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# When Growth Beats Value: Removing Tail Risk From Global Equity Momentum Strategies

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# When Growth Beats Value: Removing Tail Risk From Global Equity Momentum Strategies

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**Abstract**

We investigate the relationship between value, growth and momentum investment styles across a wide range of developed and emerging economy equity markets. As would be anticipated, value investing generally beats growth. We then determine whether the application of relative momentum or trend following filters can enhance the risk-adjusted performance for either value or growth investors. We find that both value and growth portfolios benefit from momentum filters but particularly the latter, though the application of such a filter still leaves investors with return volatility that is typical of equity markets along with negative skewness and with high maximum drawdowns. However, our results show that the use of a simple trend following filter typically delivers a much more favourable investment performance than relative momentum with considerably lower volatility and smaller drawdowns. Furthermore, the application of a simple trend following filter either on its own or in combination with a relative momentum filter, not only reduces the performance advantage of value over growth investing but actually reverses this advantage.

**Keywords: International equity; Value investing; Growth investing; Relative momentum; Trend following; Tail risk**

**JEL Classification: G0; G11; G15**

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## 1. Introduction

The outperformance of value stocks over growth stocks has been a well-documented phenomenon in the finance literature. Metrics for individual stocks that help to identify value stocks have included dividend yield (Christie, 1990), total payout yield, (Boudoukh et al, 2007) and price-to-cashflow (Lakonishok et al, 1994). Greenblatt (2010) shows that a combination of an earnings-based value measure and return on equity (ROE) identifies stocks that have historically outperformed the broader market. But perhaps the most widely known measure of value is a stock's book-to-market ratio which Fama and French (1992) exploit to create a factor that helps to explain future expected returns. Value investing techniques can also be applied at the aggregate level, with Shiller's (2005) cyclically-adjusted price-earnings ratio being one of the best known examples. While the former studies have focussed on the US equity market, Fama and French (1998) and Asness et al (2013), amongst others, have all shown that value strategies work in international markets too. The reasons why value strategies have tended to outperform growth strategies has been the source of much debate. Fama and French (1992) argue that the excess returns to value is the reward to investors for bearing some additional risk, for example, distress risk. Lakonishok et al (1994) propose a behavioural interpretation. They argue that growth stocks underperform because investors extrapolate past earnings growth too far forward thus leading to over-optimism, excessively high valuations and ultimately poor stock market performance once investors realise that the over-optimism is not well founded.

Although it has been shown that value investing tends to outperform growth investing over long periods of time, and indeed that exposure to value stocks may be a source of systematic risk, other research has identified momentum investing as a way of improving risk-adjusted returns. Jegadeesh and Titman (1993) document the positive excess returns that have accrued

to a strategy of buying winners and selling losers based on their prior 6 to 12 month returns. The Jagadeesh and Titman strategy, and similar ones, take no account of value in that no account is taken of dividend yields, P/E ratios, balance sheet strength, etc. Carhart (1997) shows how stock momentum can be used to generate a risk factor that can help explain expected returns – enhancing the Fama and French (1993) three-factor model. Momentum strategies based upon Jegadeesh and Titman (1993) work are referred to as cross-sectional, or relative momentum strategies by Antonacci (2012), where portfolios are generally formed with a fixed amount of long and short positions each month irrespective of how the aggregate market is performing (or just a fixed amount of long positions for long-only versions). Ilmanen (2011) proposes an adjustment to this strategy that involves volatility-adjusting the past return to avoid the most volatile assets appearing disproportionately often in high and low momentum categories.

The second type of momentum strategy is referred to as "time series momentum" by Moskowitz et al (2012) or as "absolute momentum" by Antonacci (2012). However, historically it has been widely known as 'trend following' and is an approach frequently used by Commodity Trading Advisors (CTAs) (see Ostgaard, 2008). In this type of momentum strategy one is interested in the absolute direction of an asset's price rather than how one asset has performed relative to another. This could be based on whether the asset has shown a positive excess return over the past 12-months (Moskowitz et al, 2012), whether the excess return has been positive over a range of time frames (Hurst et al, 2010), or whether the current price is in excess of a moving average (Faber, 2007), or on other similar metrics.

The evidence presented by Clare et al (2012) for a variety of asset classes, suggests that when relative momentum is compared absolute momentum strategies (that is trend following) it is

the latter that proves the more effective investment strategy: risk-adjusted returns are higher and maximum drawdowns are substantially reduced. They also find that the combination of relative and absolute momentum, that essentially involves only investing in relative winners if they are also in an upward trend, offers much higher returns compared to trend following alone but at the expense of higher volatility.

While value and momentum are well established investment strategies, there has been less attention focused on the interaction between the two. For a stock to become cheap on a value metric it needs the fundamentals to improve relative to the price. In the case of an earnings yield (E/P) approach, this means that E needs to increase (decrease) at a faster (slower) rate than P rises (falls). In the cases where P falls this makes it less likely the stock will qualify as a cross-sectional momentum winner and almost certainly rules it out from having positive absolute momentum. That aside though, within any group of value (or growth) stocks there will be winners and losers. Asness (1997) studies the interaction between value (defined using book-to-market and dividend yield) and relative momentum of US stocks. It is observed that momentum profits exist with both 'cheap' and 'expensive' stocks but the difference between ‘winners’ and ‘losers’ is far greater in the latter group. Furthermore, a portfolio of expensive ‘winners’ has historically returned considerably more than a portfolio of cheap ‘losers’. Little difference was observed in the returns of cheap ‘winners’ and expensive ‘winners’. Ap Gwilym et al (2009) observe similar results for UK equities when looking at the relationship between dividend yield and momentum. They observe that the highest returns came from selecting winners from a group of zero-dividend stocks.

In this paper we also explore the interaction between value and growth investing on the one hand and both absolute and relative momentum on the other. However, rather than doing this

at the individual stock level for a specific equity market, we apply our analysis to MSCI indices of value and growth for both developed economy and emerging economy stock markets.

The traditional finding that value outperforms growth is clearly present in the MSCI data. And, unsurprisingly, we find that any investor that invested in an equally weighted portfolio of the indices would have experienced significant drawdowns over the sample period, with returns being both volatile and negatively skewed. When we create portfolios using the relative momentum filter we find that returns are enhanced by the filter. However, the drawdowns, the high volatility in returns and negative skewness remain as a feature of the performance. The ability of relative momentum-based strategies to enhance returns and their inability to reduce drawdowns, volatility, and negative skewness in returns, was recently highlighted by Daniel and Moskowitz (2011) and Daniel et al (2012) who note that momentum strategy returns are often negatively skewed and are subject to 'momentum crashes' where momentum portfolio returns fall abruptly following a downturn in the market overall. This is because this particular momentum filter is based on a positive relative performance attribute, rather than on an absolute one – this means that momentum buying continues in downturns, including severe downturns.

Arguably it is the large drawdowns, or 'crash risk', that most investors wish to avoid, particularly if they are loss averse. A number of different approaches to understanding and combating downside risk have been examined in the literature. Strub (2013) compares options and cash-based methods for dealing with tail risk. The latter solutions were originally examined in the context of portfolio insurance in the 1980's, (see Brennan and

Schwartz (1989), for example). Using simulations of data from the last decade Strub (2013) shows that options-based management of tail risk using widely-available traded options, has a significantly higher cost than cash-based strategies which allocate a fraction of a portfolio to cash depending on measured Value at Risk compared with a target. The cash-based strategies generate higher returns for a given reduced level of volatility than the standard options-based alternatives. When we form portfolios using absolute momentum (trend following), where cash is the 'risk off' asset class, we find that the drawdowns evident in the unfiltered portfolios of international equity markets and in those evident in the portfolios where we have applied the relative momentum filter, are reduced by around two thirds, an improvement that is similar to the cash-based approach of Strub (2013). Option-based strategies involves buying downside protection when volatility rises which bound to be expensive, whereas moving into cash does not involve the same cost.

As well as exploring the potential for using both relative momentum and trend following filters we also explore the possibility of combing the two approaches. The results shows that this combination can improve returns, but at the cost of higher return volatility compared to the application of the trend following approach alone. However, average returns rise enough to more than compensate for this higher volatility, that is, Sharpe ratios are generally much higher than for the unfiltered equivalent portfolios.

