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Exploiting Predictability in International Anomalies

DEVRAJ BASU, CHI-HSIOU HUNG and ALEXANDER STREMME

* Devraj Basu is from Cass Business School, City University, e.mail:d.basu@city.ac.uk, Chi-Hsiou Hung (Corresponding Author) is from Durham Business School, d.c.hung@durham.ac.uk and Alexander Stremme is from Warwick Business School, alex.stremme@wbs.ac.uk

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Abstract

We construct unconditionally efficient asset allocation strategies that exploit return predictability of international size and momentum portfolios. The strategies achieve comparable returns to these investment assets while exhibiting much lower volatility. They largely avoid major losses by successfully timing these assets. The strategies utilizing the MSCI world index and the term spread as predictive variables achieve better performance than those without exploiting return predictability. The optimal strategies perform better than conditionally efficient strategies due the conservative response of the optimal portfolio weight to extreme realizations of the predictive variables, thus leading to lower volatility.

JEL Classification: G11, G15

1 Introduction

The investment industry continues relentlessly towards market integration and globalization. A major innovation is the number of truly global mandates being given to fund managers, for whom globalization has become a reality. There is thus a constant search for new international investment strategies that yield high returns. The evidence on traditional international diversification using country indices is not particularly encouraging with Britten-Jones (1999) and Sinquefeld (1996) finding no benefits for a U.S investing in foreign stock indices. There is a growing literature, however, that documents the existence of international 'anomalies' such as the size, momentum and value effect which are capable of generating high returns. The international size effect is the first to have been documented and Dimensional Fund Advisors constructed international small size portfolios as investment strategies in the mid 1960s. The momentum effect has come to the forefront more recently with papers such as Rouwenhorst (1996), Chan, Hameed and Tong (2000) and Griffin, Ji and Martin (2005) documenting the profitability of such strategies across different countries. The international value effect has also received considerable attention with the international value premium being well-documented (Fama and French (1998)).

Investing in these anomalies is far from risk-less however. Strategies involving small stocks, past winners and high book-to-market portfolios tend to exhibit greater volatility than broad stock indices and can sustain significant losses. It would thus be very useful to be able to construct strategies that can time these 'anomaly' portfolios successfully. In this paper, we focus on strategies that are capable of timing international size and momentum portfolios leading to returns comparable to these portfolios, with much lower volatility and thus largely avoiding major losses. Our strategies use global predictive variables and our study is one of the first to document return predictability for these portfolios and exploit it for asset allocation[1]. Our paper thus focuses on the economic value of return predictability for this set of portfolios and outlines how the gains from predictability may be realized in practice.

We consider a U.S. fund manager with a global mandate. In order to achieve higher returns she is considering investing in international size and momentum strategies in developed markets. As she will thus want to invest in the non-U.S. G8 countries and we consider the problem of allocation between the U.S. and the non-U.S. G8 countries. We construct the smallest size decile and past winners decile of the G8 countries without the U.S (which we will call the international) and first investigate

[1]The presence of return predictability has been noted for U.S. anomaly portfolios, particularly the momentum portfolios (Chordia and Shivakumar (2002) and Cooper, Hameed and Guttierez (2004)).

allocation between this portfolio, the corresponding U.S. portfolio[2] and the U.S. risk-free asset. We then focus on allocation across three of the largest economies in the G8, the U.S., U.K. and Germany, by using the smallest size decile and past winners decile in each of these countries as risky base assets together with the U.S. risk free asset. We compare the performance of the strategies using global predictive variables to those without, in order to gauge the economic value of return predictability in this setting. However such strategies would be difficult to implement in practice as each decile portfolio has over a hundred stocks. We thus consider equally-weighted portfolios consisting of the 30 smallest stocks[3]as well as the 30 stocks with the highest past 6 month return for the G8 without the U.S., as well as the U.S., U.K. and Germany and study timing strategies based on these. We focus on equally-weighted strategies as price-weighting gives undue influence to the best performing stocks and thus injects an element of selectivity, whereas our focus is on timing. It is also important to note that our strategies might not involve the largest stocks in the various foreign markets and therefore could not be implemented using ADRs. The gains from these strategies could not thus be realized by investing in the U.S. and actual international diversification would be necessary.

Our strategies are unconditionally efficient long-only maximum return strategies with reasonable volatility targets. Unconditionally efficient strategies (also called dynamically optimal or just optimal) may be thought of as tactical asset allocation strategies with a strategic objective, namely optimizing with respect to unconditional moments rather than conditional moments for conditionally efficient strategies that are commonly used (Solnik (1993) for example). We focus on long-only strategies as shorting size and momentum portfolios is difficult and can incur high transaction costs. Our global predictive variables are the term spread, defined as the difference in return between the 10 year Treasury bond and 1 year Treasury bond and the return on the MSCI World index. Both of these variables provide readily available global market information and have been used in a number of studies (Ferson and Harvey (1993) for example). We study the out-of-sample performance of these strategies over the 1998-2004 period, as it had both bull and bear market phases, using parameters estimated from the 1980-1997 period. We calculate various performance statistics such as Sharpe ratios and alphas relative to the MSCI World index.

The optimal strategy based on the U.S. and international decile portfolios outperforms these (both of which have high Sharpe ratios) by by successfully timing the

[2]We do not analyze book-to-market strategies as we cannot construct the corresponding G8 portfolios as there is no uniform notion of book value across the G8 countries

[3]We impose a price restriction of $5 for U.S. stocks and $2 for non U.S. stocks so that these stocks are reasonably liquid

international size portfolio, particularly over the 1998-2002 period. This leads to our optimal strategy having the lowest overall volatility and achieving a high cumulative return by avoiding major losses. The optimal strategy using the three country size decile portfolios also outperforms the base assets as well as the fixed-weight portfolio. It achieves this outperformance by taking spread positions between the various risky assets as well as the risk-free asset, thus utilizing the time-variation in expected return between the different base assets.

Turning now to the decile of past winners, the U.S. portfolio has a high mean but also a high volatility leading to a moderate Sharpe ratio of while the international has a lower mean by considerably lower volatility leading to a higher Sharpe ratio of 1.06. The optimal strategy is able to successfully time the international portfolio, outperforming the base assets and the fixed weight portfolio. The optimal strategy using the three country decile portfolios also out-performs both the base assets and the fixed-weight portfolio.

We thus see that there are substantial benefits for a U.S. fund manager to dynamically investing in foreign size and momentum portfolios. The benefits are both a result of international strategies outperforming the U.S. strategies and also from the return predictability in these strategies which allows for successful timing.

