	91%	9%
Standard Deviation (%)	100%	0%	100%	0%	100%	0%
Sharpe Ratio	100%	0%	100%	0%	97%	3%
Maximum Drawdown (%)	100%	0%	100%	0%	97%	3%

	Exhibit 7									
	Combination of Momentum and Trend Following Approaches 1971-2008									
	1971-2008 – Dev. Markets Only			1989-2008 – Dev. Markets Only			1989-2008 – All Markets			
No. of Countries in Portfolio	4	6	9	4	6	9	4	6	8	16
Ave. Monthly Return (%)	1.58	1.52	1.42	1.22	1.22	1.13	2.05	1.85	1.70	1.42
CAGR (%)	18.70	18.32	17.36	14.41	14.57	13.48	24.12	22.23	20.59	17.34
Standard Deviation (%)	18.03	15.67	13.78	15.14	13.74	12.75	24.20	19.96	17.64	14.08
Sharpe Ratio	0.72	0.80	0.84	0.69	0.77	0.74	0.83	0.91	0.94	0.95
Maximum Drawdown (%)	37.71	33.21	27.51	28.09	23.33	20.40	29.48	24.83	20.07	21.24
Annualized Turnover (%)	248	198	171	259	205	172	297	248	226	160

Exhibit 8: Comparison of Trend-Following, Momentum and Momentum with Trend Following Filter Portfolios 1971-2008

Exhibit 9

Volatility Adjusted Results of Combination of Momentum and Trend Following Approaches 1971-2008

No. of Countries in Portfolio	1971-2008 – Dev. Markets Only			1989-2008 – Dev. Markets Only			1989-2008 – All Markets			
	4	6	9	4	6	9	4	6	8	16
A. Benchmarked to Equal-Wt. Portfolio										
Alpha (%)	0.61	0.59	0.54	0.58	0.60	0.52	1.20	1.02	0.90	0.68
t-stat	3.60	4.28	4.65	2.97	3.46	3.33	3.20	3.60	3.80	3.98
Tracking Error (%)	12.69	10.83	9.95	11.75	11.07	10.72	20.23	15.76	13.59	11.43
Information Ratio	0.14	0.14	0.12	0.13	0.13	0.11	0.18	0.19	0.18	0.13
B. Benchmarked to MSCI World										
Alpha (%)	0.84	0.79	0.72	0.76	0.76	0.68	1.59	1.38	1.24	0.97
t-stat	4.27	4.89	5.21	3.48	4.00	3.89	3.82	4.25	4.47	4.78
Tracking Error (%)	14.93	12.68	11.46	12.83	11.61	11.07	22.98	18.17	15.72	12.32
Information Ratio	0.17	0.19	0.18	0.19	0.21	0.19	0.23	0.25	0.26	0.25
C. Benchmarked to MSCI Emerging Mkts										
Alpha (%)	-	-	-	-	-	-	1.27	1.11	1.00	0.79
t-stat	-	-	-	-	-	-	3.55	4.01	4.18	4.22
Tracking Error (%)	-	-	-	-	-	-	21.32	18.29	17.50	17.44
Information Ratio	-	-	-	-	-	-	0.16	0.15	0.13	0.07