The most significant aspect of our results however, relates to the way in which the relative momentum and trend following filters affects the value and growth portfolios. We find that in many cases the risk-adjusted outperformance of value over growth investing disappears, particular when the trend following filter is used and, in some cases, the performance advantage actually reverses. With an appropriate filter and over the long term we find that

growth investing can outperform value investing and in some cases can produce portfolios that generate returns that are positively skewed.

The rest of this paper is organised as follows. In Section 2 we describe the value- and growth-based equity indices that we use in this study and present the returns that a 'buy and hold' investor might have achieved by investing passively in the markets represented by these indices. In Section 3, we describe the performance of three investment strategies – relative momentum, trend following and a combination of relative momentum and trend following – that we implement to produce a range of investment portfolios based upon value and growth equity indices. In Section 4 we present the alpha estimates of the various investment strategies based upon the now familiar four-factor model. Finally, Section 5 concludes the paper with thoughts about the implications for value and growth-based investing that our results highlight.

## 2. Data

### *2.1 Indices*

This study utilizes MSCI Value and Growth equity indices for 23 developed and 21 emerging countries. Characteristics for stocks being included in value indices include book-to-market value and forward price-earnings ratios, whilst growth attributes include historical and forward EPS growth rates and historical sales growth rates[1]. We have listed below the indices for which we have monthly total return data, in US dollars. The developed economy indices begin in December 1974, while the emerging market indices start in December 1996 unless indicated otherwise in parentheses:

*Developed:*

[1] See http://www.msci.com/products/indices/style/vgvars.html for a full description.

Australia, Austria, Belgium, Canada, Denmark, Finland (12/1987), France, Germany, Greece (12/1996), Hong Kong, Israel (12/1996), Italy, Japan, Netherlands, New Zealand (12/1987), Norway, Portugal (12/1996), Singapore, Spain, Sweden, Switzerland, United Kingdom and United States.

*Emerging:*
Brazil, Chile, China, Colombia, Czech Republic, Egypt (09/1997), Hungary, India, Indonesia (05/1997), Korea, Malaysia (05/1997), Mexico, Morocco (09/1997), Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand (05/1997) and Turkey.

*2.2 Descriptive statistics: 'buy and hold'*

Table 1 shows the summary statistics for the performance of the value and growth indices. These performance statistic represent the returns that might have been achieved by an investor that bought and held the various collections of indices in an equally-weighted portfolio, rebalanced monthly back to equal weights. The results are presented for two sub-periods: 1976 to 2012 (Panel A), the whole data period, and 1998 to 2012 (Panel B), the period when all the emerging market indices are available for use in our empirical work[2]. The results are based upon an equal weighting of the indices which is rebalanced at the end of each month. The column headed "All" in this and other tables presents results where no distinction is made between growth or value indices. In Table 1, the "All" columns present the equally weighted performance of the relevant combined mix of value and growth indices. The results in the columns headed "All Countries" in Panel A of Table 1, are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the portfolio and index weights are rebalanced to be equal. The results in Panel B of Table 1 are based upon an unchanging selection of markets, since all indices in our study are available from January 1998 onwards.

[2] We use the first year of data for momentum calculations in subsequent sections, hence the somewhat later start than might be anticipated based on the availability of data on the indices.

Table 1 confirms the conventional finding that value stocks tends to outperform growth stocks across all periods and in the case of both developed and emerging markets. Returns are typically 2-3% higher per year for value indices while volatilities are fairly similar for both strategies. For example, Panel A shows that the developed economy value indices produced an annualised return of 13.19% compared with the growth equivalent of 11.11%. We also observe the large outperformance of emerging markets over developed markets in the latter time period irrespective of whether one was invested in value or growth stocks. The results also show that volatility was higher for emerging markets over the sample period, but the higher levels of return more than compensated for this higher volatility since the Sharpe ratios are substantially higher for emerging market assets than for developed economy assets. For example, Panel B shows that the Sharpe ratio for emerging value stocks is 0.47 compared with a Sharpe ratio of 0.16 for developed value stocks. The difference in Sharpe ratios is even more pronounced when we consider the performance of the growth indices, where the developed economy growth stocks produce a Sharpe ratio of 0.05 compared with an equivalent Sharpe ratio for the emerging market indices of 0.32. A comparison of Panels A and B of the developed economy index results also show that Sharpe ratios are far higher over the full sample period than for the shorter period, emphasising how poor has been recent performance for developed economy equities. However, perhaps the most important and most consistent feature of the table is the substantial maximum drawdowns in all eras and for all investing styles. The maximum drawdowns range from around 55% to just over 60%. Clearly such drawdowns represent a major disadvantage in investing in all equity markets regardless of style and geography. It is this feature of the return distribution of equity investing that we will focus on in particular throughout the rest of this paper.

## 3. Investment strategies and results

In this section of the paper we use the indices described in Section 2 and Table 1 to form portfolios based on three investment strategies – relative momentum, trend following and on a combination of both relative momentum and trend following.

*3.1 Relative momentum*

We next consider the interaction between relative momentum and investment style. Following the method of Ilmanen (2011) we rank markets according to their prior 12-month volatility-weighted return; the volatility-weighted return is calculated by dividing each index's prior 12 month return with the standard deviation of this return. Using this return we create momentum portfolios which consist of either the five indices with the highest volatility-weighted returns (Table 2A), or the top quarter of indices countries based on the rankings (Table 2B). These portfolios are then held for one month, at which point the process is rolled forward one month, the volatility-weighted returns are recalculated and the portfolios are reformed based upon the new volatility-weighted returns. This process allows us to gauge the sensitivity of our results to the market composition of the portfolios since data availability varies over the sample period. A focus on the top five performers ensures a constant number of countries in the portfolio, whereas the top quarter ensures a constant proportion.

Table 2 shows that relative momentum has improved the risk-adjusted returns of developed markets but not for of the portfolios based upon emerging market indices. For the period 1976 to 2012, the Sharpe ratio for developed markets increased from around 0.35 to 0.47 (see Table 1) to around 0.52 to 0.70 (Tables 2A and 2B) with the addition of a relative momentum filter. The developed growth portfolio constructed according to relative momentum principles returned an average of over 18% when the portfolio was based upon the top 5 or top 25% of

momentum performers, but only produced a return of 11.11% without the filter (Table 1): clearly 'hot' markets continued to offer excellent returns in subsequent months. There was also a similar improvement in performance over the period from 1988 to 2012. For example when the momentum portfolio consists of the top 25 per cent of momentum indices the return is 11.61% (Table 2B) compared with returns of 5.97% without the filter (Table 1, Panel B). There is also a commensurate rise in Sharpe ratios from, say, 0.05 for developed growth to 0.30 for the relative momentum equivalent based on the top 25% of momentum indices. During this same timeframe, however, relative momentum strategies underperformed the base (no momentum) case within emerging markets in risk-adjusted terms and in absolute terms too. For example, Table 1 shows that without the momentum filter the emerging market value portfolio produced an annualised return of 16.5% with a Sharpe ratio of 0.47, the equivalent figures shown in Table 2A are 15.6% and 0.37, and in Table 2B 14.73% and 0.35. However, the far right column in Table 2 which adds to the pool of potential indices by adding in the emerging market equity indices to the developed economy indices as they become available over time, shows that the use of the relative momentum filter again improves performance. These results indicate that while relative momentum may not have added any benefits *within* emerging markets, it has added value over time when the process is applied to selecting *between* emerging and developed equity markets.

In terms of the interaction between relative momentum and investment style (value or growth), we observe that the Sharpe ratios remain fairly similar in developed value portfolios regardless of how momentum is introduced (top 5, or top 25%). Emerging value portfolios have lower Sharpe ratios with the introduction of a relative momentum filter. The big gains from the use of relative momentum seem to accrue in the growth portfolios. For developed growth portfolios, returns increase by around 5 to 7% per annum with only slight increases in

volatility (Tables 2A and B). perhaps more interestingly, the Sharpe ratios of these growth portfolios are now higher than those of comparable value portfolios. As noted earlier, the results are less impressive within emerging markets but again substantially higher returns are displayed when all developed and emerging countries are combined versus the base case in Table 1. The evidence presented here thus supports the earlier findings of Asness (1997) and ap Gwilym et al (2009) that relative momentum has a larger impact on the performance of portfolios of growth stocks than on portfolios of value stocks.