We now move to the equally weighted portfolios based on the smallest 30 stocks and 30 stocks with highest 6 month past return. The U.S. and international portfolios have much lower Sharpe ratios than for the decile portfolios and the optimal strategy outperforms the base assets and the fixed-weight strategy by a wider margin than for the decile portfolios. We calculate the cumulative return on the optimal strategy net of transaction costs assumed to be 50 basis points, which is a reasonable estimate for a large fund manager. The optimal strategy using the U.S. and international size portfolio achieves higher net cumulative returns than the fixed weight or the U.S. portfolio, and captures much of the gains to the U.S. portfolio while avoiding the losses. The optimal strategy based on the three country size portfolios again achieves a higher Sharpe ratio than the base assets or fixed weight portfolio, and its net cumulative return is higher than the fixed weight or U.S. portfolio. The optimal strategy for the U.S. and international winner portfolio achieves the highest Sharpe ratio largely due to its lower volatility and its net cumulative return is higher than that of the U.S. or fixed-weight portfolio. It thus seems that there are substantial gains to be made, even net of transaction costs, from these strategies which are feasible to implement.

Our focus on unconditionally efficient strategies is driven by their theoretical optimality (Hansen and Richard (1987)) but we find that they out-perform conditionally

efficient strategies, the focus of earlier work. This is due to their lower volatility which is driven by the conservative response of the portfolio weights in response to extreme values of the predictive variables. In contrast, conditionally efficient strategies tend to take extreme positions in risky assets in response to large changes in the predictive variables, which leads to greater volatility without much increase in mean. The economic gains to return predictability are best realized by the use of unconditionally efficient strategies.

Finally, we investigate how these strategies work. We first examine how much of the performance of our strategies is due to timing country indices. To this end we construct a dynamically managed portfolio of U.S., U.K. and Germany. We find that our dynamic strategies in several cases have lower betas relative to this benchmark than to the World index and overall have high alphas very similar to those relative to the World index. We then examine the correlations between the asset weights and the predictive variables. We find that the strategies exhibit high correlation with the changes in the World index and have different signs for different assets. It is these differing responses to changes in the World index that seem to be drive the performance of our strategies. The active management in these strategies is thus very different from that in timing country indices and has the potential to add considerable economic value.

2 Data and Methodology

2.1 Data and Investment Assets

We use monthly equity data of eight developed countries including Canada, France, Germany, Japan, Netherlands, Switzerland, the United Kingdom and the United States from January 1980 to December 2004. For the U.S. data, we use all NYSE, AMEX and NASDAQ common equities obtained from the Center for Research in Security Price (CRSP) from January 1980 to December 2004. For other countries, we use US dollar denominated monthly returns (including dividends and capital gains) and market capitalization data obtained from Datastream. We include both listed and de-listed firms to mitigate the survivorship bias but exclude all non-common equities and companies listed outside of domestic exchanges. We use the Morgan Stanley Capital International (MSCI) World index as a proxy for the global market portfolio and the CRSP one-month Treasury bill rate as the risk-free rate. We exclude stocks with prices lower than USD $5 for the U.S. sample in constructing momentum and size portfolios. For non-U.S. firms, we exclude stocks with prices lower than USD

$2. In December 2004 the sample covers non-U.S. firms consisting of 683 firms in Canada, 648 in France, 563 firms in Germany, 1,441 in Japan, 178 in Netherlands, 97 in Switzerland and 1,095 in the United Kingdom.

We consider the investments assets selected from all stocks in the G8 sample that excludes the U.S. stocks as our international portfolio. We construct the representative momentum strategies that sort stocks on their past 6-month compounded returns. The stocks within the top 10% of past returns comprise the 'winner' portfolio (M10) and stocks within the bottom 10% of past returns comprise the 'loser' portfolio (M01). We reconstruct momentum portfolios every 6 months and do not overlap formation periods in order to reduce trading frequencies and hence the strategies require lower transaction costs in portfolio construction. We calculate monthly equally-weighted portfolio returns in each of the six months following formations. We further explore our allocation strategies and select the top 30 winner stocks from the winner deciles and then form equally weighted portfolios. For the size-sorted portfolios, we sort stocks by their market capitalizations at the time of portfolio formation. The small size portfolio ('small') and the big size portfolio ('big') contain stocks with the smallest and largest 10% of market capitalizations. We re-construct size portfolios every 12 months and calculate monthly equally-weighted portfolio returns in each of the 12 months following formation. We further explore the 30 smallest size stocks from the small size deciles and then form equally weighted portfolios. We focus on equally weighted portfolios rather than price weighted portfolio as we wish to study timing effects. Equally weighted portfolios by definition give equal importance to the return on each stock unlike price weighted portfolios which over-weight the return on the highest value stocks thus leading to selectivity effects which we wish to avoid.

We finally consider the investments assets that are selected from the U.S., the U.K. and Germany in order to conduct investigations country-by-country and relax the market integration assumption. We construct momentum portfolios for each of the three countries by sorting stocks into deciles based on past 6-month compounded returns relative only to stocks from the same country as in Rouwenhorst (1998). For each of the three countries, we form the 'winner' and the 'loser' portfolios that contain stocks within the top and the bottom 10% of past returns, respectively, in each country. We reconstruct country momentum portfolios every 6 months and calculate monthly equally-weighted portfolio returns in each of the six months following formations. We also select the top 30 winner stocks from the winner deciles in each of the three countries and then form equally weighted portfolios. We form size portfolios for each country by sorting stocks based on their market capitalizations at the time of portfolio formation. For each of the three countries, we form the small size and

the big size portfolios that contain stocks with the smallest and largest 10% of market capitalizations, respectively, relative only to stocks from the same country. We re-construct size portfolios every 12 months and calculate monthly equally-weighted portfolio returns in each of the 12 months following formation. We also apply our methodologies to the 30 smallest size stocks from the small size deciles in each of the three countries and then form equally weighted portfolios.

Our predictive variables are the (lagged) return on the MSCI World index (occasionally abbreviated as the World index), which is our global market variable, and the lagged term spread which is defined as the difference in return between a 10 year and 1 year U.S. Treasury bond, which is our global term structure variable. The variables convey readily available information about global markets and have been used in a number of studies on international asset allocation and international asset pricing.

2.2 Methodology

Most of the existing literature on predictability and international asset allocation (Solnik (1993) for example) focuses on *'myopically optimal'* (conditionally efficient) strategies. In contrast, we focus here on *'dynamically optimal'*, i.e. unconditionally efficient strategies. While the portfolio weights of the former are determined on the basis of the conditional return moments, the latter are determined on the basis of unconditional moments and their weights are determined *ex-ante* as functions of the predictive instruments. In this sense, dynamically optimal strategies are truly actively managed, while myopically optimal strategies can be though of as sequences of one-step-ahead efficient *static* portfolios. Because dynamically optimal strategies are designed to be efficient with respect to their long-run unconditional moments, they display a more 'conservative' response to changes in the predictive instruments (Ferson and Siegel (2001)). This is an important consideration in particular with respect to transaction costs. Our unconditionally efficient strategies (also called optimal) may be thought of as tactical asset allocation strategies with a strategic objective and this strategic objective makes them theoretically optimal (Hansen and Richard (1987)). For the pure timing strategies with only one risk-free asset where unconditionally efficient strategies generally out-perform conditionally efficient strategies (Abhyankar, Basu and Stremme (2006)).

