Long-Term Time Series Reversal: International Evidence

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Abstract

This paper is the first to examine the relationship between the long-term past performance and the expected equity returns for MSCI developed country indices using a time-series approach. Extending the recent findings on the short-term "time-series" momentum effect, the evidence indicates that returns following extreme low past long-term performance history tend to outperform those following extreme high past long-term returns. The positive excess returns manifest the long-term "time-series reversal" (TSR) effect. Strategies based on this effect provide persistent superior risk-adjusted returns for up to two years. A diversified country-average portfolio limits downside risk and predicts financial crises with an average lead-time of four months.

1. Introduction

The predictability of equity returns based on the information content of the past performance continues to provide a challenge to the traditional asset pricing literature. Simply buying and selling equity securities based on their past returns provides persistent abnormal profits, which are difficult to explain using the standard risk benchmarks.

In this paper, we document that the long-term past performance is able to predict expected returns across numerous international equity indices while solely considering the individual return time-series. We provide evidence for the reversal in international index returns, subsequent to extreme long-term high and low returns for up to 24 months after the event. The negative predictability from the security's own past returns is evident across the many of Morgan Stanley Capital International (MSCI) developed market indices. A contrarian strategy buying long (selling short) those indices with their lowest (highest) prior performance generate anomalous risk-adjusted returns which are unexplained by the traditional asset pricing models. We find that the long-term time-series reversal (TSR) effect is robust across a number of individual country indices and the country-average, as well as various formation and holding periods examined. A striking finding is that the occurrence of extreme long-term low past performances across all developed markets can predict global equity market shocks by an average lead time of 4 months.

The most prominent approach to predict future returns based on the past performance focuses on cross-sectional returns over short- and long-term horizons. These securities' returns are sorted based on their relative performance history in the cross-section across short-term and long-term horizons, the momentum and the reversal effect. Momentum strategies show the tendency of relative short-term winners to continue to outperform relative short-term losers (Jegadeesh & Titman, 1993, 2001). Ample evidence confirms the robustness of momentum profits across time, countries, industry portfolios and divers asset classes (Chan, Hamao, & Lakonishok, 1991; Jegadeesh & Titman, 1993; Chan, Jegadeesh, & Lakonishok, 1996; Rouwenhorst, 1998; Jegadeesh & Titman, 2001; Asness, Moskowitz, & Pedersen, 2013). DeBondt and Thaler (1985, 1987) find evidence of return reversal based on the long-term, extreme relative performance history, 3-5 years. This study shows that the outperformance of long-term losers over long-term winners drives the reversal benefits and the long-run cross-sectional predictability. This cross-sectional mean-reversion effect is found in individual US stocks and international equity indices (Richards, 1997;

Balvers, Wu, & Gilliland, 2000; Balvers & Wu, 2006). The persistent profitability of simple strategies exploiting the short-term momentum and long-term reversal effects has been widely accepted alongside the susceptibility of cross-sectional momentum strategies to a large downwards risk in bear markets (Daniel & Moskowitz, 2013; Barroso & Santa-Clara, 2015).

Recent empirical studies of Moskowitz, Ooi, and Pedersen (2012) and Antonacci (2014) present evidence of similar anomalous short-term excess returns resulting from time-series momentum (TSMOM) considerations across numerous future markets. The time-series trading signal involves buying or shorting an asset class solely based on its own recent positive (negative) excess return performance, named absolute return (Antonacci, 2014). The extreme winner/loser performance benchmarks applied in the cross-sectional approach are replaced by a zero-excess return benchmark in the time-series approach. A time-series momentum based strategy is consistently profitable across asset classes and future markets, such as equity index, fixed income, commodity and currencies, and is back-tested to the start of the last century[1]. In addition, these strategies tend to perform well in extreme markets and limit the bear market left-tail downside risk (Antonacci, 2014). By far the majority of these studies have concentrated on the analysis of the short-term intertemporal dynamics. Thus, the recent literature does not offer a comprehensive analysis of the existence or lack of the long-term time-series effect and its contribution to the long-horizon time-series predictability. To better understand the complexity of the time-series predictability, research needs to investigate whether and how long-term past returns affect future returns.

The purpose of this paper is to examine the implication of an investment strategy that considers long-term extreme past performance within its own time-series. Specifically, the extent to which such return history predicts future equity indices' returns. Although previous studies by Moskowitz et al. (2012) and He and Li (2015) note partial reversal movements of the positive time-series trend beyond 12 months, Goyal and Jegadeesh (2015) do not find significant reversing pattern. Similar to the prominent phenomenon of cross-sectional reversal by DeBondt and Thaler (1985, 1987), the time-series reversal provides us with the performance of a contrarian strategy applied to extreme long-term past returns. However, unlike the cross-sectional approach, these

[1] See Antonacci (2014), Baltas and Kosowski (2012), Chevallier and Ielpo (2014), He and Li (2015), Hurst, Ooi, and Pedersen (2012), Moskowitz et al. (2012).

returns are measured based on its own past performance history through time as benchmark for the long and short position. We examine the effect and its performance on international MSCI developed market indices using the reversal method similar to the time-series aspect discussed in Moskowitz et al. (2012). This approach ranks the complete history of the indices own long-term returns over different formation periods and forms extreme high (*HI*) and low (*LO*) portfolios with the monthly subsequent returns.

This paper documents significant positive differences between the returns following low long-term past performance and the monthly returns following high past performances. For example, monthly returns that follow an extreme low long-term performance tend to outperform those subsequent to extreme high past performance. Specifically, following 60-months formation periods the return difference in the first year amounts to 16.67%. To evaluate profitability of the time-series return effect, we investigate the TSR when used in investable contrarian trading strategies. The long-term TSR signal triggers a long and short position in a stock index based on their extreme low or high long-term past returns. This method is applied at the individual index level and aggregated to a country-average return. The analysis documents positive risk-adjusted strategy results and abnormal unexplained returns. Using the long-term TSR effect provides the potential to limit downside risk exposure when used as a market timing strategy.

Note that the long-term time-series reversal effect is related to, but significantly different from the cross-sectional concept of mean-reversion to a fundamental value. The aim of this paper is not to discriminate between market inefficiency and changing equilibrium-required returns. Thus, it does not test for the cause of the time-series reversal effect, but empirically identifies its existence, persistence and profitability of the TSR effect.

In summary, this paper provides evidence that the majority of international equity markets indices show long-term TSR effects. The robust findings across various formation and holding periods imply that investors can use the long-run TSR effect in an active trading strategy to generate superior returns. The persistence of abnormal returns cannot be explained by the global market risk exposure. Similar to the time-series momentum effect, we also find that the TSR strategies exhibit reduced drawdown risk as they reveal and avoid shocks across the global equity markets with an average lead-time of 4 months.

These findings contribute to the current literature on the time-series predictability discussion as follows. First, this paper extends the understanding of the time-series properties in the existing literature beyond the short-term horizon (Moskowitz et al., 2012; Antonacci, 2014; He & Li, 2015). Second, the findings indicate that the long-term performance may be an important consideration for explaining idiosyncratic return variations. Third, the results of this paper may benefit the investment practice to maximise the managed funds performance while managing the downside risk exposure. These benefits and forecasts are of particular importance to the future-oriented investment decision-making process of institutional investors, portfolio and superannuation managers, individual investors and the wider finance industry.

The rest of the paper is organised as follows. Section 2 describes the data. Section 3 describes the methodology used on the long-term TSR defining the extreme portfolios, the formation periods and the contrarian approach used to evaluate the profitability of each strategy. Section 4 reports the empirical results and the evidence of the long-term times-series reversal and its profitability benefits. Section 5 concludes and summarises the key findings.

2. Data

The data comprising monthly total returns for 18 MSCI developed market equity indices denoted in US dollar terms is obtained from *Datastream*. The sample contains 555 monthly returns spanning a period of 46 years and 3 months between January 1970 and March 2016. The monthly market returns for each country are based on reinvesting the gross dividend converted into US dollars.

To evaluate the strategy results with standard asset pricing benchmarks, data for the MSCI value (*V*) and growth (*G*) style indices as well as for the MSCI World index (*WI*) are downloaded from Datastream. The Fama-French size (*SMB*) and book-to-market value (*HML*) factors, together with the monthly US Treasury bill yield and the Centre of Research in Security Prices (CRSP) value-weighted market index (*VW*) of all US stocks are retrieved from the Kenneth French

website[2]. The summary statistics in Table 1 provide an overview of the characteristics of each equity index as well as the average data across all 18 countries.

[Table 1 here]

3. Methodology

Unlike the approach by DeBondt and Thaler (1985), this study examines the *time-series* long-term return reversal effect in the individual time-series of country index returns. This section presents the following: (i) the definition of time-series reversal, (ii) the methods used to identify reversal patterns within and across country indices, and (iii) the risk-adjustment procedures adopted.