The results in Tables 2A and B show that simple momentum filters can enhance the risk-adjusted performance of growth portfolios. However, the Table also shows that the maximum drawdowns for all strategies where relative momentum is applied are not reduced: the strategies still have negatively skewed returns and large drawdowns which would most likely lead to destructive margin calls in practice (see Gray and Vogel, 2013).

Table 3 presents the results of using relative momentum in a different way. This time each equity market index is equally-weighted, but the allocation to each index is either to its index of value or growth stocks. At the end of each month the decision to invest in a market's value or growth stocks is based upon each index's volatility-adjusted return over the past 12 months – the index with the highest volatility-adjusted momentum is then equally-weighted within the portfolio. This process is repeated on a monthly basis, as above. This method makes it less likely that a few countries dominate with their performance (which could conceivably happen with say Top 5 portfolios). Using this method we observe that for developed markets, risk-adjusted returns are slightly higher than those presented in Table 1 for the value or value and growth combined, but are lower than the momentum returns presented in Tables 2A and B. The returns generated by the emerging market portfolios are

comparable to the those presented in Table 1 and are slightly higher than the relative momentum results presented in Table 2. However, note once again that this process has had little effect upon portfolio skewness, or on the maximum drawdowns which remain large.

*3.2 Trend following*

Thus far we have looked only at relative momentum and found some evidence of outperformance over standard portfolios. However, a persistent feature of the performance statistics are the high maximum drawdowns. We now turn our attention to trend following (or absolute momentum) as a comparison. Consistent with Faber (2007) we use a 10-month moving average[3] to define the trend, though Clare et al (2012) show that the length of lag is not too important. More precisely, if the current price is above the simple average of the most recent 10 end-of-month prices then the asset is defined as being in an 'uptrend' and is purchased (or held if already owned). However, if the current price is below this ten-month moving average then the asset is sold (or not bought, if not already owned) and the proceeds are invested in short-term treasury bills. This process is updated on a rolling monthly basis.

Table 4 reports the results of trend following on value and growth portfolios. For the period 1976 to 2012, Panel A of Table 4 shows that the trend following returns are slightly lower for value portfolios than the equivalent results presented in Panel A of Table 1. Over the same period the trend following growth portfolios produce a slightly higher return than the equivalent unfiltered results presented in Table 1. The major difference in the results presented in Table 4 and those presented in Tables 1, 2 and 3 relate to volatility and maximum drawdown. With trend following annualised volatility falls to around 11% compared to around 17% in Panel A of Table 1. The combination of a similar return, but

[3] Faber (2007) and Clare et al (2012) show that a variety of moving average lengths between 6-12 months perform fairly similarly across a range of asset classes.

lower volatility produces Sharpe ratios that are around 0.3 higher than those reported in Table 1. Finally, and perhaps most significantly for ordinary investors, the maximum drawdown statistics for this 36-year period fall from around 55% to 60% to around 20%. The results are fairly similar regardless of whether value, growth or a combination of the two are held in portfolios (see columns headed "All").

For the period 1998 to 2012 we again observe substantial outperformance for trend following versus the unfiltered equivalents. Returns for portfolios containing developed markets are higher with emerging market returns fairly similar. Volatilities and drawdowns are again substantially reduced leading to considerably higher Sharpe ratios (around 0.65 (Table 4) versus 0.4 (Table 1)). With the addition of trend following, we observe that value and growth portfolios now exhibit less difference in returns (0.80% (Table 4) versus 2.08% (Table 1)). Moreover, relative to the results presented in Table 1, trend following has made the largest difference to growth stocks.

Comparing the effect of trend following with relative momentum (Table 2), we find that risk-adjusted returns are higher and more consistent using the former, particularly for the latter period. Nominal returns in the period 1976 to 2012 were higher using relative momentum but these came at the expense of much higher volatility. It is really only in the developed growth sector that relative momentum finds any outperformance over trend following. We also note that relative momentum suffers similar large drawdowns to the buy-and-hold portfolios of Table 1. One of the most appealing characteristics of trend following, given that many investors are assumed to experience loss aversion, appears to be the ability to substantially reduce drawdowns by being invested in T-Bills during major bear markets. This supports previous evidence presented by Faber (2007) and Clare et al (2013). A final observation is

that trend-following portfolios display less negative skew than relative momentum equivalents, which again would be perceived by loss averse investors to be a more desirable quality from an investment perspective.

The most appealing characteristic of relative momentum we have noted thus far is the very high level of nominal return that it generates, albeit at the cost of high volatility. Trend following, by contrast, has demonstrated the ability to dampen volatility. Therefore, we next consider whether there is any benefit to combining relative momentum with trend following. Antonacci (2012) refers to this as 'dual' momentum.

*3.3 Relative momentum with a trend following filter*

Table 5 displays the results of combining relative momentum with trend following. Portfolios are formed in the same fashion using relative momentum as previously described. However, in this instance the risk asset (equity index) is only included, with an equal weight, in the portfolio if it is also in a positive trend according to the volatility-weighted relative momentum rule. Should an index pass this relative momentum filter but fail the trend following filter then this part of the portfolio allocation will be turned over to T-bills. Thus indices must be both relative and absolute winners to be included in the portfolio. Table 5A reports results for this rule where the relative momentum rule is used to choose the top 5 relative momentum performers, while Table 5B reports results based upon the top 25% of relative momentum performers. The two sets of results are qualitatively very similar.

In general Table 5 shows that the combination of the two filters produces higher returns than those presented in Tables 1 to 4. For example, at Table 5A, Panel A shows that the annualised return for the Developed growth portfolio is 19.37% compared with 11.11%

achieved without any filters (Table 1, Panel A) and 12.19% when the trend following filter is applied (see Tables 4, Panel A). The Sharpe ratios for the combined filter results are also higher. The developed, growth portfolio produces a Sharpe ratio of 0.35 over the whole sample without any filters (Table 1, Panel A), an equivalent Sharpe ratio of 0.65 when the trend following filter is applied (Table 4, Panel A), but a Sharpe ratio of 0.82 when both filters are applied (Table 5A, Panel A). There are many instances where the annualised returns in Table 5 are greater than the comparable figures when only the relative momentum filter is used (Table 2). The volatility and skewness of returns and the maximum drawdowns are also higher in Table 2. They are also generally higher than those produced by the trend following filter (Table 4) which, when combined with the higher returns, means that the Sharpe ratios produced using both filters are similar to those produced using only the trend following filter. The portfolios whose risk/return characteristics benefit most from the use of the dual filter approach are the developed growth stock portfolios. Portfolios containing these have Sharpe ratios in the 0.80 to 0.90 range for the full 1976-2012 period. The high nominal returns of these growth stocks also make them attractive to investors that are prepared to operate near the more extreme end of the risk-reward spectrum, but may still suffer from leverage aversion (see Asness, 1997).

The final point to note about Table 5 is that the returns generated by some of the strategies are now positively skewed. An interesting result, given that the strategies do not incorporate short positions or derivatives.

The evidence presented here demonstrates the role that momentum, particularly the absolute kind, has as an investment technique. Both value and growth strategies benefit from it but the latter seems to benefit most. From a practitioner's perspective, it seems particularly unwise to

invest in growth stocks without the tailwind of a positive trend. It may be that these stocks are harder to value, e.g. traditional value metrics are harder to use when a company has no earnings, or perhaps even no sales too, than firms that have historic track records of profitability. The dot-com boom perhaps provides an illustration of the most recent difficulties that investors face when assigning a price to this type of security. As further support to our results, Faber (2011) compares the performance of buy-and-hold portfolios versus trend following ones over 12 asset price bubbles during the last 100 years. The results show improved real returns to trend following with considerably less volatility and lower maximum drawdowns. Trend following thus can be a valuable reference point for investors when emotions are running high.