We first estimate a predictive regression

$$R_t - r_f e = \mu + \beta y_{t-1}^0 + \epsilon_t \tag{1}$$

where y_{t-1} is the vector of predictive instruments, in order to specify the conditional moments of returns The weights of any unconditionally efficient managed strategy

can then be written as be written as,

$$\theta^*_{t-1} = \frac{w - r^f_{t-1}}{1 + H^2_{t-1}} \cdot \Sigma^{-1}_{t-1} \, (\, \mu_{t-1} - r_f 1 \,). \tag{2}$$

From our predictive regression $\mu_{t-1} = \mu + \beta y^0_{t-1}$ and $\Sigma_{t-1} = \Sigma_\epsilon$ are the conditional (on y_{t-1}) mean vector and variance-covariance matrix of the base asset returns H_{t-1} is the conditional Sharpe ratio of the base assets, and w is a constant. By choosing w in (2) appropriately, we can construct efficient strategies that track a given target expected return or target volatility. In our empirical applications, we consider long only maximum-return strategies (designed to track a given target volatility), as unconstrained strategies that short either small stocks or past winner stocks are difficult to implement and incur very high transaction costs.

3 Results

As our focus is on the economic gains from return predictability, we study the out-of-sample performance of our strategies, as it is these strategies that can be implemented in practice. We first compare the out-of-sample performance of the various strategies and then analyze the return profiles as well as the dynamic portfolio weights and then compare the performance of our unconditionally efficient strategies to conditionally efficient strategies which have been the focus of earlier studies. We next analyze how the strategies work by comparing their performance to a dynamic strategy that times country benchmarks and finally we analyze how the strategies respond to changes in the predictive variables. Our target volatility is 15% in all cases except one where it is increased to 20%.

3.1 Comparison of Out-of-Sample Portfolio Performance

We study the out-of-sample properties of our strategies over the 1998-2004 period while the parameters are estimated over the 1980-1997 period. We first focus on the decile strategies starting with the size decile. From Table 1 we see that over the 1998-2004 period the U.S. smallest size decile had a mean return of 22.2% and a volatility of 16.4% leading to a high Sharpe ratio of 1.04, while the international size decile performs much better with a mean of 37.4%, a volatility of 15.9% leading to a higher Sharpe ratio of 1.83. From Table 2 we see that a fixed-weight long only maximum return strategy with a volatility target of 15% achieves a performance similar to the international decile with a mean of 29.9% and a volatility of 13.0% leading to a Sharpe ratio of 1.79. It has a low beta of 0.48 with the World index and a high alpha of

23.8%. The strategy using predictive variables performs better with a higher mean of 31.3% and a lower volatility of 11.6% leading to an improved Sharpe ratio of 2.09. It has a lower beta of 0.34 leading to a higher alpha of 25.7%. If we then move to the three country strategy involving the smallest size deciles, the difference between the fixed weight and optimal strategy becomes more pronounced. Panel B of Table 2 shows that the fixed-weight strategy has a mean of 16.2% and a volatility of 10.4% with a Sharpe ratio of 1.15, slightly better than the U.S. small decile. Our optimal strategy has a higher mean of 19.5%, a lower volatility of 9.0% leading to a higher Sharpe ratio of 1.63, which is the highest overall. It has an alpha of 14.6% compared to 11.0% for the fixed-weight strategy.

We next consider the momentum decile strategies starting with the decile of past winners for the U.S. and international stocks. From Table 1 we see that the U.S. decile of past winners has a mean of 30.6%, but a high volatility of 35.5% leading to a moderate Sharpe ratio of 0.67, while the international portfolio has a lower mean of 27.6% but a considerably lower volatility of 20.1% leading to a higher Sharpe ratio of 1.06. Table 3 shows that the fixed weight strategy with a target volatility of 15% again resembles the international decile portfolio with a mean of 25.5%, a volatility of 20.8% and a Sharpe ratio of 0.95. The optimally managed strategy with a target volatility of 15% has a higher mean of 29.0%, and almost achieves its target with a volatility of 16.8% leading to a considerably higher Sharpe ratio of 1.33. It has a lower beta of 0.64 compared to the fixed-weight strategy's 0.82, leading to a higher alpha of 22.2% compared to 18.2% for the fixed weight strategy. In the three country case the fixed-weight portfolio has a mean of 20.8%, a volatility of 18.2% with a Sharpe ratio of 0.87, higher than for the U.S. portfolio. Our optimal strategy achieves a higher mean of 22.9%, a slightly lower volatility of 17.4% with a higher Sharpe ratio of 1.01. The two strategies have similar betas but the optimal strategy has an alpha of 16.1% compared to 13.9% for the fixed-weight strategy.

There are thus substantial benefits for a U.S. fund manager to investing in international size and momentum strategies. This is due in part to the international strategies out-performing the U.S. strategies over this period, but also due to the return predictability in these portfolios. We see that for both size and momentum decile portfolios the strategies using predictive variables outperform the fixed weight strategies, and are the best performing strategies overall. The superior performance of the optimal strategies is driven by the predictability in the base assets which, as measured by regression R^2 (Table 1), are reasonable over this time period for the international portfolio particularly (13.4% for the size and 3.83% for the momentum portfolio) and this translates into economic gains as it allows for successful portfolio

timing. For the individual countries the U.K. portfolios have the highest R^2 (29.3% for the size and 8.1% for the momentum portfolios) and strategies based on timing the U.K. alone perform very well, with Sharpe ratios almost doubling for the size portfolios.

These strategies are however not likely to be feasible to implement as each decile portfolio has over a hundred stocks and our strategies require period-by-period rebalancing. We hence construct equally weighted portfolios of either the smallest or the top 30 past winner stocks for each decile, and study the performance of these strategies. We only consider U.S. stocks with price higher than \$5 and non-U.S. stocks with price higher than \$2 so the stocks we obtain are reasonably liquid. We first analyze the size portfolios. Table 1 shows that for the U.S. and international portfolio strategy the performance of the smallest 30 stock portfolios is not nearly as good as the decile portfolios with the U.S. portfolio having a mean of 12.1% and a volatility of 16.21% leading to a Sharpe ratio of 0.51 and the international portfolio having a mean of only 6.7% and a Sharpe ratio of 0.17. Table 4 shows that the fixed weight strategy has a mean of 10.4% with a volatility of 12.7% leading to a Sharpe ratio of 0.53. The optimal strategy performs considerably better with a mean of 14.9%, a volatility of 12.6% and a considerably higher Sharpe ratio of 0.85. The alpha of this strategy is also considerably higher at 10.4% compared to 6.0% for the fixed-weight strategy. Moving to the three country strategy the 30 stock country portfolio do not under-perform the decile portfolios by such a wide margin and the fixed weight strategy has a mean of 11.3%, a volatility of 8.4% leading to a Sharpe ratio of 0.89 comparable to the decile strategy. The optimal strategy again outperforms the fixed weight strategy with a higher mean of 16.25% and a slightly lower volatility leading to a considerably higher Sharpe ratio of 1.44. It also has a considerably higher alpha of 11.9% compared to 7.0% for the fixed weight strategy.