3.1. Time-series reversal

In contrast to the cross-sectional approach where stocks are classified into the extreme past losers and past winners portfolios based on their recent 3-5 year performances *relative to their peers* (DeBondt and Thaler, 1985, 1987), the univariate time-series reversal approach examines the asset's return behaviour based on its own prior extreme low and high long-term past returns. We investigate whether past extreme long-term performances tend to reverse.

To classify an asset's past performance, we employ *J*-month formation periods for $J = 48$, 60 and 72 months. These three lengths are selected because they are centered at five years, and five years is frequently used in cross-sectional studies (Asness et al., 2013). Consequently, we regard the $J = 60$ as our base case, and include the other lengths for robustness purposes. At the end of each month *t,* its most-recent *J*-month compound return is classified as low (*LO*) or high (*HI*), based on the entire sample of rolling *J*-month returns for that country index. The entire sample produces 508 rolling 48-month formation periods, 496 rolling 60-month formation periods and 484 rolling 72-month formation periods. An index's *J*-month returns are classified as *LO* if they are amongst the lowest 25% of all the *J*-month returns for that asset in the sample. Similarly, its *J*-month returns are classified as *HI* if they are amongst the highest 25% of all the *J*-month

[2] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

returns for that asset in the sample. To investigate possible reversal patterns, we record average annual returns for the first five years following the *LO* and the *HI* returns.

Let *y* denote the years post-formation (*y* = 1, 2,…, 5) and *i* denote the respective country, (*i* = 1, 2,…, 18), while the absence of *i* denotes the country-average result. The annual average returns following the *LO* and *HI* returns are denoted as $R_{yi|LO}$ and $R_{yi|HI}$ respectively. If TSR is present, we expect significantly higher annual returns following *LO* returns than following *HI* returns. Thus, our main focus is on the significance of the return differences ($R_{yi|LO} - R_{yi|HI}$), with significantly positive differences evidence of a TSR effect. Note that, by construction, the expected value of the $R_{yi|LO} - R_{yi|HI}$ difference is slightly positive under the null hypothesis of independent monthly returns. For risk purposes, we also report the corresponding annual Sharpe ratios and respective Sharpe differences, $S_{yi|LO}$, $S_{HI|yi}$, $S_{yi|LO} - S_{yi|HI}$. The Sharpe ratios allow us to test whether observed significance in raw returns could have a simple risk-based explanation.

As the distributions of these test-statistics are not known, we employ the Fisher randomization test procedure, which is based on the null hypothesis assumption of independently distributed returns. This procedure provides exact small sample *p*-values, and is similar to the bootstrap technique except that the random sampling is without replacement[3]. In particular, it is able to accommodate overlapping returns and the slightly positive mean return difference under the null hypothesis. We employ 10,000 permutations in the randomization tests.

3.2. Construction of TSR based strategies and regression analysis

In this section, we describe the construction of TSR strategies designed to investigate the profitability of the long-term TSR effect in the MSCI indices, and the methods of risk-adjustment employed.

We apply the strategy based on the long-term TSR rules at each month *t* to each country index *i* from Jan 1970 to March 2016. For robustness, we examine TSR trading strategies across various formation and holding periods. As in the previous section, *J* is used to define the length of the formation period specific to the trading signal (*J* = 48, 60, 72), while *K*-month refers to one of

[3] See Noreen (1989) for further details of Fisher randomization methods.

the nine different holding periods (K = 1, 3, 6, 9, 12, 24, 26, 48, 60) following the formation period. All (J, K) pairs provide 27 possible strategy combinations. For the TSR induced trading signal, we apply a contrarian response strategy[4]. In detail, a long or short position in month t is conditional on the extreme low (high) prior J-month formation period return for each country i and is held for K months. To avoid 'look-ahead bias', in the case of the TSR strategies we determine whether a country's recent J-month return is classified as *LO* or *HI* (or neither) by using J-month thresholds from pre-1970 data. Specifically, we employ the CRSP US value-weighted market index (*VW*) monthly returns from 1926 to December 1969. In this period, 25% of the *VW*'s 48-month, 60-month and 72-month rolling formation returns did not exceed 23.5%, 39.6% and 58.1%, respectively. These *VW* thresholds establish the J-month *LO* thresholds to be applied to each country's J-month returns. Similarly, 25% of the VW's 48-month, 60-month and 72-month periods achieved returns of at least 85.0%, 109.9% and 125.1%, respectively. These *VW* thresholds define the *HI* thresholds to be applies to each country.

For example, if a country's current J-month formation return is below (above) the corresponding *VW LO* (*HI*) threshold, the country's J-month return is defined as *LO* (*HI*) and the J-month TSR strategies initiate a long (short) position in the particular country index. If the J-month return for a country index does not classify as either *LO* or *HI*, no trade is initiated in the equity market for that country index at that time. Each TSR(J, K) contrarian strategy return in each month t, denoted $R_t^{TSR(J,K)}$, is an equally weighted average return of all countries' TSR strategy returns with a K-month holding period. To strengthen our results, we test for the significance of the strategy returns with the overlapping portfolio of Jegadeesh and Titman (1993, 2001) for K-month holding periods longer than one month. This method tends to reduce the risk of receiving spurious results based on lead-lag effects, reduces transaction costs, and allows the use of simple t-statistics by avoiding overlapping returns (Lee & Swaminathan, 2000).

[4] See DeBondt and Thaler (1985, 1987) and Chopra, Ritter, and Lakonishok (1992).

To test whether TSR-based trading strategies generate positive abnormal returns, we compute the alphas of the following two regression models:

$$r_t^{TSR(J,K)} = \alpha + \beta \ R_{MSCI,t} + h\mathrm{VmG}_t + \varepsilon_t \quad (1)$$

$$r_t^{TSR(J,K)} = \alpha + \beta \ R_{MSCI,t} + sSMB_t + hHML_t + \varepsilon_t, \quad (2)$$

where $r_t^{TSR(J,K)}$ denotes the TSR (*J*,*K*) strategy excess returns determined by subtracting the US Treasury bill rate from $R_t^{TSR(J,K)}$. The independent variables are as follows: $R_{MSCI,t}$ is the excess return on the MSCI World Index; and VmG_t is the value minus growth factor calculated as the return on the MSCI Value index minus the return on the MSCI growth index; while SMB_t and HML_t are the Fama-French US size and value factor returns. Similar to prior studies, these models ensure that the TSR strategy returns are not driven by passive market exposures or by well-known anomalies such as the size or value effects (Balvers & Wu, 2006; Moskowitz et al., 2012; Marshall, Nguyen, & Visaltanachoti, 2014). A significant alpha would show that these risk-based regression models are unable to explain the monthly returns of the TSR-based strategy.

4. Results

4.1. Time-series reversal

Figure 1 reports each country's return differences following the extreme past performance. The consistent positive return differences, $R_{yi|LO} - R_{yi|HI}$, provide an initial indication of the prevailing reversal patterns in developed market indices with a one month holding period (*K* = 1). As the first two years of the base case (*J* = 60) are the most profitable overall, the figures in *Panels A* and *B* focus on years one and two across the three ranking periods (*J* = 48, 60, 72). Remarkably, all countries indicate positive annual average return differences post-formation, with the exception of Japan for *J* = 60 and 72 for the years one and two and the Netherlands for *J* = 48 for the year one only. The formation period is crucial for the magnitude and distribution of return differences through time. Similar patterns are observed regarding the Sharpe ratio differences, $S_{yi|LO} - S_{yi|HI}$.

[Figure 1 here]

Table 2 reports the average annual returns differences ($R_{yi|LO} - R_{yi|HI}$) for the first four years post-formation for J=48, 60, 72 months for each country index[5]. Across the three formation periods, many countries exhibit positive average differences that are significant at the 5% level. For example, Belgium with J = 60 has a significantly higher returns following *LO* returns than those subsequent to *HI* returns, with positive differences of 21.04% and 25.52% in the first and second years, respectively. In contrast, Hong Kong, Japan, the Netherlands and the US do not report significant average return differences for any *J*. Overall, the results show that the time series reversal for formation periods of J = 48 months is strongest in the second year (with seven countries displaying significant differences), while for the J = 60 and 72 cases, it is strongest in the first year (with eight countries and seven countries showing significant differences, respectively). These patterns indicate the importance of the formation period for the timing and duration of the TSR effect. Note that the most significant results are found in the J = 60 months base case over two years. Before proceeding to examine country-average results, we next consider more details of the base case results for individual countries.