## 4. The search for alpha

### *4.1 Buy and hold alphas*

The properties of the investment strategies thus far are based upon unconditional returns. In this section of the paper we examine whether the excess returns can be explained by well-known, and widely employed risk factors. Table 6 presents alpha estimates and related t-values for all of the strategies presented in Tables 2, 4 and 5. The alphas for each of the j investment strategies ($\alpha_j$) were generated as follows:

$$ER_{jt} = \alpha_j + \beta_1 \mathrm{MKT}_t + \beta_2 \mathrm{SMB}_t + \beta_3 \mathrm{HML}_t + \beta_4 \mathrm{UMD}_t + \epsilon_{jt} \qquad (1)$$

where $\mathrm{ER_j}$ is the excess return on investment strategy j; MKT, SMB and HML represent Fama and French's three factors (market, size and value respectively); UMD is Carhart's momentum factor; and $\epsilon_{jt}$ is a white noise error term.

Table 6A presents the alphas for the strategies for the full sample period, relating to the results presented in Panels A of Tables 1, 2, 4 and 5[4]. The first row of the table presents the alphas from the 'buy and hold' value and growth portfolios. It shows over the full sample period that international value investing (alpha of 0.24% pm) on a risk-adjusted basis has outperformed a growth investing equivalent (alpha of 0.13% pm). Although the alphas for the developed economy equity portfolios are economically meaningful, they are not found to be statistically different from zero in their own right. However, when we gradually add indices to the portfolios as they become available (shown in the columns headed "All countries") we find that Value investing across all available value indices over time produces an alpha of 0.42% per month which is found to be highly, and statistically significant. Although the equivalent results for growth investing produces an economically meaningful alpha of 0.26% we find that it is not statistically significant. Combining value and growth indices (see the column headed "All"), does produce an economically and statistically significant alpha of 0.32%, which is approximately halfway between the value and growth only alphas.

The columns headed "Val-Gro" in Table 6 present the alphas and related t-values from the following regression:

$$RVG_{jt} = \alpha_j + \beta_1 \mathrm{MKT}_t + \beta_2 \mathrm{SMB}_t + \beta_3 \mathrm{HML}_t + \beta_4 \mathrm{UMD}_t + \epsilon_{jt} \qquad (2)$$

where $\mathrm{RVG_j}$ represents the return on a value strategy minus the return on the equivalent growth strategy (all other elements of (2) are as described for expression (1)). RVGj therefore represents an arbitrage portfolio which allows us to test the economic and statistical

[4] In the interest of parsimony, the full regressions for Tables 6A and 6B are not presented here but are available on request from the authors.

difference in the risk-adjusted performance produced by strategies that are based on value and growth indices, but that are identical in all other ways. The results in Panel A indicate that for developed economy equity portfolios there is a statistically significant difference between the alpha produced by value and growth investing, although it is only statistically significant at the 90% level of confidence. When we consider the "All country" approach we find that the value portfolio produces an additional alpha of 0.16% per month, over and above that produced by the growth portfolio; a result that is highly statistically significant.

Table 6B presents results that are analogous to those presented in Table 6A but for the sample 1998 to 2012 relating to the results presented in Panels B of Tables 1, 2, 4 and 5. The estimated alphas for the developed economy equity portfolios produce results that are similar to those presented for the full period – alphas are economically but not statistically significant. However, the results for the portfolios created from the emerging market equity indices show that both value and growth investing over this sample period produced alphas that were both economically and statistically significant, 1.02% and 0.77% respectively. This result indicates that perhaps the style of emerging market investing was not that important over this period. However, when we estimate expression (2) we find that the alpha produced by Value investing was significantly higher than that produced by growth investing (a t-value of 2.46). When the portfolios are formed with both the developed economy and emerging market indices the results are similar, though less economically and statistically significant.

Taken together our 'buy and hold' results show that on an international basis, value has tended to outperform growth investing across developed and emerging economy equity markets. These results are therefore consistent with many others based upon individual

equities, within individual equity markets, that is, on a risk-adjusted basis value investing beats growth investing.

*4.2 Relative momentum alphas*

The other rows in Tables 6A and 6B present the alphas produced by the relative momentum, trend following and relative momentum with trend following rules. Table 6A shows that momentum investing has almost no impact on the value portfolios comprising developed economy equity indices. However, although the use of relative momentum focussing on the top 5 performers actually reduces the size of the growth alpha for developing economy equities, when it focuses on the top 25% of performers it produces an alpha of 0.56% per month which is statistically significant. However, the alphas for the "All Countries" portfolios shown in Table 6A are all positive and significant for the relative momentum rules based on the top 5 and top 25% performers. Perhaps most interestingly, we find that when we use the top 25% relative momentum rule that the alphas based upon growth indices is greater than that produced by the value indices and that this difference is statistically significant. For example, the top 25% momentum rule produces an alpha of 0.29% using the value indices with a t-statistic of 1.55, but an alpha of 0.56% and t-statistic of 2.64. The t-statistic based on the alpha from expression (2) shows that this difference is statistically significant. Table 6B shows that the alpha on the developed economy portfolios using the momentum rules are also smaller than those produced by the growth indices, but that these differences are not statistically significant. The results for the emerging equity market portfolios in Table 6B show that the value alphas are larger than the growth alphas, though not significantly so. This result contrasts with the equivalent results in row 1 of the table where value alphas are found to be significantly bigger than the growth alphas. When it comes to style investing in emerging markets then, our results show that simple, relative

momentum rules can reduce the advantage that value investing has over growth investing. The All countries results for relative momentum also show a diminution of the superiority of value investing over growth investing.

### *4.3 Value or Growth alphas*

Tables 6A and 6B also present the alphas produced by the investments strategy where the decision to invest in a market's value or growth stocks is based upon each index's volatility-adjusted return over the past 12 months – the index with the highest volatility-adjusted momentum is then equally-weighted within the portfolio. Because of the process there are no value or growth-specific alphas and nor any alphas estimated using expression (2). However, the results in Table 6A show that this simple strategy produces alphas that are well in excess of those produced by the buy and hold strategy and are both highly economically and statistically significant. Table B shows that these results hold for the shorter sample and work well, if not better, when applied to the emerging equity market indices. In this case the strategy produces an alpha of 1.06% per month with a t-statistic of 3.24. These results therefore contribute to the "style rotation" literature, where researchers attempt to identify successful strategies for timing investments in different equity styles[5].

### *4.4 Trend following alphas*

The alphas produced by the trend following strategies over the whole sample for developed economy equity portfolios are presented in Table 6A. In each case the alphas are larger than those produced by the buy and hold strategy. But we see that the biggest improvement is in the growth portfolio, where the alpha rises from a statistically insignificant 0.13% per month to a statistically significant 0.24%. Although the value alphas is larger (at 0.31% per month)

[5] See Wang (2005) for a fuller evaluation of this related literature.

the estimate of expression (2) shows that this difference is not statistically significant. However the "All countries" results show that the value portfolio produces a larger alpha (0.40%pm) than the equivalent growth portfolio (0.30%pm) and that this difference is statically significant (with a n associated t-statistic of 1.92). The gradual addition of the emerging market indices in this case tips the balance in favour of value as opposed to growth investing.

The trend following results for the developed economy portfolios in Table 6B show that the alphas are larger than their buy and hold equivalents in row one of the table and highly statistically significant, and although they are a little smaller than those produced by the buy and hold strategy applied to emerging equity markets, they are more statistically significant, though only marginally so. Perhaps the most interesting result relates to the alpha estimate from the estimation of expression (2) using the trend following returns. In each case the alpha is both economically and statistically insignificant. This result suggests that when a trend following filter is applied, one can afford to be agnostic about investment style, that is, value versus growth.

*4.4 Combined relative momentum and trend following alphas*

The last two rows in Tables 6A and 6B present alphas generated from expressions (1) and (2) for the investment strategies based upon relative momentum and trend following. Table 6A shows that the alphas generated from this strategy, whether we use the top 5 or top 25% of past performers, are higher than for the other strategies and are all highly economically and statistically significant. Arguably the most striking feature of the table is the improvement in the alpha produced by the growth portfolios. For alpha of the developed economy growth portfolios are estimated to be 0.65% and 0.66 % for the top 5 and top 25% momentum filter

respectively, while the equivalent alphas for the "All countries" growth portfolios are 0.82% and 0.77%. These alphas compare very favourably with the buy and hold alphas of 0.13% and 0.26% for the developed economy and all countries equity portfolios respectively. This improvement in risk-adjusted performance is also reflected in the alphas estimated using expression (2), which are all negative. In other words, using this combination of filters, growth investing produces not only higher risk-adjusted returns than a more passive approach to growth investing, but also risk-adjusted returns that are superior to those produced by value investing over a sample period where a passive, value investor might have expected to have outperformed a passive growth investor. All of the alphas from expression (2) are statistically significant, with the exception of the one produced for the All countries portfolio when using the top 25% of past performers.