We now turn to the strategies based on the equally weighted portfolio of the winner stocks. The results for the U.S. and international portfolios are very similar to the decile portfolios. We use a target volatility of 20% to account for the more volatile base assets, and from Table 5 we see that the fixed weight strategy has a mean of 36.4% and a volatility of 32.0% leading to a Sharpe ratio of 0.88. The optimal strategy has a higher mean of 46.6%, a lower volatility of 26.6% and a Sharpe ratio of 1.34. The optimal strategy also has a considerably higher alpha of 38.3% compared to 27.4% for the fixed weight strategy. Finally, the results for the three country strategy are again similar to those for the decile portfolios. The target volatility is again 15% and the fixed weight strategy has a mean of 19.7% and a volatility of 16.4% with a Sharpe ratio of 0.91, while the optimal strategy has a higher mean of 24.1% and a

very similar volatility leading to a higher Sharpe ratio of 1.10.

We thus see that our optimal strategies continue to deliver high Sharpe ratios in this setting, even though some of the fixed-weight strategies have considerably lower Sharpe ratios compared to the decile portfolios. This shows that it is possible to carry out successful size and momentum timing strategies with a small number stocks, which should make it feasible to implement in practice.

3.2 Further Analysis of the Strategies

In order to analyze what the strategies are doing we turn to their time-series of returns, as well as their weights. Figure 1 analyzes the size decile strategies and in Panel (A) we see that investing in the international portfolio has significant benefits for a U.S investor, both in the fixed-weight and optimal setting as the cumulative returns of these strategies far exceeds that of the U.S. portfolio. The optimal strategy which has a higher return and lower volatility focuses on timing the international portfolio particularly over the 1998-2002 period. The bottom graph of Panel (A) shows the returns of the strategy relative to the U.S. portfolio and we see that our strategy has a much smoother return profile and avoids sharp losses. From Panel (B) of Figure 1 we see that the returns to the three country portfolio are lower, but the optimal strategy outperforms the fixed-weight strategy by a wider margin and has considerably lower volatility than the U.S. portfolio. There is a considerable amount of 'spread' trading between the three country portfolios as well as the risk-free asset which exploits the time-variation in expected returns between the portfolios as well as the differences in volatility and leads to it outperforming the fixed-weight portfolio.

The findings are quite similar for the momentum decile portfolios. The top diagram of Panel (A) of Figure 2 shows that the optimal U.S. and international portfolio outperforms both its fixed weight counterpart and again mainly times the international portfolio. The return profile of the optimal strategy is significantly smoother than the U.S. top decile portfolio avoiding sharp movements in either direction. From Panel (B) we see that the cumulative returns of the optimal three country strategy are very close to that of the U.S., but with significantly lower volatility. The optimal portfolio takes opposite positions in the U.K. and Germany while keeping the weight in the U.S. almost constant.

For the strategies involving the equally weighted portfolios of 30 smallest stocks or 30 past winners, we compute the cumulative return on the optimal strategy net of transaction costs which are assumed to be 50 basis points a transaction. This is a reasonable level of transaction costs for a large fund manager who is capable of large block trades in individual stocks. From Figure 3 we see that even net of transaction

costs both sets of optimal strategies for the size portfolios achieve higher cumulative returns than either the fixed-weight or U.S. portfolio. They appear to capture much of the gains in the underlying U.S. portfolio and avoid the losses. The difference in return between the optimal and U.S. portfolio is most pronounced for the optimal portfolio involving the top 30 U.S. and international winners (Panel (A) of Figure 4), and in addition it has a much smoother return profile than the U.S. portfolio which is extremely volatile. The optimal three country portfolio net of transaction costs has a cumulative return almost identical to the fixed-weight strategy (Panel (B) of Figure 4). While the cumulative return on the optimal portfolio is significantly lower than that on the U.S. portfolio, it is significantly less volatile than the U.S. portfolio. There is spread trading between all of the assets, including the risk-free asset. It thus seems that there are substantial gains to be made, even net of transaction costs, from these strategies which are feasible to implement.

3.3 Comparison with Conditionally Efficient Strategies

Our unconditionally efficient strategies which optimize with respect to unconditional moments and are conditionally efficient. However conditionally efficient strategies which optimize with respect to conditional moments are not necessarily unconditionally efficient (Hansen and Richard (1987)). In this setting we investigate whether our unconditionally efficient strategies do out-perform conditionally efficient strategies, which have been the focus of earlier research in this area (Solnik (1993)). The performance of the conditionally efficient strategies are shown in the third column of Tables 2 and 3 and we see that their performance resembles that of the fixed-weight strategies with their Sharpe ratios uniformly lower than that of the unconditionally efficient strategies, and in some cases lower than the fixed weight strategies. An investor utilizing conditionally efficient strategies would thus not have seen any economic gains from return predictability. The lower Sharpe ratios are due to conditionally efficient strategies exhibiting higher volatility which is due to their greater sensitivity to changes in the values of the predictive variables. Unconditionally efficient strategies in contrast exhibit a 'conservative' response to extreme values of the predictive variable and tend to move into the risk-free asset, which results in these strategies having lower volatility. We find that this conservative response does have economic value as unconditionally efficient strategies achieve mean returns as high, and sometimes higher than the fixed weight or conditionally efficient strategies while having uniformly lower volatility. The unconditionally efficient strategies thus are the ones that allow us to realize the economic gains from return predictability.

3.4 Comparison With Dynamically Managed Country Indices

Our results may be attributed to the ability to time various risky asset portfolios successfully. It is natural to ask whether this performance could be achieved by timing passive country indices alone, in the spirit of Ferson and Schadt (1996). To that end we construct a dynamically managed portfolio of the U.S., U.K. and German country indices with the term spread and the World index as predictor variables over the 1998-2004 period and measure the performance of our strategies relative to it. This dynamically managed strategy has a mean of 14.3% and a Sharpe ratio of 0.69. The dynamic management does add some value relative to the World index as this portfolio has a alpha of 8.21%. Our strategies relative to this benchmark have alphas very similar to that using the World index as a benchmark as they have lower betas relative to the dynamically managed benchmark. This shows that the active management in our strategies is very different from timing the various country indices, and thus their performance cannot be replicated by managing passive benchmarks. The active management in these strategies does add value and thus should be of interest to fund managers employing global tactical asset allocation strategies.