[Table 2 here]

As not all countries experience significantly positive TSR reversal patterns in the average return differences, Table 3 presents a detailed breakdown of the average annual returns and Sharpe ratios of the first two years following the *LO* and the *HI* returns, as well as the corresponding average return differences and Sharpe ratio differences. This overview exhibits the base case (J = 60) for the first two years post-formation event. Table 3 reports that ten out of 18 countries exhibit at least one significant Sharpe Ratios following *LO* periods, while only eight out of 18 exhibit significant average returns following the *LO* returns at the 5% level in any one of the first two years. Similar findings are documented for the average and Sharpe ratio return differences, eight versus nine respectively. Whereas there are less countries with significant Sharpe ratios than averages when investigating the set of returns following *HI* past performances. As the spread amongst returns following *LO* tend to be smaller than among those following *HI* returns, the volatility adjustment in the Sharpe ratio seems to have a stronger impact on the latter returns. This seems to indicate

[5] As indicated in the methodology, five years post-formation were investigated. Results for the fifth year are available on request.

that returns subsequent to *LO* periods tend to exhibit more extreme results than in returns following *HI* periods. In turn, this causes the magnitude of the reversal of these returns subsequent to *LO* returns to be stronger in the Sharpe ratio which also shows in the significance of Sharpe ratios of the return differences. The persistence of the TSR in many of the country indices suggests that the country-average exhibits similar pattern.

[Table 3 here]

In contrast to the individual country comparison, Table 4 reports the overview of the average returns of the $R_{yi|HI}$, $R_{yi|LO}$ and the $R_{yi|LO} - R_{yi|HI}$ averaged across the 18 developed markets for the various formation periods and a one-month holding period (*K*=1). For *J* = 48, Table 4 manifests strong evidence of TSR pattern in the annual mean returns during the second and third year. The Sharpe ratios in this case are only significant in the first three years. The base case shows strong reversal evidence for the first two years in the mean average difference and the Sharpe ratio, while the 72-months formation period is only followed by one year of strong reversal-driven returns. It shows that the average duration of the reversal benefit is captured within the first two years post-formation period. This is apparent in the sharp decline in the outperformance of returns succeeding the *LO* over *HI* in the fourth year for *J*=48 months, and the third year for *J*=60 and 72-month. The return differences, $R_{yi|LO} - R_{yi|HI}$, are positive across almost all *J*-month and all five years' post-ranking periods. The only exception is the Year 5 for the J=48 case indicating an insignificant 3.24% loss. With the most stable distribution of significant differences, the base case is the most profitable. It represents a clear outperformance of the months following a *LO* over the ones following a *HI* in year one, with two highly significant returns of 22.69% and 6.02% respectively. Similar pattern are observed in the second year, whereas the average return post-*HI* is only weakly significant. The result of the return difference is driven by the long position in the months following the extreme low performance. Similar observations are made pertaining to the Sharpe ratios as risk-adjusted return measure.

[Table 4 here]

The persistence of the long-run TSR effect has been reported for many countries and the country-average over diverse formation periods. At least 95% of the country-average differences over a time frame of two years confirm the hypothesis of persisted positive outperformance of the returns subsequent to the *LO* over the *HI*. Hence, we infer that the long-term TSR effect does not capture randomness, but a substantial evidence of return dependence over time. Overall, the findings establish the evidence for predictable long-term time-series reversal patterns and the return dependence over time. Notable is that the similar pattern observed across the international indices suggest underlying commonalities across the equity markets.

For this effect to be classified as anomaly, the exploitation of the effect within a trading strategy would need to provide persistent unexplained risk-adjusted returns. The strategy excess and risk-adjusted returns are considered in the following

4.2. Profitability

Having shown the evidence for the time-series reversal effect, we construct 27 TSR(*J, K*) based strategies for 3 lookback and 9 holding periods to evaluate the profitability. Be reminded that while the trading signal decision is made on the individual country level, the analysis of the TSR strategy returns is conducted on the aggregated country-average. Hence, we evaluate the average strategy's excess returns computed across each countries' long and short positions over *K*-month. The country-average contributes to maximise the diversification benefits through time and across countries.

Table 5 presents the average monthly excess returns ($r_t^{TSR(J,K)}$) for various long-term TSR strategies that vary the formation and holding periods. All strategies earn positive excess returns whose magnitudes and significance tend to show similar pattern with increasing holding periods. For example, the base case *J*=60 months starts with 0.32% monthly average for the *K*=1 month holding period (*t*-statistics 1.67) and peaks with 0.54% (*t*-statistics 3.38) for *K*=24 months, after which the returns display a diminishing tendency to 0.28% for *K*=60 months (*t*-statistics 2.59). These patterns are shifted by one year backwards for *J*=48 and one year forward for *J*=72 months. The faster decline in the magnitude and the *t*-statistic level for *J*=48 months suggests a shorter reversal duration and less profitability relative to *J*=60. Overall, the strategies with the 60-month

formation period appear to provide the highest monthly profitability due to the longest duration of the TSR effect. The persistence of significant, positive TSR strategy returns across diverse (*J, K*) combinations supports the evidence and robustness of time-series reversal documented in the previous Table 4. The TSR-based trading signal combined with a simple contrarian trading strategy generates strong profitability.

[Table 5 here]

Figure 2 plots the post-formation behaviour measured by the monthly excess returns of the *K*=1 strategies and the significance levels through time. The three panels illustrate the average magnitude and t-statistic of post-formation returns from one to 60 months. The months for which the blue line exceeds the horizontal green line indicate significant post-formation excess strategy returns at the 5% significance level. These positive returns confirm significant long-term time-series reversal and inform about the duration of the reversal effect. For example, *Panel B* supports the insight that the base case, (*60,1*) strategy, provides the longest lasting significant performance consisting of 26 months compared with 16 months for the (*48,1*) strategy in *Panel* A and 20 months for the (*72,1*) strategy in *Panel* C; while the latter two also display small negative returns in later periods. A common pattern across panels is the return decay over time after reaching the peak, which is similar to the cross-sectional evidence in Richards (1997) and consistent with time-series findings in Moskowitz *et al.* (2012) and He and Li (2015). The minimum duration of the TSR effect over at least 16 months across diverse formation periods provides the evidence that the long-term TSR effect is not spurious. These results confirm the time-series predictability characteristic of the information content of past return patterns for expected returns.

[Figure 2 here]

Important to bear in mind is that the returns discussed exclude transaction costs. Earlier studies, which employ re-balancing strategies, use transaction costs between 0.2% and 1%[6]. However, for several reasons it is reasonable to assume that the transaction costs are unlikely to significantly affect the TSR performance (Balvers et al., 2000; Berghorn, 2015). First, the MSCI developed market indices consist of large, liquid stocks. Secondly, each MSCI country index is traded in form of exchange-traded funds (ETFs) or futures implying lower transaction costs[7]. Second, Jegadeesh and Titman (1993) and Gârleanu and Pedersen (2013) suggest that contrarian strategies that select stocks based on their longer past returns show a more persistent trading signal which reduces the transaction intensity and transaction costs respectively. Lastly, the increase of aggregate liquidity over time across international markets, especially in the equity markets, further decreases transaction costs (Jones, 2002)[8].

In line with the measure applied for the TS momentum (Hurst et al., 2012; Antonacci, 2014), we measure the diversification properties of the long-only TSR strategies during extreme equity bear market conditions using the worst-case performance during peak-to-trough drops, named the maximum drawdown. The overall market BnH strategy experiences a maximum drawdown of 59.38% since 1970 compared to 39.06%, 40.12%, 39.19% and 38.29% for the (*60,1*), (*60,6*), (*60,12*), (*60,24*) "long-only" strategies. We see that the TSR strategies, which are complemented by the Treasury bill investment, deliver lower downside risk-exposure, which partially explains the outperformance of the long-term TSR strategies over the BnH strategy.

To evaluate the abnormal TSR results under traditional risk considerations, we compute the alphas as per equation (1) and (2). Both models incorporate the rational risk factors. Table 5 shows the decomposition of the *(J, K*) TSR strategy results into risk-driven performance and an abnormal unexplained alpha. All strategies earn positive and significant alphas in the majority of the cases, which confirms the profitability of the TSR based effect. Further, it contests the risk factors or the market exposure as sole source for abnormal returns. Table 6 *Panel* A relates to equation (1) and

[6] See Antonacci (2014), Berkowitz, Logue, & Noser (1988), He & Li (2015), Jegadeesh (1990) and Jegadeesh & Titman (1993).
[7] See https://www.msci.com/resources/pdfs/Exchange_Traded_Products_Based_on_MSCI_Indices.pdf.
[8] Despite these arguments, we also examined the returns using a 0.5% transaction costs and find that the returns of the TSR strategy are not significantly affected.

Panel B relates to equation (2) for the first and second year post-formation period. The results manifest the long-term TSR effect at a 5% significance level, which is robust across lookback and holding periods for 16 out of 27 strategies in the first year model (1) compared to 15 out of 27 for model (2). Skipping the first year after formation provides stronger results with 21 and 19 strategies out of 27 showing positive significant results.