The developed economy portfolio alphas presented in Table 6B for the shorter sample, present a similar picture to those presented for the longer sample in Table 6A – growth investing produces a greater risk-adjusted return than value investing, a result that is statistically significant for both momentum filters. However, the alphas produced by the emerging equity market portfolios only show that growth investing when we use the top 25% of past performers outperforms value investing, and that this outperformance is not statistically significant. When we use the top 5 of past performers then value alpha is larger than the growth, though this difference is not found to be statistically significant. The "All countries" growth alphas are greater than the value alphas, but again, not significantly so.

## 5. Conclusion

We have investigated the relationship between value and growth investing on the one hand and both relative momentum and trend following on the other. We find that without the

application of the filters considered here that value has outperformed growth in an international context. but this gap diminishes when a relative momentum filter is applied. Indeed for portfolios containing developed markets growth actually displayed higher risk-adjusted returns. The exception was within emerging markets where value still outperformed. When trend following was applied to value and growth portfolios both showed substantially improved risk-adjusted returns compared to the base case scenario. Volatilities were reduced by around 40% and maximum drawdowns declined markedly too. Compared to relative momentum, trend following delivered a more favourable investment performance, particularly in the case of emerging markets. The exception was in developed growth stocks where relative momentum still delivered small outperformance. Finally, we considered the combination of relative momentum and trend following. We found that while Sharpe ratios were similar in many cases to just trend following alone, the nominal level of return was considerably higher. Volatility was also commensurately higher and maximum drawdowns increased too. These remained more subdued though than when relative momentum was applied alone. The benefits accrued to both value and growth portfolios but particularly to the latter. We thus suggest that both value and growth strategies can be enhanced using momentum-based strategies. In particular, a trend following (absolute momentum) overlay offers substantial benefits compared to any unfiltered, buy-and-hold approach largely because it helps to reduce the tail risk that all investors fear most. Furthermore, when we apply these filters to international equity growth and value indices, we find that not only does the value investing advantage disappear, in some cases growth investing offers superior risk-adjusted returns over value investing.

Finally, as regards transactions' costs, while these will have varied very substantially over our sample period, and hence would be impossible to introduce with any degree of accuracy

to our calculations, we can certainly say that there is no evidence of over-trading with less than 1 round trip transaction per country per year on average over our sample period. In fact, for both developed and emerging, and for value and growth, the average only ranged between 0.83 and 0.87 transactions per year. This suggests that, whatever the charges, the relative returns would be unaffected. Further, ETFs and similar instruments are only recently being introduced for these countries and styles and hence any practical implementation would involve a swap being constructed by an investment bank. Where ETFs are available for these countries, the developed ones should cost less than 50bp per year and the emerging ones around 65bp, with transaction fixed charges of only a few bps per purchase or sale, and under one transaction per asset per year on average. These low fees will not adversely affect our conclusions that once the left tail risk is managed, growth can outperform value in both absolute and risk-adjusted terms, for developed and emerging countries alike.

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## Table 1: Performance statistics for 'buy and hold'

This table presents the summary statistics for value and growth indices over the study period. The results are presented for two sub-periods: 1976 to 2012 (Panel A), the whole data period, and 1998 to 2012 (Panel B). The results are based upon an equal weighting of the indices which is rebalanced at the end of each month. The columns headed "All" presents results where no distinction is made between growth or value indices. The results in the columns headed "All Countries" in Panel A of the Table, are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the equally-weighted portfolio. The results presented in Panel B of the Table are based upon an unchanging selection of markets, since all indices in our study are available from January 1998 onwards. The constituents of all portfolios are equally-weighted and rebalanced monthly.

| | Developed | | | Emerging | | | All Countries | | |
|---|---|---|---|---|---|---|---|---|---|
| | Value | Growth | All | Value | Growth | All | Value | Growth | All |
| *Panel A: 1976-2012* | | | | | | | | | |
| Annualized Return (%) | 13.19 | 11.11 | 12.18 | - | - | - | 14.97 | 12.62 | 13.56 |
| Annualized Volatility (%) | 17.14 | 17.03 | 16.88 | - | - | - | 17.53 | 17.76 | 17.56 |
| Sharpe Ratio | 0.47 | 0.35 | 0.42 | - | - | - | 0.56 | 0.42 | 0.48 |
| Max. Monthly Return (%) | 18.53 | 13.98 | 15.20 | - | - | - | 18.22 | 15.34 | 16.43 |
| Min. Monthly Return (%) | -25.32 | -23.99 | -24.66 | - | - | - | -26.48 | -27.00 | -26.74 |
| Maximum Drawdown (%) | 61.25 | 57.51 | 59.40 | - | - | - | 58.36 | 58.67 | 58.50 |
| Skew | -0.86 | -0.95 | -0.94 | - | - | - | -0.87 | -0.97 | -0.95 |
| *Panel B: 1998-2012* | | | | | | | | | |
| Annualized Return (%) | 7.94 | 5.97 | 7.01 | 16.50 | 13.17 | 14.86 | 12.19 | 9.57 | 10.91 |
| Annualized Volatility (%) | 17.14 | 17.03 | 16.88 | 24.45 | 24.81 | 24.49 | 17.53 | 17.76 | 17.56 |
| Sharpe Ratio | 0.16 | 0.05 | 0.11 | 0.47 | 0.32 | 0.40 | 0.40 | 0.25 | 0.33 |
| Max. Monthly Return (%) | 18.53 | 13.98 | 15.20 | 18.09 | 18.00 | 17.76 | 18.22 | 15.34 | 16.43 |
| Min. Monthly Return (%) | -25.32 | -23.99 | -24.66 | -27.75 | -30.29 | -29.02 | -26.48 | -27.00 | -26.74 |
| Maximum Drawdown (%) | 61.25 | 57.51 | 59.40 | 55.06 | 60.05 | 57.61 | 58.36 | 58.67 | 58.50 |
| Skew | -0.74 | -0.80 | -0.80 | -0.74 | -0.84 | -0.81 | -0.78 | -0.84 | -0.83 |

## Table 2A: Performance statistics for Relative Momentum

This table presents the performance of portfolios constructed on the basis of relative momentum. Each index within a portfolio is ranked according to its prior 12-month volatility-weighted return the volatility-weighted return is calculated by dividing each index's prior 12 month return with the standard deviation of this return. Using this return momentum portfolios are created with the five indices with the highest volatility-weighted returns. These portfolios are then held for one month, at which point the process is rolled forward one month and the volatility-weighted returns are recalculated. The results are presented for two sub-periods: 1976 to 2012 (Panel A), the whole data period, and 1998 to 2012 (Panel B), the period that emerging markets are introduced. The results are based upon an equal weighting of the indices which is rebalanced at the end of each month. The columns headed "All" presents results where no distinction is made between growth or value indices. The results in the columns headed "All Countries" in Panel A of the Table, are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the equally-weighted portfolio. The results in Panel B of the Table are based upon an unchanging selection of markets, since all indices in our study are available from January 1998 onwards. The constituents of all portfolios are equally-weighted and rebalanced monthly.