3.5 How Do The Strategies Work ?

We finally analyze how the strategies respond to changes in the predictive variables. We focus on the strategies using equally weighted portfolios of 30 smallest stocks or past winners, as these are more likely to be implemented by fund managers. We first compute the correlations between the portfolio weights and the predictive variables over the out-of-sample period. We find that the portfolio weights are more highly correlated overall with changes in the return on the World index rather than the return on the World index, and hence we report correlations with changes in the return on the World index and term spread in Table 6. For the size strategy with the US and international portfolios the correlation between the weight on the US and the changes in the return on the World index (DWorld) is -0.58 and between the international and DWorld is 0.45. The weights on these two assets thus respond in opposite fashion to changes in the return on the World index while they both have positive correlation with the term spread and the two predictive variables thus lead to different behavior in the weights. For the three country portfolio DWorld is negatively correlated with the weights on the US and the UK and is positively correlated with the weight on Germany. All three country weights are positively correlated with the term spread. It appears that the superior performance of these size strategies is driven

by the differing responses to the various risky asset weights to changes in the return on the World index.

For the momentum portfolios the results are somewhat different. For the strategy with the US and international portfolio, the best performing strategy overall, the weight on the US portfolio has low negative correlation with changes in the World index and high negative correlation with the term spread. The weight on the international portfolio which has far greater variability is negatively correlated with DWorld and positively with term spread. The weight on the international portfolio together with the returns on DWorld and term spread are shown in Figure 5, which provides further evidence of the negative correlation with DWorld and positive correlation with term spread. The performance of this strategy is largely due to the successful timing of the international portfolio and both the lagged World index and lagged term spread play a role in this timing. For the three country portfolio the weights on the US and the UK are negatively correlated with DWorld while the weight on Germany is positively correlated with it. The US weight is negatively correlated with the term spread while the UK and German weights are positively correlated and the magnitude of these correlations are lower than those for DWorld.

Finally, the nature of the weights is very different for the two predictive variables. When we use term spread alone as the predictive instrument the average one period change in weights for the momentum strategy based on the US and international equally weighted portfolios is 3.7% for the international portfolio. In contrast, using the World index alone for this strategy leads to an average one period change of 29.6% on the international portfolio. The strategy utilizing both predictive variables performs best overall, and this may be attributed to the combination of 'timing' due to the World index and 'smoothing' due to the term spread.

4 Conclusion

In this paper, we show that there are substantial benefits for a U.S. fund manager to dynamically investing in international size and momentum portfolios. The benefits come from both the better performance of international strategies than the U.S. strategies and the ability in utilizing the return predictability for timing these strategies. We construct unconditionally efficient allocation strategies that exploit return predictability in timing international size and momentum portfolios.

We first consider the optimal strategy that dynamically allocate portfolio weights between the international (G8 excluding the U.S.) and U.S. smallest size deciles and the risk-free asset. The optimal strategy has the lowest overall volatility and achieves

a higher Sharpe ratio of 2.09 and a higher alpha than the decile portfolios and the fixed-weight strategy. The optimal strategy that allocates weights across the smallest size decile portfolios in the U.S., the U.K. and Germany achieves the highest Sharpe ratio of 1.63 and alpha of 14.6% among all size portfolios and the fixed-weight strategy. We next consider unconditionally efficient dynamic allocation based on the equally weighted portfolio of the smallest 30 stocks that is practically feasible for implementation. The optimal strategy based on the international and U.S. smallest 30 stocks outperforms the base assets and the fixed-weight strategy by a wide margin than for the decile portfolios. The cumulative return on the optimal strategy net of transaction costs is higher than those of the U.S. and the fixed-weight strategy while avoiding the losses. The optimal strategy that allocates across the international and U.S. equally weighted portfolios of the top 30 winner stocks achieves the highest net cumulative return and is much less volatile than the U.S. portfolio. The unconditionally efficient strategies reward comparable returns to the investment assets while exhibit lower volatility than conditionally efficient strategies and thus lead to better performance in capturing economic gains from return predictability.

Finally we show that our active management in size and momentum portfolios is very different from those strategies that time country indices. The performance of the optimal strategies cannot be achieved by dynamically managing passive benchmarks. The active management in these strategies does add value and thus should be of interest to fund managers employing global tactical asset allocation strategies.

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	Mean	Vol	SR	TS	WD	R^2
Panel A: Equally Weighted Smallest Size Decile						
Int:	37.40	15.05	1.83	0.94	0.25	13.40
U.S.:	22.20	16.43	1.03	0.48	0.25	7.91
UK:	11.07	9.56	0.76	0.79	0.24	29.29
DE:	27.10	16.47	1.27	0.48	0.02	1.50
Panel B: Equally Weighted Portfolio of Smallest 30 Stocks						
Int:	6.68	16.90	0.19	0.50	-0.03	1.55
U.S.:	12.08	16.21	0.50	0.60	0.22	7.74
UK:	12.61	10.53	0.82	0.90	0.24	27.22
DE:	35.53	19.45	1.42	0.47	0.02	1.06
Panel C: Equally Weighted Past Winner Decile						
Int:	27.58	20.09	1.06	0.53	0.19	3.83
U.S.:	30.58	35.49	0.67	0.33	0.12	0.47
UK:	19.11	14.80	0.97	0.46	0.22	8.06
DE:	24.32	22.82	0.82	0.19	-0.00	0.12
Panel D: Equally Weighted Portfolio of 30 Past Winners						
Int:	33.95	33.78	0.78	0.94	0.33	4.12
U.S.:	53.93	52.38	0.78	0.20	0.18	0.35
UK:	20.26	19.18	0.80	0.50	0.27	7.02
DE:	31.50	27.77	0.88	0.31	-0.04	0.25

Table 1: Performance of Size and Momentum Base Asset Portfolios

In this table we provide the summary statistics for our base assets over the 1998-2004 period. We report mean and volatility in percent per year, Sharpe ratios, the betas with respect to the term spread (TS) and the World index (WD) in the predictive regression (1 in Sec 2.2) of the base assets on these lagged variables, as well as the R^2 of this regression. The base assets are described in Sec 2.1.

	Fixed-Weight	Optimal	Conditionally Efficient
Panel A: U.S. and International Size Deciles			
Mean:	29.90%	31.29%	29.14%
Volatility:	12.97%	11.63%	12.62%
Sharpe Ratio:	1.79	2.09	1.79
World Beta:	0.48	0.34	0.43
Alpha:	23.79%	25.69%	23.25%
Panel B: U.S., U.K. and German Size Deciles			
Mean:	16.24%	19.49%	18.33%
Volatility:	10.37%	9.01%	11.51%
Sharpe Ratio:	1.15	1.63	1.19
World Beta:	0.40	0.29	0.40
Alpha:	11.03%	14.55%	13.03%

Table 2: Out of Sample Performance of Strategies Based on Size Decile Portfolios

In this table we provide the performance statistics for out of sample portfolio strategies using size decile portfolios as the base assets. The out of sample period is 1998-2004 and the model is estimated over the 1980-1997 period. The fixed weight strategies are static long only maximum return portfolios while 'Optimal' denotes unconditionally efficient long only dynamic minimum variance portfolios. The base assets in Panel (A) are the U.S. and international (G8 without U.S.) decile of smallest size firms, while in Panel (B) it is the decile of smallest firms for the U.S., U.K. and Germany. The alphas and betas of the strategies are computed relative to the MSCI World index and the alpha as the mean return, volatility and Sharpe ratio are all annualized. The predictive instruments are the term spread and the World index. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.