In summary, the base case *J*=60 months provides significant results for *K*>6 months (*Panel A & B)*. A comparison of the risk-adjusted alpha ($\alpha = 0.40 - Panel\ A, \alpha = 0.39 - Panel\ B$) with the excess return of 0.45% of the (*60, 9*) strategy in Table 5 indicates almost the same magnitude. This leads to the conclusion that none of the two models can explain the strength of the TSR strategy nor reject the implication for time-series predictability. In addition, skipping one year to avoid the tendency of long-term reversal being offset by short-term continuation of returns also provides significant alphas.

[Table 6 here]

The significant alphas provide strong evidence that the abnormal return performance of the long-term TSR strategies is not based on market movements, which are captured by traditional asset pricing models. The TSR based strategy exhibits anomalous risk adjusted returns while managing downside risk. We document long-term TSR evidence across excess return and risk-adjusted returns.

From the investment perspective, the comparison of the base case strategy returns with the diversified "buy-and-hold" (BnH) strategy allows to evaluate the economic significance. We construct a long-only TSR strategy, solely consists of countries, which experienced a past *J*-month return below the external CRSP *VW* lower benchmark and subsequently adopt a long position. In periods, which are characterised by either extreme *HI* returns and by returns which do not classify for either of the extremes across each of the country indices, the TSR strategy switches into Treasury bills. The combination of the equity investment and Treasury bills lowers the market risk exposure by diversifying through time and offers protection during forecasted declining markets. Figure 3 highlights that all TSR strategies for *J*=60 months outperform the BnH strategy over time. The advantage of the long-only TSR strategies is that they do not experience the sharp declines

exhibited by the BnH returns during the times associated with past systemic market shocks. By only adopting active market exposure subsequent to *LO* past returns, this long-only TSR strategy avoids the equity market altogether under all other market conditions, including those periods following *HI* returns with high uncertainty. The combination of the equity investment and Treasury bills lowers the market risk exposure by diversifying through time and offers protection during forecasted declining markets. In particular, (*60,1*), (*60,6*) and (*60,12*) outperformed the market BnH during the September 1987 crash. The (*60,6*) and (*60,12*) strategies perform the best during the 2008 final crisis. Overall the total timeframe the (*60,6*) strategy outperforms. These findings are consistent with Moskowitz et al. (2012) who identify sharp TS momentum losses at the end of the 2008 Global Financial Crisis, specifically March, April and May of 2009, due to the trend reversal. The extended holding periods, in particular 6 months and 12 months, manage and bridge the market exposure during period of high uncertainty the best.

[Figure 3 here]

Besides the predictability and profitability of the TSR strategy returns, the long-only strategy provides striking potential for predicting systemic market shocks and limiting the drawdown risk. Figure 4 shows the number of long positions adopted across all countries, while the periods when no country classifies for a long position coincide with the prediction of major systemic crises of the international equity market. The (*60, 1*) TSR contrarian strategy exhibits the following "no long" gaps in June 1987 which lasted for 5 months until October 1987. Whereas the actual stock market crash only set in on the 19th of October 1987, referred to as Black Monday, effectuated by abnormal price increases above the earnings growth, new influx of pension investors and favorable tax treatments. The second phenomenon predicted in May 1989 lasting for 23 months until March 1991, corresponds with the US economy's recession in 1990 coinciding with the collapse of the saving and loan crises, the Iraq's invasion of Kuwait and the associated oil price shock. The last substantial gap of "no long" periods lasted 17 months from May 2007 until December 2008 and was leading the global financial crisis starting to unfold in October 2007[9]. While the "no long" gap in 2014 only lasts for 3 months and does not coincide with a specific market event, the long

[9] The dot.com bubble burst appears to be a more industry and country specific phenomenon, which is why has not affected the whole market to the same extend as other financial crises.

positions provide important indication of the overall risk in the international equity market. In the figure 3 these "no-long" periods are characterised by mild growth periods as the long-only TSR strategy switches to the US Treasury bill indicating the increased risk levels and prevailing preferences for liquidity during these times. Similar to economic leading indicators, the TSR strategy can predict major systemic shocks with an average lead-time of 4 months. The lead-time shows that there is valuable information gained from the past data, which further can assist in asset allocation and timing decisions.

[Figure 4 here]

5. Conclusion

Recent studies examining the time-series predictability of financial assets solely focus on the short-term perspective of the past performance[10]. The gap in the empirical literature motivated the interest to investigate the relation between the long-term past performance and subsequent returns and the implication for the time-series predictability.

In this paper, we adopt an existing cross-sectional approach to long-term reversal and apply this to the return time-series of 18 international MSCI developed market indices. The parameter of interest is the return difference between the returns subsequent to low performing periods compared to the returns following high past performing period. In line with the expectation of the underlying reversal pattern in time-series, the hypothesis is that monthly returns following low long-term performing periods outperform those returns conditioned by high long-term past performance. Hence, positive return differences provide evidence for the long-term time-series reversal effect, which reflects an intertemporal dependency through time.

We provide evidence of significant positive return differences on the individual country level as well as for the aggregate country-average over a two years horizon post-formation period. This implies return dependence through time and confirms the predictive components within the knowledge of past long-term performance. The results identified similar pattern for the majority of countries, which suggests underlying commonalities across the international equity market. The

[10] See Antonacci (2014), He and Li (2015) and Moskowitz et al. (2012)

common nature of the pattern across 3 formation periods and 18 countries strengthens the argument for a pervasive and robust long-term time-series reversal effect.

Interpreting the results from the practical perspective, the profitability of this effect can only be evaluated in combination with an investable trading strategy, when compared with the performance of the basic buy-and-hold strategy. The majority of 27 long-term TSR strategies provide robust excess and risk-adjusted strategy returns. Rational risk and market exposure explanation cannot explain the abnormal performance and alphas of these strategies. The base case, 60-month formation period, long-only strategy consistently outperforms the BnH market alternative. The evidence for predictive power in the long-term past performance built a strong base for intertemporal dependency of returns in international developed equity markets.

Beyond the evidence of the long-term reversal pattern, this paper identified two major features. First, the use of the TSR effect in trading strategies may assist in improving investment performance for managed funds by limiting downside risk. Second, the long-only TSR strategy allows predict systemic financial crisis by an average lead-time of 4 month, which may enhance asset allocation and market-timing decisions.

This study raises interest in future research examining the relation of the TSR effect to existing value factors as well as the reason for the persistence and source of this effect across diverse international markets.

6. Appendices

Table 1 Summary Statistics

Reported are the averages and standard deviations of monthly returns in the two samples from January 1970 to March 2016 across the 18 MSCI developed markets, as well as the skewness and kurtosis. The average across all countries is referred to as country average. R_f denotes the one month US Treasury bill. DV stands for the average across all countries.

	Countries	Average monthly return (in %)	Standard Deviation (in %)	Skewness	Kurtosis
1	Australia	0.95	6.97	-0.65	4.26
2	Austria	0.84	6.81	-0.23	4.06
3	Belgium	1.10	5.90	-0.54	5.06
4	Canada	0.90	5.68	-0.51	2.23
5	Denmark	1.21	5.65	-0.17	1.79
6	France	0.99	6.49	-0.13	1.29
7	Germany	0.97	6.35	-0.34	1.32
8	Hong Kong	1.61	9.91	0.92	11.85
9	Italy	0.68	7.39	0.14	0.70
10	Japan	0.91	6.09	0.22	0.78
11	Netherlands	1.10	5.56	-0.49	2.15
12	Norway	1.12	7.87	-0.35	1.46
13	Singapore	1.18	8.15	0.39	5.77
14	Spain	0.91	6.80	-0.13	1.51
15	Sweden	1.27	6.92	-0.15	1.05
16	Switzerland	1.03	5.25	-0.14	1.28
17	UK	0.96	6.30	1.17	11.36
18	USA	0.89	4.42	-0.41	1.82
	Average DV	**1.03**	**4.78**	**-0.78**	**3.11**
	R_f	**0.51**	**0.28**	**0.54**	**0.41**

Table 2: Reversal in developed market indices: Country results across formation periods

Reported are the *average annual returns* of the country specific differences following past *LO* or *HI* formation periods for four years post-formation event date. The 48-, 60- and 72-month formation periods are presented.

Note: *, **, *** Denote the significance of 10%, 5% and 1% levels, respectively.