| | Developed | | | Emerging | | | All Countries | | |
|---|---|---|---|---|---|---|---|---|---|
| | Value | Growth | All | Value | Growth | All | Value | Growth | All |
| *Panel A: TOP 5: 1976-2012* | | | | | | | | | |
| Annualized Return (%) | 14.54 | 18.52 | 17.36 | - | - | - | 16.17 | 21.04 | 18.42 |
| Annualized Volatility (%) | 18.25 | 19.44 | 19.26 | - | - | - | 19.82 | 20.39 | 21.11 |
| Sharpe Ratio | 0.52 | 0.69 | 0.63 | - | - | - | 0.56 | 0.78 | 0.63 |
| Max. Monthly Return (%) | 15.80 | 15.83 | 22.10 | - | - | - | 21.76 | 18.35 | 24.23 |
| Min. Monthly Return (%) | -34.27 | -34.65 | -35.57 | - | - | - | -34.27 | -34.65 | -35.57 |
| Maximum Drawdown (%) | 61.02 | 51.39 | 51.13 | - | - | - | 59.27 | 52.35 | 60.27 |
| Skew | -1.31 | -1.05 | -1.13 | - | - | - | -0.73 | -0.99 | -0.84 |
| *Panel B: TOP 5: 1998-2012* | | | | | | | | | |
| Annualized Return (%) | 8.19 | 10.89 | 12.06 | 15.60 | 9.37 | 12.07 | 12.01 | 16.78 | 14.58 |
| Annualized Volatility (%) | 18.25 | 19.44 | 19.26 | 28.30 | 27.65 | 29.38 | 19.82 | 20.39 | 21.11 |
| Sharpe Ratio | 0.17 | 0.30 | 0.36 | 0.37 | 0.15 | 0.24 | 0.35 | 0.57 | 0.45 |
| Max. Monthly Return (%) | 13.80 | 15.83 | 22.10 | 21.16 | 17.73 | 24.52 | 21.76 | 18.35 | 24.23 |
| Min. Monthly Return (%) | -25.09 | -20.00 | -23.89 | -35.68 | -34.75 | -36.39 | -24.70 | -26.34 | -25.71 |
| Maximum Drawdown (%) | 61.02 | 51.39 | 51.13 | 59.60 | 63.74 | 61.66 | 59.27 | 52.35 | 60.27 |
| Skew | -0.81 | -0.47 | -0.56 | -0.73 | -0.97 | -0.65 | -0.03 | -0.46 | -0.24 |

## Table 2B: Performance statistics for Relative Momentum

This table presents the performance of portfolios constructed on the basis of relative momentum. Each index within a portfolio is ranked according to its prior 12-month volatility-weighted return the volatility-weighted return is calculated by dividing each index's prior 12 month return with the standard deviation of this return. Using this return momentum portfolios are created with the 25% of indices with the highest volatility-weighted returns. These portfolios are then held for one month, at which point the process is rolled forward one month and the volatility-weighted returns are recalculated. The results are presented for two sub-periods: 1976 to 2012 (Panel A), the whole data period, and 1998 to 2012 (Panel B), the period that emerging markets are introduced. The results are based upon an equal weighting of the indices which is rebalanced at the end of each month. The columns headed "All" presents results where no distinction is made between growth or value indices. The results in the columns headed "All Countries" in Panel A of the Table, are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the equally-weighted portfolio. The results in Panel B of the Table are based upon an unchanging selection of markets, since all indices in our study are available from January 1998 onwards. The constituents of all portfolios are equally-weighted and rebalanced monthly.

| | Developed | | | Emerging | | | All Countries | | |
|---|---|---|---|---|---|---|---|---|---|
| | Value | Growth | All | Value | Growth | All | Value | Growth | All |
| *Panel A: TOP QUARTER: 1976-2012* | | | | | | | | | |
| Annualized Return (%) | 15.05 | 18.84 | 16.82 | - | - | - | 16.42 | 19.74 | 18.36 |
| Annualized Volatility (%) | 18.17 | 19.59 | 18.29 | - | - | - | 18.86 | 20.43 | 19.20 |
| Sharpe Ratio | 0.55 | 0.70 | 0.64 | - | - | - | 0.60 | 0.72 | 0.69 |
| Max. Monthly Return (%) | 15.80 | 18.23 | 15.05 | - | - | - | 16.90 | 17.60 | 15.61 |
| Min. Monthly Return (%) | -34.27 | -34.65 | -34.16 | - | - | - | -34.27 | -34.65 | -34.16 |
| Maximum Drawdown (%) | 59.27 | 50.48 | 57.51 | - | - | - | 60.69 | 59.73 | 59.76 |
| Skew | -1.35 | -1.05 | -1.36 | - | - | - | -1.15 | -1.21 | -1.25 |
| *Panel B: TOP QUARTER: 1998-2012* | | | | | | | | | |
| Annualized Return (%) | 9.37 | 11.61 | 9.79 | 14.73 | 13.22 | 13.97 | 12.62 | 13.72 | 13.39 |
| Annualized Volatility (%) | 18.17 | 19.59 | 18.29 | 27.69 | 27.41 | 26.62 | 18.86 | 20.43 | 19.20 |
| Sharpe Ratio | 0.23 | 0.33 | 0.25 | 0.35 | 0.30 | 0.33 | 0.40 | 0.42 | 0.43 |
| Max. Monthly Return (%) | 12.89 | 18.23 | 15.05 | 19.79 | 25.73 | 19.91 | 16.90 | 17.60 | 15.61 |
| Min. Monthly Return (%) | -25.91 | -23.20 | -24.56 | -35.68 | -34.75 | -35.48 | -27.31 | -29.91 | -28.61 |
| Maximum Drawdown (%) | 59.27 | 50.48 | 57.51 | 59.28 | 63.20 | 59.01 | 60.69 | 59.73 | 59.76 |
| Skew | -0.89 | -0.47 | -0.90 | -0.88 | -0.97 | -0.93 | -0.59 | -0.86 | -0.78 |

**Table 3: Performance statistics based on switching between Value and Growth within markets**

This table presents results based upon equally-weighted allocations to a market's growth or value index. At the end of each month the decision to invest in a market's value or growth stocks is based upon each index's volatility-adjusted return over the past 12 months – the index with the highest volatility-adjusted momentum is then equally-weighted within the portfolio. The results are presented for two sub-periods: 1976 to 2012 (Panel A), the whole data period, and 1998 to 2012 (Panel B). The columns headed "All" presents results where no distinction is made between growth or value indices. The results in the column headed "All Countries" in Panel A of the Table, are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the equally-weighted portfolio. The results presented in Panel B of the Table are based upon an unchanging selection of markets, since all indices in our study are available from January 1998 onwards. The constituents of all portfolios are equally-weighted and rebalanced monthly.

| | Developed | Emerging | All Countries |
|---|---|---|---|
| *Panel A: 1976-2012* | | | |
| Annualized Return (%) | 14.00 | - | 15.32 |
| Annualized Volatility (%) | 16.71 | - | 17.45 |
| Sharpe Ratio | 0.53 | - | 0.58 |
| Max. Monthly Return (%) | 15.22 | - | 16.29 |
| Min. Monthly Return (%) | -23.64 | - | -26.39 |
| Maximum Drawdown (%) | 57.40 | - | 57.42 |
| Skew | -0.91 | - | -0.97 |
| *Panel B: 1998-2012* | | | |
| Annualized Return (%) | 9.02 | 14.82 | 12.17 |
| Annualized Volatility (%) | 16.71 | 24.86 | 17.45 |
| Sharpe Ratio | 0.23 | 0.39 | 0.40 |
| Max. Monthly Return (%) | 15.22 | 18.45 | 16.29 |
| Min. Monthly Return (%) | -23.64 | -29.67 | -26.39 |
| Maximum Drawdown (%) | 57.40 | 57.57 | 57.42 |
| Skew | -0.80 | -0.89 | -0.89 |

## Table 4: Performance statistics for Trend Following

This table presents the performance of portfolios constructed on the basis of trend following. The process involves the following steps: if the index value at time t is above the simple average of its 10 end-of-month prices, then the asset is defined as being in an 'uptrend' and is purchased (or held if already owned); however, if the current price is below this ten-month moving average then the asset is sold (or not bought, if not already owned) and the proceeds are invested in short-term treasury bills. This process is updated on a rolling monthly basis. The results are presented for two sub-periods: 1976 to 2012 (Panel A) and 1998 to 2012 (Panel B), the period that emerging markets are introduced. The results are based upon an equal weighting of the indices which are rebalanced at the end of each month. The columns headed "All" presents results where no distinction is made between growth or value indices. The results in the columns headed "All Countries" in Panel A of the Table, are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the equally-weighted portfolio. The results in Panel B of the Table are based upon an unchanging selection of markets, since all indices in the study are available from January 1998 onwards.