	Fixed-Weight	Optimal	Conditionally Efficient
Panel A: U.S. and International Momentum Deciles			
Mean:	25.52%	28.95%	29.68%
Volatility:	20.81%	16.81%	24.24%
Sharpe Ratio:	0.95	1.34	0.95
World Beta:	0.82	0.64	0.89
Alpha:	18.20%	22.18%	21.85%
Panel B: U.S., U.K. and German Momentum Deciles			
Mean:	20.77%	22.90%	20.83%
Volatility:	18.18%	17.39%	23.14%
Sharpe Ratio:	0.87	1.01	0.68
World Beta:	0.78	0.72	0.91
Alpha:	13.87%	16.13%	13.40%

Table 3: Out of Sample Performance of Strategies Based on Momentum Decile Portfolios

In this table we provide the performance statistics for out of sample portfolio strategies using past winners decile portfolios as the base assets. The out of sample period is 1998-2004 and the model is estimated over the 1980-1997 period. The fixed weight strategies are static long only maximum return portfolios while 'Optimal' denotes unconditionally efficient long only dynamic minimum variance portfolios. The base assets in Panel (A) are the U.S. and international (G8 without U.S.) decile of past winners, while in Panel (B) it is the decile of past winners for the U. S., U.K. and Germany. The alphas and betas of the strategies are computed relative to the MSCI World index and the alpha as the mean return, volatility and Sharpe ratio are all annualized. The predictive instruments are the term spread and the World index. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.

	Fixed-Weight	Optimal	Conditionally Efficient
Panel A: Equally Weighted Portfolios of Smallest 30 U.S. and International Stocks			
Mean:	10.36%	14.90%	11.42%
Volatility:	12.74%	12.55%	12.80%
Sharpe Ratio:	0.53	0.85	0.60
World Beta:	0.24	0.22	0.30
Alpha:	5.95%	10.38%	6.75%
Panel B: Equally Weighted Portfolios of 30 Smallest U.S., U.K. and German Stocks			
Mean:	11.27%	16.25%	14.37%
Volatility:	8.35%	8.28%	8.90%
Sharpe Ratio:	0.89	1.43	1.15
World Beta:	0.21	0.17	0.21
Alpha:	6.95%	11.89%	9.92%

Table 4: Out of Sample Performance of Equally Weighted Portfolios Based on 30 Smallest Stocks

In this table we provide the performance statistics for out of sample portfolio strategies using equally weighted portfolios of the 30 smallest stocks as the base assets. The out of sample period is 1998-2004 and the model is estimated over the 1980-1997 period. The fixed weight strategies are static long only maximum return portfolios while 'Optimal' denotes unconditionally efficient long only dynamic minimum variance portfolios. The base assets in Panel (A) are thee U.S. and international equally weighted portfolios, while in Panel (B) it is the equally weighted portfolio for the U.S., U.K. and Germany. The alphas and betas of the strategies are computed relative to the MSCI World index and the alpha as the mean return, volatility and Sharpe ratio are all annualized. The predictive instruments are the term spread and the World index. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.

	Fixed-Weight	Optimal	Conditionally Efficient
Panel A: Equally Weighted Portfolio of Top 30 U.S. and International Past Winner Stocks			
Mean:	36.42%	46.56%	52.73%
Volatility:	32.03%	26.58%	36.27%
Sharpe Ratio:	0.88	1.34	1.10
World Beta:	1.09	0.80	1.16
Alpha:	27.35%	38.25%	42.30%
Panel B: Equally Weighted Portfolio of Top 30 U.S., U.K. and German Past Winner Stocks			
Mean:	24.33%	27.51%	26.14%
Volatility:	20.54%	19.86%	26.32%
Sharpe Ratio:	0.91	1.07	0.77
World Beta:	0.78	0.69	0.89
Alpha:	17.25%	20.60%	18.50%

Table 5: Out of Sample Performance of Strategies Based on Equally Weighted Portfolios of 30 Past Winners

In this table we provide the performance statistics for out of sample portfolio strategies using equally weighted portfolios of the 30 stocks with highest 6 month past return as the base assets. The out of sample period is 1998-2004 and the model is estimated over the 1980-1997 period. The fixed weight strategies are static long only maximum return portfolios while 'Optimal' denotes unconditionally efficient long only dynamic minimum variance portfolios. The base assets in Panel (A) are thee U.S. and international equally weighted portfolios, while in Panel (B) it is the equally weighted portfolio for the U.S., U.K. and Germany. The alphas and betas of the strategies are computed relative to the MSCI World index and the alpha as the mean return, volatility and Sharpe ratio are all annualized. The predictive instruments are the term spread and the World index. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.

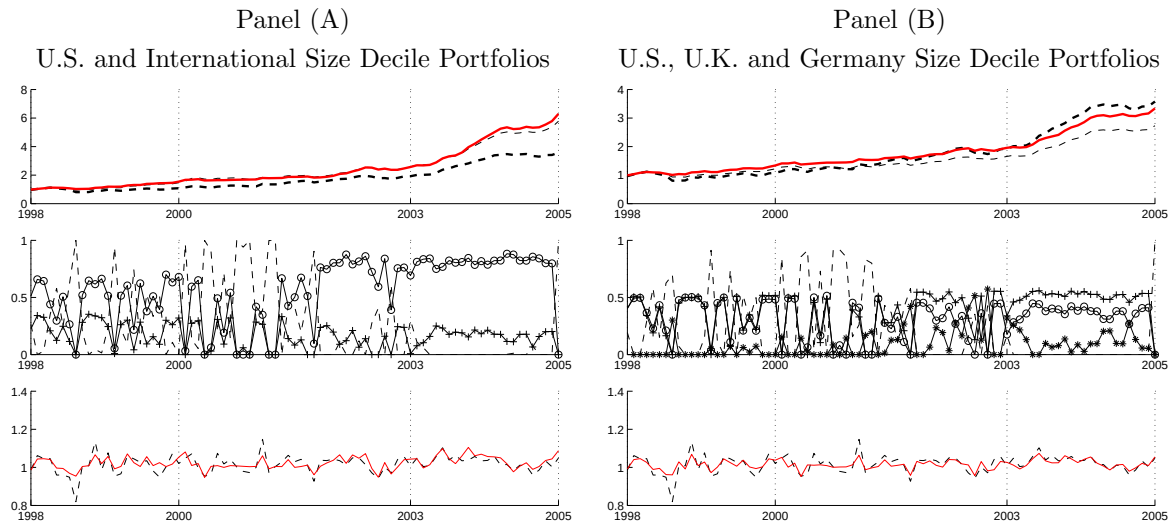

Figure 1: Out of Sample Performance of Strategies Based on the Smallest Size Decile

In this figure we show the out-of-sample performance of long-only unconditionally efficient maximum-return strategies using the equally weighted decile of smallest size firms. In Panel (A) we consider the U.S. and G8 without the U.S. (International) and in Panel (B) we consider the U.S., U.K. and Germany. The solid line in the top part of Panel (A) and (B) shows the cumulative return of the unconditionally efficient strategy, the light dotted line is the cumulative return of the fixed weight strategy and the heavy dotted line is the cumulative return on the U.S. size decile. The middle graph in Panel (A) shows the weight on the G7 ($\circ$), on the U.S. ($+$) and that on the risk free asset (dotted line), while in Panel (B) the circles represent the weight on the U.S., the plus signs the weight on the U.K. and the stars the weight on Germany. The bottom graph in both panels compares the return on the optimal strategy (solid line) to that of the U.S. portfolio (dotted line). The predictive instruments are the term spread and the return on the World index. The model is estimated over the 1980-1997 period and the out-of-sample period is 1998-2004. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.