Formation	**48**				**60**				**72**			
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Australia	0.1574	0.0999	0.1157	0.1043	0.1913*	0.2005*	0.0876	-0.0002	0.2236**	0.1355	0.0469	0.0488
Austria	0.0424	0.1686*	0.1576*	0.1572*	0.0932	0.1149	0.1516	0.1256	0.0686	0.1448	0.1930*	0.2629**
Belgium	0.0408	0.2427***	0.2388***	0.2026**	0.2104**	0.2552***	0.1300	0.2157**	0.2126**	0.1647*	0.1075	0.1617*
Canada	0.1412*	0.1410*	0.1201	-0.0019	0.2294**	0.1454*	0.0186	-0.0908	0.2470***	0.0963	-0.0214	0.0296
Denmark	0.1479*	0.1726**	0.1428*	0.1389*	0.2601***	0.1642*	0.1203	0.0401	0.2724***	0.1310	0.0558	0.1246
France	0.1693*	0.2873***	0.1710*	0.0238*	0.2671***	0.2640***	0.0163	-0.1049	0.2142**	0.1547	-0.0426	-0.0767
Germany	0.0833	0.2559***	0.2063**	0.1499*	0.2377**	0.2796***	0.1730*	0.0473	0.2868***	0.1813*	0.0151	0.0966
HK	0.2012	0.0994	0.1740	-0.0672	0.1678	0.1756	0.0455	-0.1825	0.2062	0.0218	-0.1222	-0.1170
Italy	0.1730	0.2721***	0.1445	-0.0032	0.1676	0.1956*	0.0540	-0.0373	0.1462	0.1115	-0.0164	0.0826
Japan	0.0301	0.0397	-0.0687	-0.1358	-0.0306	-0.0940	-0.1095	-0.1103	-0.0917	-0.0597	-0.0655	-0.0088
Netherland	-0.0002	0.0990	0.0845	0.0595	0.0649	0.0692	0.0113	0.0529	0.0670	0.0359	-0.0174	0.0151
Norway	0.2397**	0.2846**	0.0595	-0.0706	0.2570**	0.1928	0.0116	-0.0405	0.2093	0.1159	0.0286	0.1026
Singapore	0.1963	0.1277	0.0635	0.0381	0.2076	0.1119	0.0048	-0.0563	0.2386*	0.0437	-0.0300	0.0923
Spain	0.0212	0.1402	0.2208**	0.1767*	0.0492	0.1473	0.1480	0.2152	0.0756	0.0456	0.1833*	0.2678**
Sweden	0.1713	0.1318	0.0302	0.1292	0.2669**	0.0791	0.0002	0.0668	0.1851	0.1072	0.0169	0.1679
Switzerland	0.0777	0.2061***	0.1390*	0.1126	0.1799**	0.1607**	0.1313*	0.0160	0.1610*	0.1299	0.0042	0.0474
UK	0.0738	0.1534*	0.1067	0.0594	0.1403	0.0774	0.0602	-0.0586	0.2386**	0.0437	-0.0300	0.0923
USA	0.0039	0.0331	0.0401	0.0207	0.0412	0.0303	0.0139	0.0132	0.0438	0.0525	0.0063	0.0329

Table 3: Breakdown of *LO* and *HI* returns, and return differences by country

Reported are the average annual returns and Sharpe ratios for the first two years post-formation event. This table provides a detailed breakdown these measures for the set of returns following the *LO* and *HI* returns, and the return differences. The table is limited to the base case (J=60). *Note:* *, **, *** Denote the significance of 10%, 5% and 1% levels, respectively.

	LO				***HI***				***LO-HI***			
	Average $(R_{yi\|LO})$		**Sharpe Ratio** $(S_{yi\|LO})$		**Average** $(R_{yi\|HI})$		**Sharpe Ratio** $(S_{yi\|HI})$		**Average** $(R_{yi\|LO} - R_{yi\|HI})$		**Sharpe Ratio** $(S_{yi\|LO} - S_{yi\|HI})$	
	Year 1	**Year 2**	**Year 1**	**Year 2**	**Year 1**	**Year 2**	**Year 1**	**Year 2**	**Year 1**	**Year 2**	**Year 1**	**Year 2**
Australia	0.2436*	0.2507**	0.8408**	0.7149*	0.0523	0.0502	-0.0448	-0.0237	0.1913*	0.2005*	0.8855**	0.7386*
Austria	0.2066*	0.2298**	0.3895	0.4177	0.1135	0.1149	0.1349	0.1468	0.0932	0.1149	0.2546	0.2709
Belgium	0.2703**	0.2819**	1.0249**	0.9016*	0.0599	0.0267**	0.0251	-0.0752**	0.2104**	0.2552***	0.9999**	0.9768**
Canada	0.2049*	0.2238**	0.8298**	0.9231**	-0.0245***	0.0784	-0.3893***	0.0672	0.2294**	0.1454*	1.2191**	0.8559*
Denmark	0.2518*	0.2329	1.0981**	0.9111*	-0.0082***	0.0688*	-0.2733***	0.1154*	0.2601***	0.1642*	1.3714***	0.7957**
France	0.3049***	0.2892**	0.9695***	0.8497**	0.0378	0.0252*	-0.0800	-0.1116*	0.2671***	0.2640***	1.0495**	0.9613**
Germany	0.2631**	0.3203***	0.7343*	0.8033**	0.0254*	0.0407	-0.1223*	-0.0622	0.2377**	0.2796***	0.8566**	0.8655**
HK	0.2923	0.2280	0.8543**	0.6282	0.1245	0.0524*	0.1487	-0.0519**	0.1678	0.1756	0.7056*	0.6801*
Italy	0.1078	0.1754	0.2309	0.4029	-0.0599**	-0.0202*	-0.5421**	-0.3391*	0.1676	0.1956*	0.7730*	0.7421*
Japan	0.1697	0.0721	0.5738	0.2343	0.2003	0.1662	0.3317	0.2985	-0.0306	-0.0940	0.2421	-0.0643
Netherland	0.1728	0.1728	0.7780	1.0762**	0.1078	0.1036	0.1989	0.2474	0.0649	0.0692	0.5791	0.8287**
Norway	0.2965**	0.2803**	0.6173	0.5367	0.0395	0.0876	-0.0475	0.1063	0.2570**	0.1928	0.6648	0.4304
Singapore	0.2613	0.1424	0.5471	0.3361	0.0538	0.0305*	-0.0568	-0.1035*	0.2076	0.1119	0.6039	0.4396
Spain	0.1176	0.1455	0.1949	0.2205	0.0684	-0.0018**	0.0585	-0.2163*	0.0492	0.1473	0.1364	0.4368
Sweden	0.2868*	0.2640	1.0338**	1.0337**	0.0199**	0.1849	-0.1347**	0.3115	0.2669**	0.0791	1.1686***	0.7222*
Switzerland	0.2518**	0.2656***	0.8152	0.8735*	0.0719	0.1050	0.0740	0.2228	0.1799**	0.1607**	0.7412*	0.6507
UK	0.2294*	0.1706	1.0041***	0.9655***	0.0891	0.0932	0.0511	0.1286	0.1403	0.0774	0.9530**	0.8369**
USA	0.1532	0.1225	1.1654***	0.9916**	0.1120	0.0923	0.3480	0.2178	0.0412	0.0303	0.8174*	0.7738*

Table 4: Reversal in developed market indices: Country-average results

Reported are the average annual returns and Sharpe ratios (both averaged across countries) following past *LO* and *HI* formation period returns, as well as their $R_{y|LO} - R_{y|HI}$ differences for five years post-formation event date. The *J*-month *HI (LO)* returns for a country index are those with *J*-month returns contained in the highest (lowest) of 25% *J*-month formation periods of that index's entire return series. The $R_{y|LO} - R_{y|HI}$ is the difference between the average *LO* and *HI* returns of a corresponding post-formation period. Associated randomisation p-values are provided in parentheses underneath each respective return for each of the formation period (*J*=48, 60 and 72).

	Annual Returns					Sharpe Ratios				
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Formation		**48**								
LO	0.1947	0.2265	0.2056	0.1635	0.1050	0.5997	0.7868	0.6102	0.3999	0.1675
(p)	(0.064)	(0.007)	(0.030)	(0.271)	(0.904)	(0.055)	(0.001)	(0.050)	(0.476)	(0.955)
HI	0.0852	0.0623	0.0863	0.1027	0.1375	0.0915	0.0019	0.1131	0.2174	0.3781
(p)	(0.200)	(0.031)	(0.158)	(0.320)	(0.77)	(0.091)	(0.014)	(0.096)	(0.309)	(0.797)
LO-HI	0.1095	0.1642	0.1192	0.0608	-0.0324	0.5082	0.7849	0.4971	0.1826	-0.2106
(p)	(0.082)	(0.006)	(0.042)	(0.260)	(0.893)	(0.045)	(0.001)	(0.043)	(0.375)	(0.942)
Formation		**60**								
LO	0.2269	0.2149	0.1667	0.1188	0.1545	0.7612	0.7123	0.4337	0.2182	0.3214
(p)	(0.007)	(0.021)	(0.276)	(0.827)	(0.393)	(0.002)	(0.008)	(0.416)	(0.932)	(0.737)
HI	0.0602	0.0721	0.1073	0.1126	0.1297	-0.0178	0.0488	0.2048	0.2571	0.3753
(p)	(0.042)	(0.085)	(0.435)	(0.486)	(0.699)	(0.017)	(0.044)	(0.316)	(0.461)	(0.793)
LO-HI	0.1667	0.1427	0.0594	0.0062	0.0248	0.7790	0.6634	0.2289	-0.0388	-0.0539
(p)	(0.006)	(0.020)	(0.318)	(0.712)	(0.554)	(0.001)	(0.008)	(0.341)	(0.805)	(0.809)
Formation		**72**								
LO	0.2287	0.1861	0.1322	0.1718	0.1605	0.7155	0.5654	0.2939	0.3778	0.3264
(p)	(0.011)	(0.168)	(0.757)	(0.261)	(0.370)	(0.011)	(0.135)	(0.846)	(0.614)	(0.742)
HI	0.0618	0.0941	0.1149	0.0928	0.1466	0.0018	0.1412	0.2435	0.1979	0.4758
(p)	(0.068)	(0.319)	(0.556)	(0.253)	(0.853)	(0.032)	(0.208)	(0.470)	(0.310)	(0.948)
LO-HI	0.1669	0.0920	0.0173	0.0790	0.0139	0.7069	0.4242	0.0504	0.1799	-0.1495
(p)	(0.011)	(0.188)	(0.695)	(0.216)	(0.668)	(0.007)	(0.125)	(0.721)	(0.443)	(0.92)