| | Developed | | | Emerging | | | All Countries | | |
|---|---|---|---|---|---|---|---|---|---|
| | Value | Growth | All | Value | Growth | All | Value | Growth | All |
| *Panel A: 1976-2012* | | | | | | | | | |
| Annualized Return (%) | 12.99 | 12.19 | 12.62 | - | - | - | 14.19 | 13.10 | 13.66 |
| Annualized Volatility (%) | 10.97 | 10.93 | 10.74 | - | - | - | 11.27 | 11.33 | 11.14 |
| Sharpe Ratio | 0.72 | 0.65 | 0.70 | - | - | - | 0.80 | 0.70 | 0.77 |
| Max. Monthly Return (%) | 11.32 | 10.30 | 10.06 | - | - | - | 11.79 | 13.02 | 10.90 |
| Min. Monthly Return (%) | -18.53 | -20.58 | -19.55 | - | - | - | -18.53 | -20.58 | -19.55 |
| Maximum Drawdown (%) | 18.66 | 20.75 | 19.71 | - | - | - | 18.66 | 20.75 | 19.71 |
| Skew | -0.73 | -1.03 | -0.93 | - | - | - | -0.48 | -0.84 | -0.70 |
| *Panel B: 1998-2012* | | | | | | | | | |
| Annualized Return (%) | 10.00 | 10.17 | 10.12 | 15.59 | 14.35 | 15.00 | 12.89 | 12.37 | 12.65 |
| Annualized Volatility (%) | 10.97 | 10.93 | 10.74 | 14.39 | 14.15 | 14.09 | 11.27 | 11.33 | 11.14 |
| Sharpe Ratio | 0.44 | 0.46 | 0.46 | 0.73 | 0.65 | 0.70 | 0.69 | 0.64 | 0.68 |
| Max. Monthly Return (%) | 11.32 | 10.30 | 9.92 | 15.21 | 16.00 | 13.80 | 11.79 | 13.02 | 10.90 |
| Min. Monthly Return (%) | -10.79 | -9.06 | -9.93 | -11.02 | -11.19 | -11.10 | -9.21 | -9.04 | -9.12 |
| Maximum Drawdown (%) | 17.24 | 18.04 | 17.63 | 15.52 | 17.57 | 16.10 | 16.32 | 15.92 | 16.12 |
| Skew | -0.25 | -0.24 | -0.31 | 0.46 | 0.18 | 0.29 | 0.20 | 0.03 | 0.07 |

## Table 5A: Performance statistics from combining Trend Following with Relative Momentum (top 5)

This table presents the performance of portfolios constructed on the basis of relative momentum and trend following. The portfolio formation process involves the following steps. First, risk-weighted momentum portfolios are formed by ranking each index according to its prior 12-month volatility-weighted return. The volatility-weighted return is calculated by dividing each index's prior 12 month return with the standard deviation of this return. Using this volatility-weighted return, momentum portfolios are created with the five indices with the highest volatility-weighted returns. Each of the five indices is then included in an equally-weighted portfolio if its index level is above its ten month moving average (see notes to Table 4). In the event that the index level is below this ten-month moving average then the allocation to this index is invested in T-bills. These portfolios are then held for one month, at which point the process is rolled forward one month. The results are presented for two sub-periods: 1976 to 2012 (Panel A) and 1998 to 2012 (Panel B), the period that emerging markets are introduced. The results are based upon an equal weighting of the indices which are rebalanced at the end of each month. The columns headed "All" presents results where no distinction is made between growth or value indices. The results in the columns headed "All Countries" in Panel A of the Table, are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the equally-weighted portfolio. The results in Panel B of the Table are based upon an unchanging selection of markets, since all indices in the study are available from January 1998 onwards.

| | Developed | | | Emerging | | | All Countries | | |
|---|---|---|---|---|---|---|---|---|---|
| | Value | Growth | All | Value | Growth | All | Value | Growth | All |
| *Panel A: 1976-2012* | | | | | | | | | |
| Annualized Return (%) | 14.89 | 19.37 | 17.80 | - | - | - | 16.90 | 21.63 | 18.82 |
| Annualized Volatility (%) | 15.95 | 17.30 | 17.75 | - | - | - | 17.72 | 18.32 | 19.56 |
| Sharpe Ratio | 0.61 | 0.82 | 0.71 | - | - | - | 0.66 | 0.90 | 0.70 |
| Max. Monthly Return (%) | 15.80 | 15.83 | 22.10 | - | - | - | 21.76 | 18.35 | 24.23 |
| Min. Monthly Return (%) | -34.27 | -34.65 | -35.57 | - | - | - | -34.27 | -34.65 | -35.57 |
| Maximum Drawdown (%) | 34.27 | 35.21 | 35.57 | - | - | - | 40.96 | 38.38 | 40.04 |
| Skew | -1.32 | -1.07 | -1.07 | - | - | - | -0.67 | -0.85 | -0.74 |
| *Panel B: 1998-2012* | | | | | | | | | |
| Annualized Return (%) | 9.69 | 14.28 | 14.59 | 17.29 | 13.95 | 16.09 | 14.50 | 19.70 | 17.06 |
| Annualized Volatility (%) | 15.95 | 17.30 | 17.75 | 22.53 | 21.86 | 25.52 | 17.72 | 18.32 | 19.56 |
| Sharpe Ratio | 0.29 | 0.53 | 0.53 | 0.54 | 0.40 | 0.43 | 0.53 | 0.80 | 0.61 |
| Max. Monthly Return (%) | 13.80 | 15.83 | 22.10 | 20.87 | 17.73 | 24.52 | 21.76 | 18.35 | 24.23 |
| Min. Monthly Return (%) | -15.51 | -16.73 | -15.96 | -28.81 | -27.92 | -36.39 | -15.51 | -16.73 | -15.96 |
| Maximum Drawdown (%) | 28.62 | 35.21 | 27.15 | 41.74 | 47.62 | 48.01 | 40.96 | 38.38 | 40.04 |
| Skew | -0.38 | 0.02 | 0.11 | -0.31 | -0.38 | -0.40 | 0.38 | 0.16 | 0.21 |

## Table 5B: Performance statistics from combining Trend Following with Relative Momentum (Top 25%)

This table presents the performance of portfolios constructed on the basis of relative momentum and trend following. The portfolio formation process involves the following steps. First, risk-weighted momentum portfolios are formed by ranking each index according to its prior 12-month volatility-weighted return. The volatility-weighted return is calculated by dividing each index's prior 12 month return with the standard deviation of this return. Using this volatility-weighted return, momentum portfolios are created with the top 25% of indices with the highest volatility-weighted returns. Each of these indices is then included in an equally-weighted portfolio if its index level is above its ten month moving average (see notes to Table 4). In the event that the index level is below this ten-month moving average then the allocation to this index is invested in T-bills. These portfolios are then held for one month, at which point the process is rolled forward one month. The results are presented for two sub-periods: 1976 to 2012 (Panel A) and 1998 to 2012 (Panel B), the period that emerging markets are introduced. The results are based upon an equal weighting of the indices which are rebalanced at the end of each month. The columns headed "All" presents results where no distinction is made between growth or value indices. The results in the columns headed "All Countries" in Panel A of the Table, are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the equally-weighted portfolio. The results in Panel B of the Table are based upon an unchanging selection of markets, since all indices in the study are available from January 1998 onwards.

| | Developed | | | Emerging | | | All Countries | | |
|---|---|---|---|---|---|---|---|---|---|
| | Value | Growth | All | Value | Growth | All | Value | Growth | All |
| *Panel A: 1976-2012* | | | | | | | | | |
| Annualized Return (%) | 15.03 | 19.71 | 17.38 | - | - | - | 17.28 | 20.72 | 19.07 |
| Annualized Volatility (%) | 15.79 | 17.33 | 16.00 | - | - | - | 16.44 | 17.51 | 16.62 |
| Sharpe Ratio | 0.63 | 0.84 | 0.77 | - | - | - | 0.74 | 0.89 | 0.84 |
| Max. Monthly Return (%) | 15.80 | 18.23 | 15.05 | - | - | - | 15.80 | 17.60 | 15.61 |
| Min. Monthly Return (%) | -34.27 | -34.65 | -34.16 | - | - | - | -34.27 | -34.65 | -34.16 |
| Maximum Drawdown (%) | 34.27 | 34.65 | 34.16 | - | - | - | 34.27 | 35.62 | 34.16 |
| Skew | -1.36 | -1.02 | -1.33 | - | - | - | -1.00 | -1.04 | -1.10 |
| *Panel B: 1998-2012* | | | | | | | | | |
| Annualized Return (%) | 10.03 | 15.09 | 12.37 | 15.96 | 17.17 | 15.88 | 15.41 | 17.51 | 16.42 |
| Annualized Volatility (%) | 15.79 | 17.33 | 16.00 | 21.86 | 21.54 | 22.04 | 16.44 | 17.51 | 16.62 |
| Sharpe Ratio | 0.31 | 0.57 | 0.45 | 0.50 | 0.56 | 0.49 | 0.63 | 0.71 | 0.68 |
| Max. Monthly Return (%) | 12.63 | 18.23 | 15.05 | 18.62 | 25.73 | 19.91 | 15.10 | 17.60 | 15.61 |
| Min. Monthly Return (%) | -14.38 | -16.88 | -16.18 | -28.81 | -27.92 | -32.07 | -14.59 | -15.60 | -14.69 |
| Maximum Drawdown (%) | 25.95 | 34.09 | 28.16 | 42.69 | 39.59 | 44.76 | 24.05 | 35.62 | 32.62 |
| Skew | -0.42 | 0.16 | -0.27 | -0.37 | -0.31 | -0.60 | 0.21 | 0.03 | 0.07 |