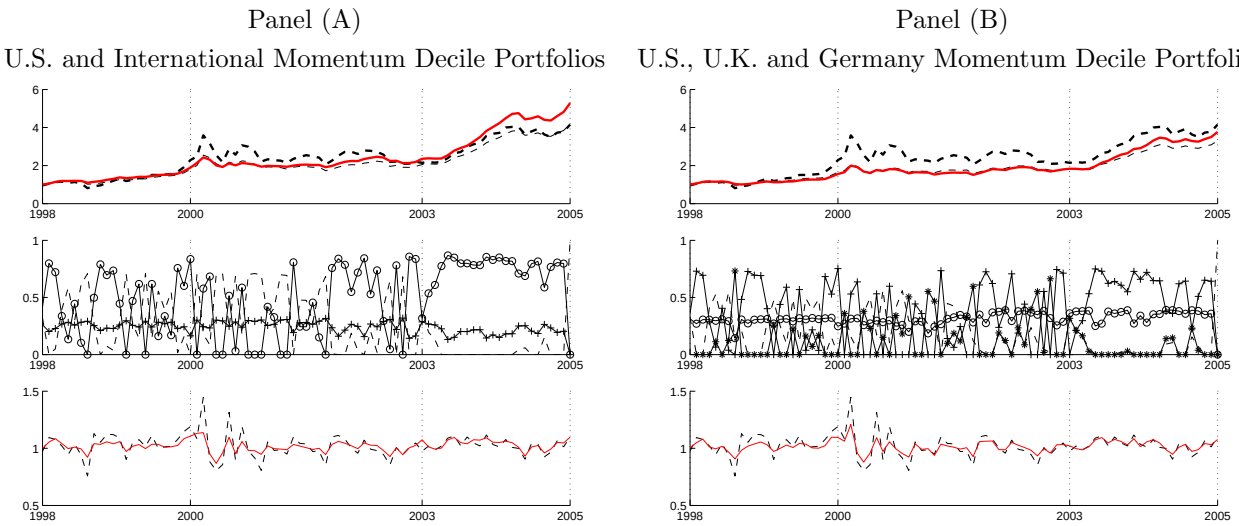

Figure 2: Out of Sample Performance of Strategies Based on Momentum Decile Portfolios

In this figure we show the out-of-sample performance of long-only unconditionally efficient maximum-return strategies using the equally weighted decile of past winners, re-balanced every six months. In Panel (A) we consider the U.S. and G8 without the U.S. (International) and in Panel (B) we consider the U.S., U.K. and Germany. The solid line in the top part of Panel (A) and (B) shows the cumulative return of the unconditionally efficient strategy, the light dotted line is the cumulative return of the fixed weight strategy and the heavy dotted line is the cumulative return on the U.S. size decile. The middle graph in Panel (A) shows the weight on the G7 ($\circ$), on the U.S. ($+$) and that on the risk free asset (dotted line), while in Panel (B) the circles represent the weight on the U.S., the plus signs the weight on the U.K. and the stars the weight on Germany. The bottom graph in both panels compares the return on the optimal strategy (solid line) to that of the U.S. portfolio (dotted line). The predictive instruments are the term spread and the return on the World index. The model is estimated over the 1980-1997 period and the out-of-sample period is 1998-2004. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.

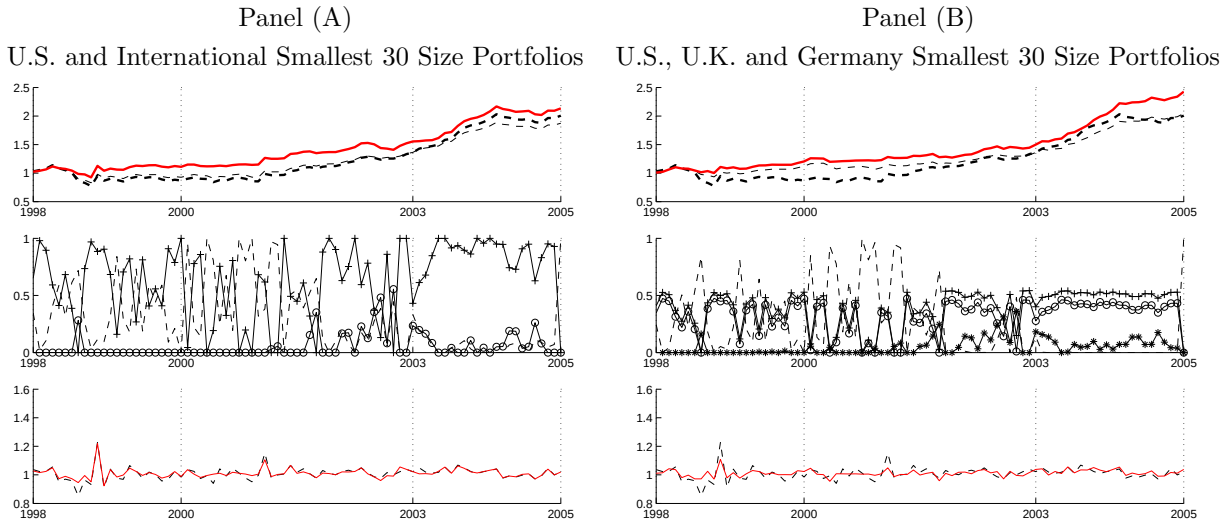

Figure 3: Out of Sample Performance of Strategies Based on 30 Smallest Stocks

In this figure we show the out-of-sample performance of long-only unconditionally efficient maximum-return strategies using the equally weighted portfolio of 30 smallest stocks, re-balanced yearly. In Panel (A) we consider the U.S. and G8 without the U.S. (International) and in Panel (B) we consider the U.S., U.K. and Germany. The solid line in the top part of Panel (A) and (B) shows the cumulative return of the unconditionally efficient strategy net of transaction costs, the light dotted line is the cumulative return of the fixed weight strategy and the heavy dotted line is the cumulative return on the U.S. size decile. The middle graph in Panel (A) shows the weight on the G7 ($\circ$), on the U.S. ($+$) and that on the risk free asset (dotted line), while in Panel (B) the circles represent the weight on the U.S., the plus signs the weight on the U.K. and the stars the weight on Germany. The bottom graph in both panels compares the return on the optimal strategy (solid line) to that of the U.S. portfolio (dotted line). The predictive instruments are the term spread and the return on the World index. The model is estimated over the 1980-1997 period and the out-of-sample period is 1998-2004. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.