Table 5 Average Excess Returns of various (J/K) contrarian strategies (Long/Short)

The table reports average monthly excess strategy returns ($r_t^{TSR(J,K)}$) and the respective t-statistics. The average monthly returns are presented in percentages and the t-statistic in parentheses. To determine the *long/short* position for each country index *i* in each month *t*, the prior *J*-month rolling returns are compared with the CRSP VW quartile threshold levels; excluded are the country indices in each month *t*, which fall in-between those extreme thresholds. The country-average portfolio only consists of those countries indices that each classify for a *long* or *short* position. The *J*-month formation and *K*-months holding periods are displayed in the first column and row respectively. Across all three formation periods, *J*=48, 60 and 72 months, and 9 holding periods, *K*= 1,3,6,9,12,24,36 and 60 months, the table presents 27 different monthly TSR strategy results. For holding periods longer than one month, overlapping portfolios, as in Jegadeesh and Titman (1993), are used.

Note: *, **, *** Denote the significance of 10%, 5% and 1% levels, respectively.

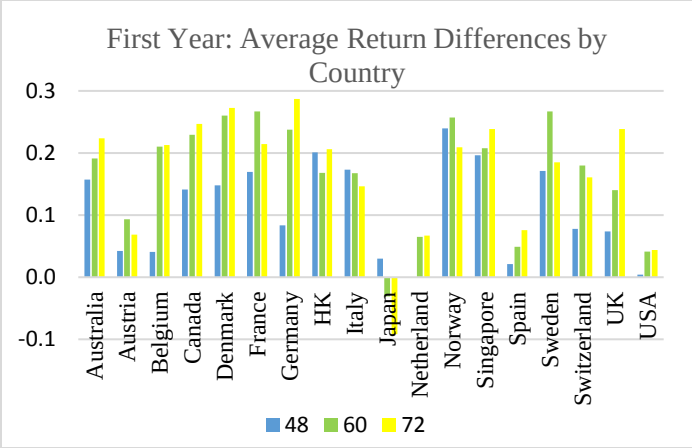
			Holding Period (K months)								
			1	3	6	9	12	24	36	48	60
Formation periods (in months)	**48**	**Av. Return**	0.18	0.24	0.30*	0.30*	0.30*	0.39**	0.44***	0.37***	0.27**
		t-statistic	(0.91)	(1.31)	(1.65)	(1.68)	(1.76)	(2.36)	(2.93)	(2.85)	(2.55)
	60	**Av. Return**	0.32*	0.34*	0.42**	0.45**	0.45***	0.54***	0.44***	0.35***	0.26***
		t-statistic	(1.67)	(1.83)	(2.28)	(2.51)	(2.62)	(3.38)	(3.12)	(2.94)	(2.59)
	72	**Av. Return**	0.45**	0.44**	0.51***	0.53***	0.52***	0.43***	0.30**	0.24**	0.17*
		t-statistic	(2.49)	(2.53)	(3.03)	(3.22)	(3.31)	(2.99)	(2.40)	(2.14)	(1.69)

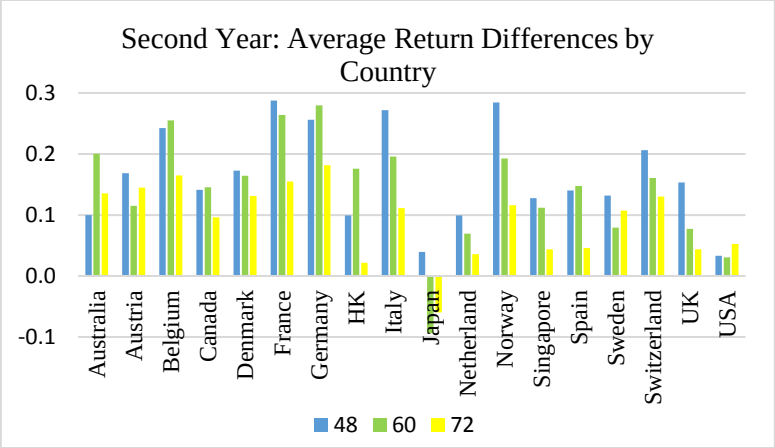
Table 6 Alphas and t-statistic of time series reversal strategies (*J*, *K*) (Long/short)

Reported are the risk-adjusted return of TSR strategies, referred to as alphas (intercepts), and respective t-statistics from for 3 lookback (J = 48, 60, 72) and 9 holding periods (K = 1, 3, 6, 9, 12, 24, 36, 48, 60, 72). Alpha (α) is reported in percentage and the t-statistic in parentheses. The strategy is applied immediately after the lookback period's ending. The regressors for the MSCI regression factors (2.2) (*Panel A*) are: MSCI World Index and MSCI VmG. The Fama and French regression factors (2.1) (*Panel B*) are: MSCI World Index and the Fama and French SMB and HML.
Note: *, **, *** Denote the significance of 10%, 5% and 1% levels, respectively.

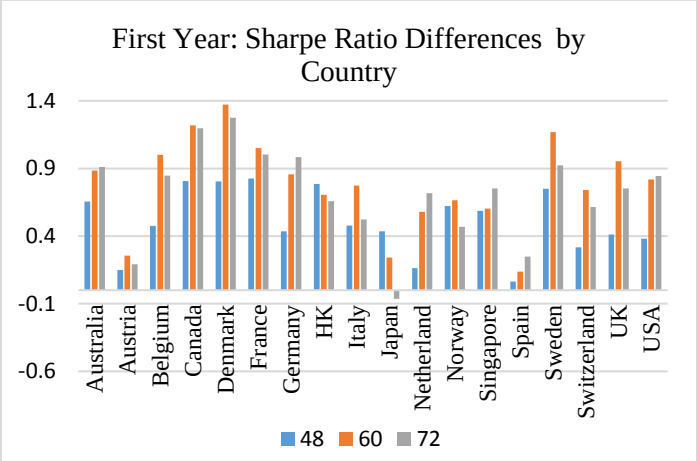
Year 1 Long-Short		**1**	**3**	**6**	**9**	**12**	**24**	**36**	**48**	**60**
Panel A: MSCI Regression										
48	**alpha**	0.00	0.12	0.20	0.23	0.27	0.41**	0.50***	0.43***	0.32***
	t-statistic	(-0.01)	(0.61)	(1.01)	(1.19)	(1.39)	(2.27)	(3.09)	(3.24)	(3.04)
60	**alpha**	0.19	0.25	0.35*	0.40**	0.43**	0.55***	0.47***	0.37***	0.27***
	t-statistic	(0.94)	(1.24)	(1.72)	(2.04)	(2.21)	(3.17)	(3.10)	(3.02)	(2.66)
72	**alpha**	0.38*	0.38*	0.46**	0.50***	0.51***	0.45***	0.31**	0.26**	0.18*
	t-statistic	(1.90)	(1.95)	(2.49)	(2.75)	(2.92)	(2.91)	(2.46)	(2.25)	(1.75)
Panel B: Fama and French Factors										
48	**alpha**	-0.06	0.09	0.18	0.22	0.25	0.40**	0.48***	0.41***	0.30***
	t-statistic	(-0.27)	(0.43)	(0.87)	(1.06)	(1.20)	(2.08)	(2.76)	(2.96)	(2.79)
60	**alpha**	0.14	0.23	0.33	0.39*	0.41**	0.53***	0.44***	0.35***	0.25**
	t-statistic	(0.66)	(1.07)	(1.54)	(1.84)	(2.00)	(2.82)	(2.77)	(2.74)	(2.43)
72	**alpha**	0.34	0.34	0.42**	0.463**	0.48**	0.43***	0.29**	0.23**	0.16
	t-statistic	(1.58)	(1.63)	(2.12)	(2.38)	(2.54)	(2.59)	(2.17)	(2.00)	(1.47)
Year 2 Long-Short		**1**	**3**	**6**	**9**	**12**	**24**	**36**	**48**	**60**
Panel A: MSCI Regression										
48	**alpha**	0.38*	0.43**	0.48**	0.54***	0.56***	0.59***	0.46***	0.32***	0.20**
	t-statistic	(1.86)	(2.16)	(2.47)	(2.82)	(3.01)	(3.48)	(3.24)	(2.72)	(1.98)
60	**alpha**	0.56***	0.58***	0.60***	0.63***	0.64***	0.45***	0.33**	0.23*	0.11
	t-statistic	(2.79)	(2.97)	(3.13)	(3.39)	(3.53)	(2.81)	(2.47)	(1.94)	(1.03)
72	**alpha**	0.49***	0.44**	0.41**	0.40**	0.36**	0.20	0.17	0.10	0.038
	t-statistic	(2.70)	(2.43)	(2.37)	(2.45)	(2.36)	(1.48)	(1.33)	(0.81)	(0.31)
Panel B: Fama and French Factors										
48	**alpha**	0.37*	0.43**	0.48**	0.54***	0.55***	0.58***	0.45***	0.31**	0.19*
	t-statistic	(1.72)	(2.05)	(2.36)	(2.68)	(2.84)	(3.15)	(3.00)	(2.55)	(1.83)
60	**alpha**	0.53**	0.55***	0.58***	0.60***	0.61***	0.43**	0.31**	0.21*	0.087
	t-statistic	(2.49)	(2.67)	(2.79)	(3.03)	(3.15)	(2.53)	(2.25)	(1.74)	(0.80)
72	**alpha**	0.49**	0.43**	0.40**	0.39**	0.35**	0.17	0.15	0.072	0.00
	t-statistic	(2.47)	(2.21)	(2.15)	(2.21)	(2.14)	(1.27)	(1.13)	(0.56)	(0.02)