## Table 6A: Four factor alpha estimates for the investment strategies (1977 to 2012)

This table presents the alpha estimates of the investment strategies described in Tables 1, 2, 3, 4 and 5. The alphas were generated using the Fama and French (1992) three factors, MKT, SMB and HML, plus Carhart's (1997) momentum factor, UMD (see expression (1) in the text)). The numbering in column 1 of the table refer to the tables where the descriptive statistics of the investment strategies are presented. The alphas are monthly and are presented in bold, while the related t-values are presented in italics. The column headed "Val-Gro" presents the alphas and related t-values where the dependent variable is the excess return on the relevant value strategy minus the excess return on the related growth strategy (see expression (2) in the text)). The columns headed "All" present results where no distinction is made between growth or value indices. The results in the columns headed "All Countries" are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the equally-weighted portfolio.

| | Developed | | | | All Countries | | | |
|---|---|---|---|---|---|---|---|---|
| | **Value** | **Growth** | **All** | **Val-Gro** | **Value** | **Growth** | **All** | **Val-Gro** |
| **1. Buy & hold** | **0.24%** | **0.13%** | **0.18%** | **0.11%** | **0.42%** | **0.26%** | **0.32%** | **0.16%** |
| | *1.47* | *0.78* | *1.15* | *1.67* | *2.50* | *1.52* | *1.91* | *2.79* |
| **2A. Momentum (Mom5)** | **0.25%** | **0.11%** | **0.44%** | **0.14%** | **0.44%** | **0.68%** | **0.54%** | **0.18%** |
| | *1.31* | *0.55* | *2.06* | *0.94* | *1.97* | *2.99* | *2.25* | *1.11* |
| **2B. Momentum (Mom 25%)** | **0.29%** | **0.56%** | **0.39%** | **-0.26%** | **0.42%** | **0.66%** | **0.54%** | **-0.24%** |
| | *1.55* | *2.64* | *2.06* | *-1.83* | *2.09* | *2.98* | *2.63* | *-1.76* |
| **3 Value or Growth** | **-** | **-** | **0.71%** | **-** | **-** | **-** | **0.84%** | **-** |
| | - | - | *4.42* | - | - | - | *4.99* | - |
| **4. Trend following (TF)** | **0.31%** | **0.24%** | **0.27%** | **0.07%** | **0.40%** | **0.30%** | **0.35%** | **0.10%** |
| | *2.39* | *1.90* | *2.20* | *1.27* | *3.02* | *2.32* | *2.73* | *1.92* |
| **5A. TF & Mom5** | **0.35%** | **0.65%** | **0.52%** | **-0.30%** | **0.54%** | **0.82%** | **0.63%** | **-0.28%** |
| | *1.83* | *3.25* | *2.48* | *-2.08* | *2.48* | *3.78* | *2.61* | *-1.81* |
| **5B. TF & Mom25%** | **0.36%** | **0.66%** | **0.49%** | **-0.30%** | **0.54%** | **0.77%** | **0.64%** | **-0.14%** |
| | *1.90* | *3.30* | *2.68* | *-2.13* | *2.74* | *3.74* | *3.32* | *-0.62* |

## Table 6B: Four factor alpha estimates for the investment strategies (1998 to 2012)

This table presents the alpha estimates of the investment strategies described in Tables 1, 2, 3, 4 and 5. The alphas were generated using the Fama and French (1992) three factors, MKT, SMB and HML, plus Carhart's (1997) momentum factor, UMD (see expression (1) in the text)). The numbering in column 1 of the table refer to the tables where the descriptive statistics of the investment strategies are presented. The alphas are monthly and are presented in bold, while the related t-values are presented in italics. The column headed "Val-Gro" presents the alphas and related t-values where the dependent variable is the excess return on the relevant value strategy minus the excess return on the related growth strategy (see expression (2) in the text)). The columns headed "All" present results where no distinction is made between growth or value indices. The results in the columns headed "All Countries" are based upon the equally-weighted combination of available indices, that is, as an index becomes available it is added to the equally-weighted portfolio.

| | Developed | | | | Emerging | | | | All Countries | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Value** | **Growth** | **All** | **Val-Gro** | **Value** | **Growth** | **All** | **Val-Gro** | **Value** | **Growth** | **All** | **Val-Gro** |
| ***Panel B: 1998-2012*** | | | | | | | | | | | | |
| **1. Buy & hold** | **0.18%** | **0.12%** | **0.15%** | **0.07%** | **1.02%** | **0.77%** | **0.90%** | **0.26%** | **0.58%** | **0.43%** | **0.51%** | **0.16%** |
| | *0.81* | *0.55* | *0.71* | *0.59* | *3.19* | *2.38* | *2.82* | *2.41* | *2.42* | *1.79* | *2.15* | *1.76* |
| **2A. Momentum (Mom5)** | **0.19%** | **0.26%** | **0.53%** | **-0.08%** | **1.00%** | **0.57%** | **0.84%** | **0.43%** | **0.60%** | **0.88%** | **0.77%** | **-0.08%** |
| | *0.72* | *1.03* | *2.04* | *-0.37* | *2.26* | *1.36* | *1.78* | *1.49* | *1.64* | *2.62* | *2.08* | *-0.29* |
| **2B. Momentum (Mom 25%)** | **0.28%** | **0.51%** | **0.31%** | **-0.24%** | **0.88%** | **0.80%** | **0.84%** | **0.09%** | **0.57%** | **0.74%** | **0.64%** | **-0.17%** |
| | *1.13* | *2.02* | *1.35* | *-1.20* | *2.07* | *1.93* | *2.12* | *0.32* | *1.97* | *2.43* | *2.24* | *-0.98* |
| **3 Value or Growth** | **-** | **-** | **0.48%** | **-** | **-** | **-** | **1.06%** | **-** | **-** | **-** | **0.77%** | **-** |
| | *-* | *-* | *2.23* | *-* | *-* | *-* | *3.24* | *-* | *-* | *-* | *3.23* | *-* |
| **4. Trend following (TF)** | **0.43%** | **0.45%** | **0.44%** | **-0.02%** | **0.89%** | **0.79%** | **0.84%** | **0.10%** | **0.66%** | **0.62%** | **0.64%** | **0.04%** |
| | *2.22* | *2.63* | *2.49* | *-0.21* | *3.37* | *3.10* | *3.29* | *1.08* | *3.20* | *3.21* | *3.26* | *0.53* |
| **5A. TF & Mom5** | **0.40%** | **0.76%** | **0.78%** | **-0.37%** | **1.07%** | **0.89%** | **1.13%** | **0.18%** | **0.85%** | **1.18%** | **1.03%** | **-0.34%** |
| | *1.49* | *3.17* | *3.12* | *-1.74* | *2.54* | *2.27* | *2.40* | *0.74* | *2.37* | *3.74* | *2.75* | *-1.32* |
| **5B. TF & Mom25%** | **0.41%** | **0.80%** | **0.58%** | **-0.39%** | **0.94%** | **1.07%** | **0.97%** | **-0.14%** | **0.84%** | **1.03%** | **0.92%** | **-0.14%** |
| | *1.63* | *3.31* | *2.55* | *-1.94* | *2.32* | *2.81* | *2.47* | *-0.62* | *2.92* | *3.79* | *3.39* | *-0.62* |