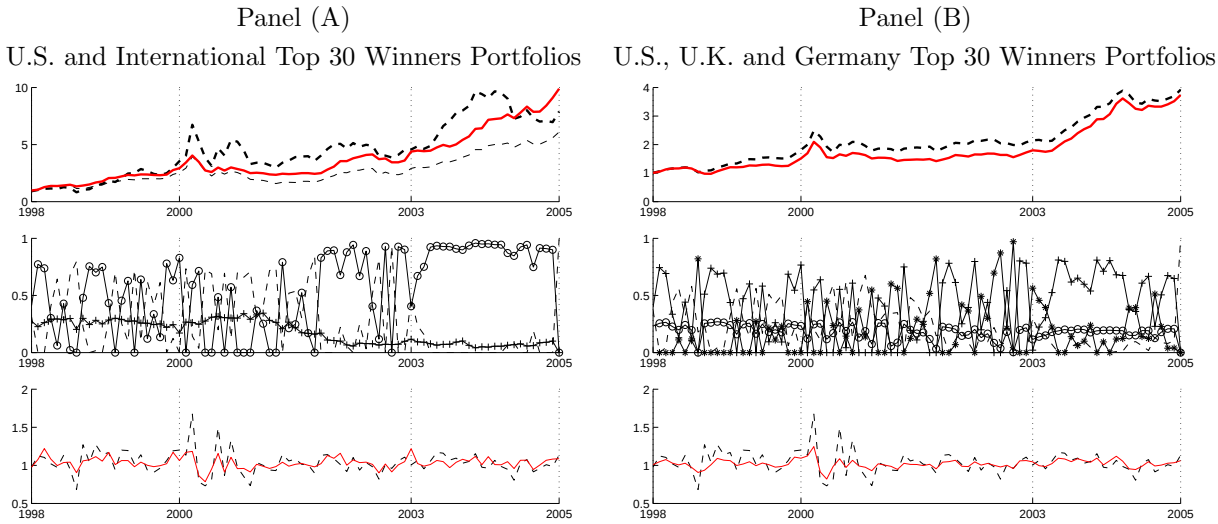

Figure 4: Out of Sample Performance of Strategies Based on 30 Past Winners

In this figure we show the out-of-sample performance of long-only unconditionally efficient maximum-return strategies using the equally weighted portfolio of top 30 past winner stocks, re-balanced every six months. In Panel (A) we consider the U.S. and G8 without the U.S. (International) and in Panel (B) we consider the U.S., U.K. and Germany. The solid line in the top part of Panel (A) and (B) shows the cumulative return of the unconditionally efficient strategy net of transaction costs, the light dotted line is the cumulative return of the fixed weight strategy and the heavy dotted line is the cumulative return on the U.S. size decile. The middle graph in Panel (A) shows the weight on the G7 ($\circ$), on the U.S. ($+$) and that on the risk free asset (dotted line), while in Panel (B) the circles represent the weight on the U.S., the plus signs the weight on the U.K. and the stars the weight on Germany. The bottom graph in both panels compares the return on the optimal strategy (solid line) to that of the U.S. portfolio (dotted line). The predictive instruments are the term spread and the return on the World index. The model is estimated over the 1980-1997 period and the out-of-sample period is 1998-2004. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.

	DWorld	Term Spread
Panel A: Equally Weighted Portfolio of Smallest 30 U.S. and International Stocks		
Int:	0.452	0.431
U.S.:	-0.580	0.397
Panel B: Equally Weighted Portfolio of Smallest 30 U.S., U.K. and German Stocks		
U.S.:	-0.606	0.290
UK:	-0.554	0.433
Ger.:	0.472	0.512
Panel C: Equally Weighted Portfolio of Top 30 International and U.S. Past Winner Stocks		
Int:	-0.430	0.654
U.S.:	-0.038	-0.976
Panel D: Equally Weighted Portfolio of Top 30 U.S., U.K. and German Past Winner Stocks		
U.S.:	-0.637	-0.277
UK:	-0.538	0.283
Ger.:	0.629	0.205

Table 6: Correlations Between Strategies Based on 30 Smallest Stocks and Past Winners and Predictive Instruments

In this table we provide the correlations for our out of sample portfolio strategy weights with the predictive instruments. The base assets are the equally weighted portfolios of the 30 smallest stocks as well as the 30 stocks with highest 6 month past return. The out of sample period is 1998-2004 and the model is estimated over the 1980-1997 period. The correlations are calculated with the changes in the MSCI World index (DWorld) and the term spread. The base assets in Panels (A) and (C) are the equally weighted portfolios for the U.S. and the G8 countries without the U.S. (International) while in Panels (B) and (D) we consider equally weighted portfolios for the U.S., U.K. and Germany. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.

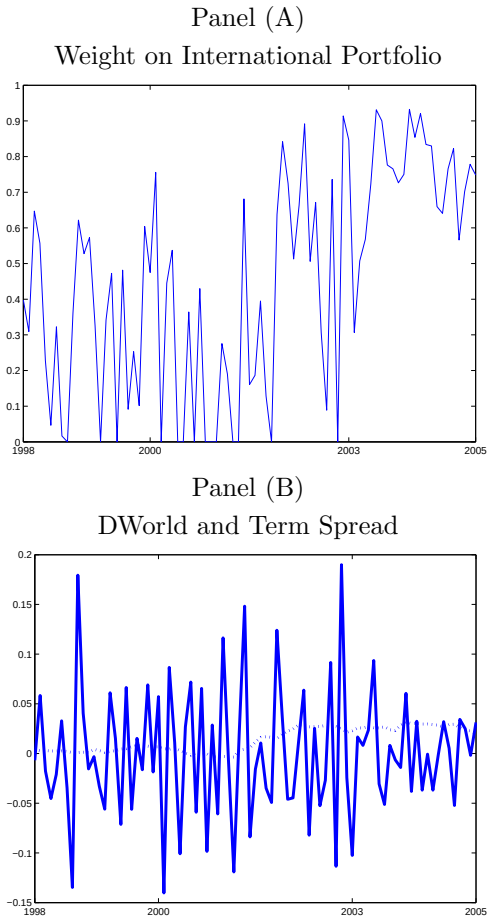

Figure 5: Out of Sample Performance of Strategies Based on the 30 Past Winners

The top panel of this figure shows the time-series of the weight on the International (G8 without the U.S.) equally weighted portfolio of 30 largest past winners over the 1998-2004 out-of-sample period. The lower panel shows the time series of the changes in the World index, DWorld, (solid line) and the term spread (dotted line) over the same period. The model is estimated over the 1980-1997 period and the out-of-sample period is 1998-2004. The construction of the base assets is in Section 2.1 and the details of the strategy are all given in Section 2.2.