Panel A





Panel B



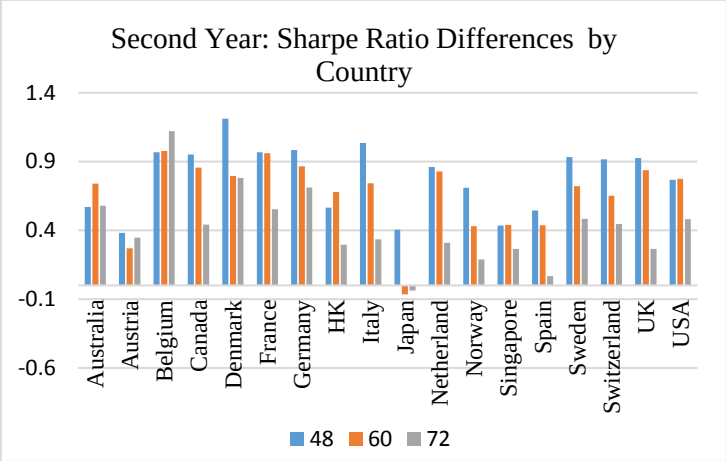
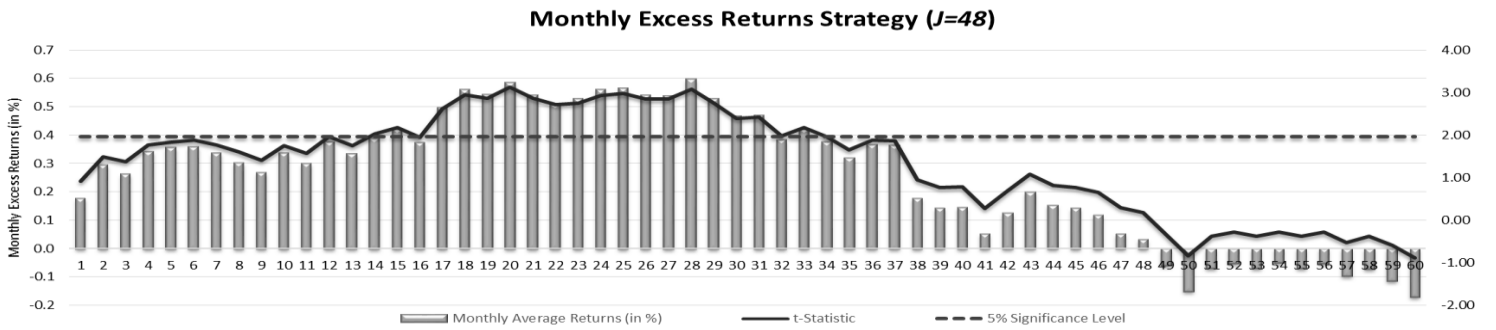


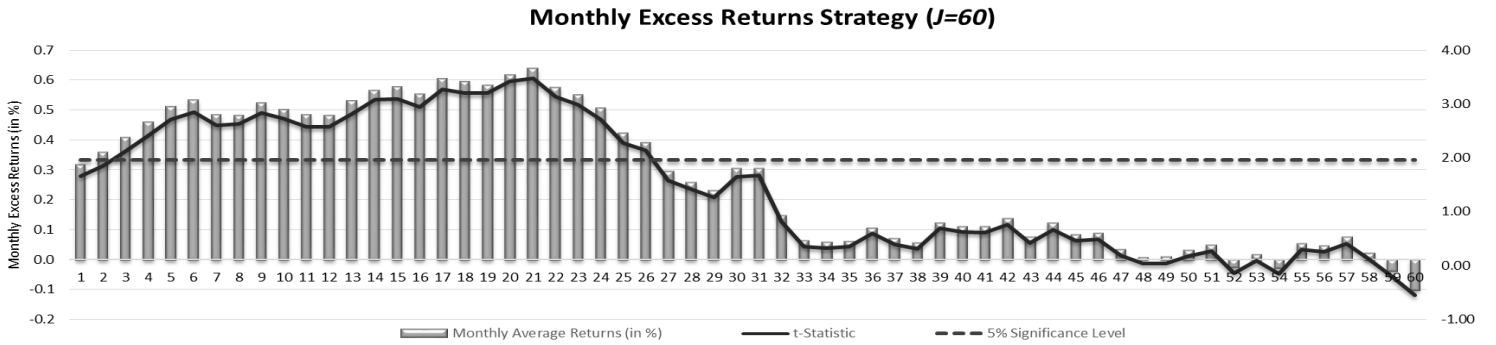
Figure 1 Return Differences and Sharpe Ratio differences by developed country

Panel A depicts the annual average return differences, $R_{yi|LO} - R_{yi|HI}$, for the first year and second year following the end of the formation periods for the 18 developed countries. *Panel B* reports the *annual average Sharpe ratio* differences, $S_{yi|LO} - S_{yi|HI}$, for the first year and second year following the end of the formation periods for the 18 developed countries. The formation period varies in length (J = 48, J = 60 and J = 72).

Panel A



Panel B



Panel C

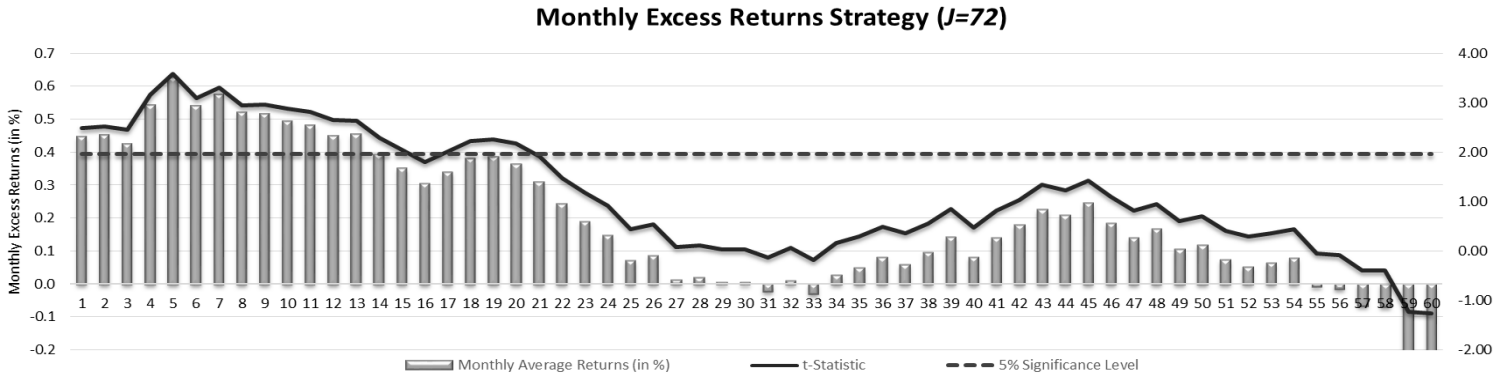


Figure 2. Average monthly excess returns profitability based on the strategy

Panel A, B and C plot the monthly average excess returns generated by a contrarian strategy accounting for past performance across formation periods (*J*=48, 60 and 72). The bars, which are scaled to the left axis, indicate the average excess monthly returns. The line indicating the *t*-statistics and the horizontal dotted line providing the 5% significance level (critical *t*-statistic=1.96) are both scaled to the right axis. The months the blue line cuts the green underneath (above) indicates the start (end) of the significant average monthly returns post-formation.

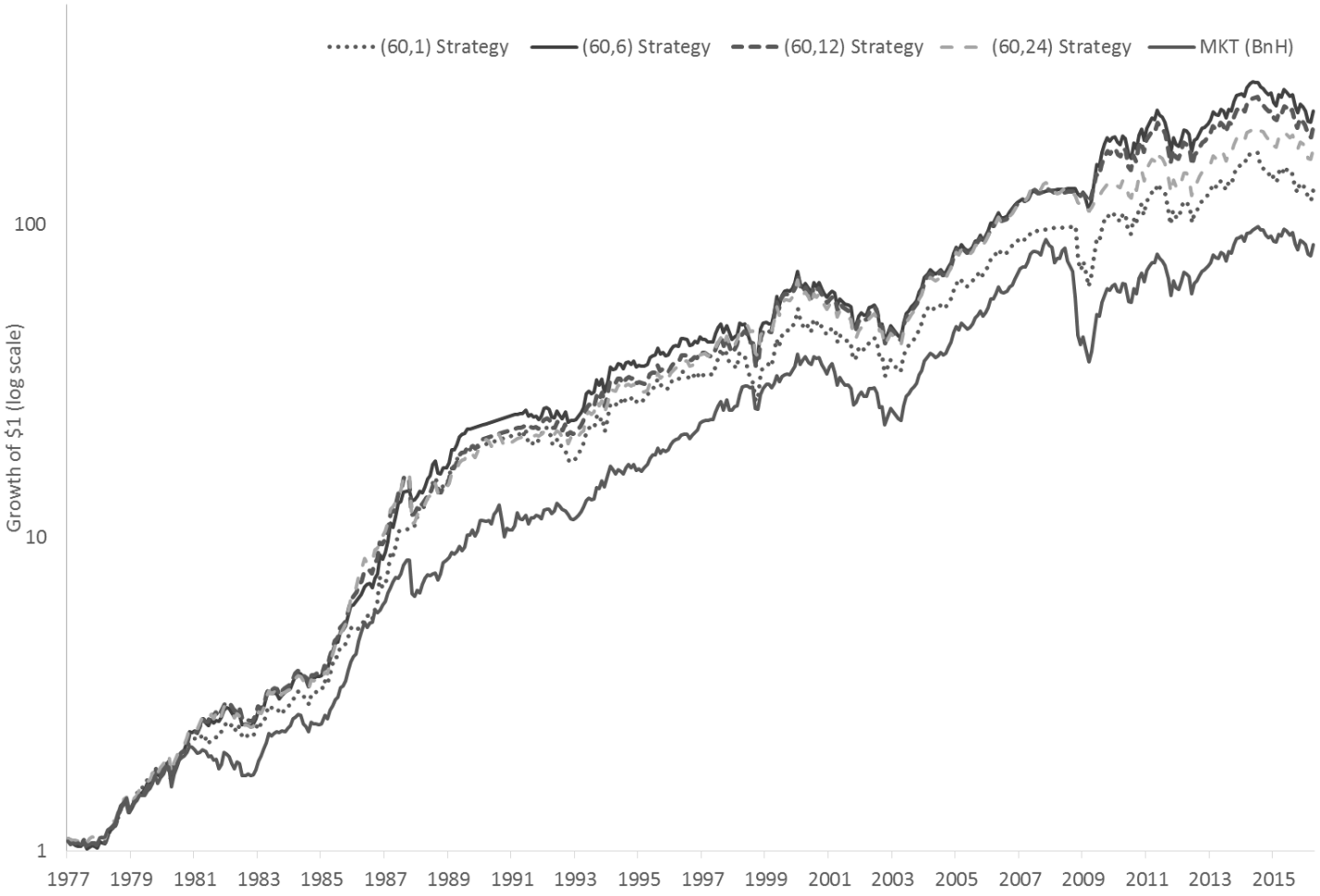


Figure 3 Long-Only TSR strategy performance Plotted are the overlapping "long-only" TSR compound strategy returns for J=60 and various holding periods (K=1, 6, 12, 24). In periods in which the returns do not classify for a long position in the market, the strategy invests in the Treasury bills. The long-term TSR strategy performance compares to the "buy-and-hold" (BnH) strategy performance of the diversified MSCI World index portfolio for the time horizon from January 1977 to March 2016.

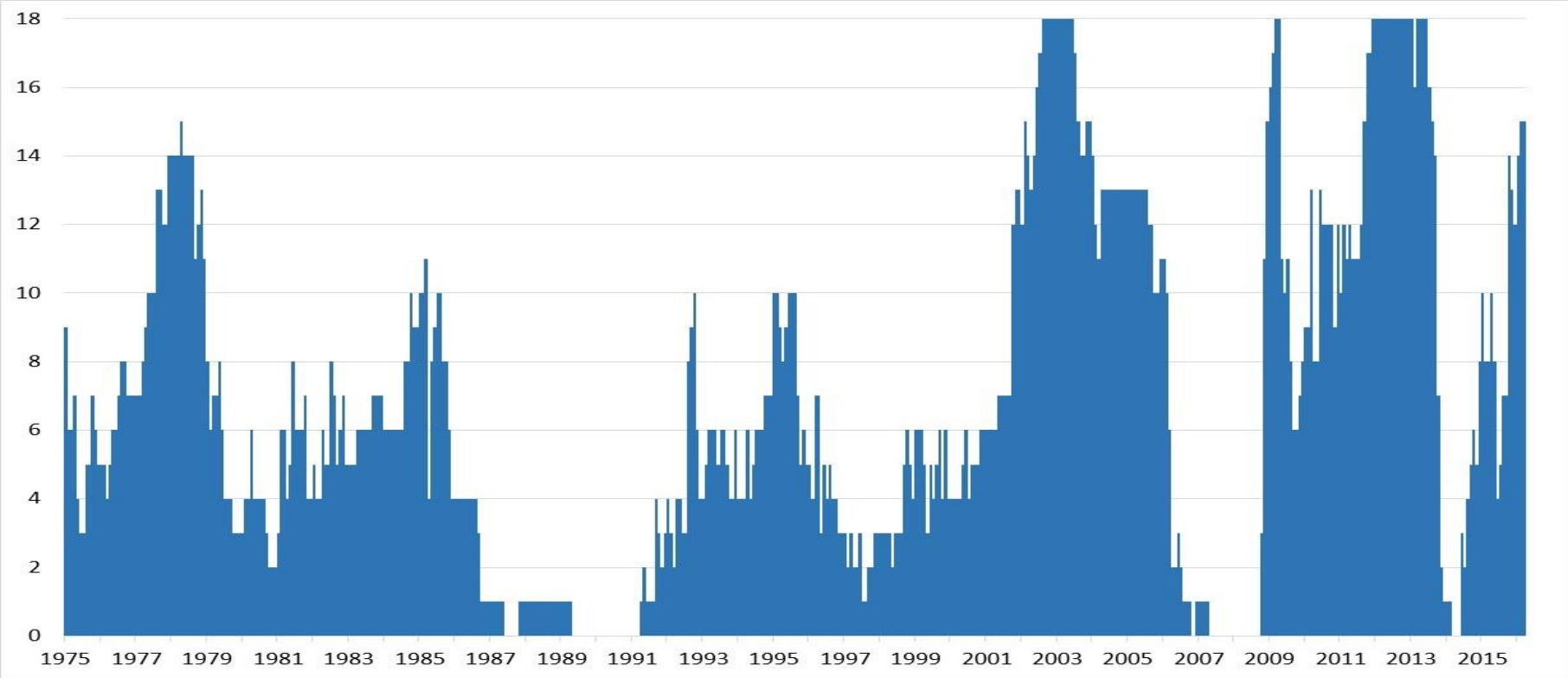


Figure 4: Long positions of the (60,1) strategy This graph displays the total number of long positions adopted across all 18 countries within the country portfolio in month spanning a time frame from Jan 1975 to March 2016. The maximum amount of long position is 18 countries if each experienced past extreme low long-term performance. The gaps reflect past high long-term performance or a past non-extreme performance potentially signaling a forthcoming systemic shock to the individual country equity markets.

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