Dash for Cash: Month-End Liquidity Needs and the Predictability of Stock Returns

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Abstract. This paper uncovers strong return reversals in stock market returns around the last monthly settlement day, *T*-3, which guarantees liquidity for month-end cash distributions. We show that these return reversals are stronger in countries where the mutual fund ownership is large, and that in the US the return reversals have become stronger over time as the mutual fund ownership of stocks has increased. Finally, in the cross-section of stocks, the reversals around turn of the month are stronger for stocks more commonly held by mutual funds, for liquid stocks, and for more volatile stocks (controlling for liquidity).

Key words: asset pricing, limits of arbitrage, mutual funds, short-term reversals, turn-of-the-month effect

JEL classification: G10, G12, G13

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1. Introduction

It is surprising how little attention academic literature has devoted to understand equity market returns around the turn of the month, despite the observations of Lakonishok and Smidt (1988) and McConnell and Xu (2008) among others that most of the returns accrue during a four-day period, from the last trading day to the third trading day of the month. We find that the market returns are abnormally high also on the three days *before* the turn of the month. In fact, combining the two observations, we find that since 1926, one could have held the S&P 500 index for only seven business days a month and pocketed almost the entire market return with forty percent lower volatility compared to a buy and hold strategy. Since 1987, all of the positive equity returns have accrued during these seven trading days, and the average returns during the rest of the month have been negative. Odgen (1990) relates the high returns at the beginning of the month to the monthly payment cycle – the fact that large part of investors' cash receipts are obtained on the last or the first business day of the month. Our findings lend additional support to this hypothesis.[1]

[INSERT FIGURE 1 HERE]

In this paper, we explore the turn of the month phenomenon further and discover new, previously unidentified patterns in equity returns. Our findings concern not only the returns after the turn-of-the month, but also those immediately preceding it. In particular, we uncover strong return reversals in stock market returns around the last monthly settlement day, *T*-3, which guarantees liquidity for month-end cash distributions. In addition, our research sheds light on the forces behind the stock return predictability around the turn of the month. Besides confirming the importance of the payment cycle as a determinant of the turn-of-the-month return patterns, our results suggest that agency reasons such as "window dressing" within the mutual fund industry (e.g., Lakonishok, Shleifer, Thaler and Vishny, 1991) play a role.

We begin our study by investigating the potential market implications of the turn of the month payment cycle of pension funds, mutual funds, corporations and other institutions.

[1]Cadsby and Ratner (1992) provide international evidence about the turn of the month anomaly by discovering abnormally high turn of the month returns in 6 out of 10 studied markets. McConnell and Xu (2008) find that the turn of the month return anomaly is significant in 33 out of 34 countries. Dzhabarov and Ziemba (2010) show that US equity index futures also exhibit turn of the month effect.

Due to this cycle, potentially billions of dollars invested in the stock market get liquidated every month just a few days prior to the month end and distributed as cash to pensioners, employees, and recipients of corporate or mutual fund dividends. In order to meet their month-end cash liabilities on time, all institutions and individuals whose liquid funds are invested in the equity market must sell their stocks at least three business days before the month end, following the most common settlement rule of the developed stock markets. As a result, for some time period preceding the third business day before month end, which we label *T-3* (here *T* refers to the last day of the month), the market must absorb a large amount of order flow to accommodate the sellers' liquidity needs. Under perfectly efficient markets, market makers and speculators would ensure that prices are barely affected by such sell orders, which do not reflect any investment views. However, in the absence of sufficient speculative capital, it is likely that market prices get temporarily depressed due to the selling pressure and that it takes some time for prices to revert back to their fundamental values. This is the main hypothesis we investigate in this paper. Similarly, at the beginning of the month, buying pressure from the recipients of the turn of the month payments can lead to temporary overvaluation of the stock market that reverts over time. We also explore this idea in our paper.[2] [3]

The intuition that asynchronously arriving sellers and buyers to the stock market cause short-term return reversals in equity returns has been present in the literature for a long time (e.g., Grossman and Miller, 1988). However, only limited empirical support for the idea that investors' aggregate buying and selling pressures would lead to market level short-term return reversals has been presented. To our knowledge only two papers show evidence on this. First, Campbell, Grossman and Wang (1997) show that high trading volume in the stock market (signaling buying or selling pressure from some groups of investors in their model) reduces the otherwise positive autocorrelation in stock index returns in their sample. Second, Ben-Raphael, Kandel, and Wohl (2011) provide evidence that aggregate mutual fund flows in Israel seem to have created price pressure in the aggregate stock market leading to market level short-term return reversals. However, they do not tie these market

[2] For evidence that the 3-day settlement convention is most common internationally, see e.g. Thomas Murray Ltd. 2014 report "CMI In Focus: Equities Settlement Cycles." In the US, the 3-day settlement convention was adopted in June 1995.

[3] Seasonality in institutional investors' portfolio rebalancing, due e.g. to prevalence of asset allocation meetings near the month ends, can be a factor that further amplifies the investors' selling pressure near the month end and buying pressure in the beginning of the month.

level short-term return reversals to the turn of the month time period. Given this, our findings that the investors' systematic selling and buying pressures around the turn of the month cause predictability in the stock market returns, and short-term return reversals at a market level, are new to the literature. Our findings help tie the anomalous turn-of-the-month returns to the standard theories on imperfectly functioning financial markets and limits of arbitrage (see Gromb and Vayanos, 2012, for a survey of this literature). We also present evidence that the buying and selling pressure around the turn of the month is particularly strong for stocks commonly held by the mutual fund industry. Moreover, good funding conditions for hedge funds seem to mitigate the turn of the month return patterns.

Our results can be divided into three main categories:

1. **Evidence from market returns.** Looking at aggregate market prices alone, we find significant predictability of stock returns around the third business day before the month end. Market returns before *T-3* are significantly lower than market returns over the subsequent three business days, which have systematically delivered high aggregate market returns. Our first contribution is to show that lower than average market returns before *T-3* tend to be followed by higher than average subsequent returns, thus providing evidence of return reversals around *T-3*. Similarly, higher than average returns on the first three business days of the month are followed by lower returns on average on the following five days. Our evidence on such return reversals around *T-3* is not limited to the US but we find similar evidence from other developed markets. In all 24 markets that we survey, there is evidence of return reversals around *T-3,* and in 18 of the 24 markets the return reversals are statistically significant. The return reversals following the first 3 days' returns, in turn, are statistically significant in 12 out of the 24 countries. This evidence on return reversals is consistent with the idea that limits of arbitrage affect the turn of the month returns as we discussed earlier.[4] [5]

[4] Interestingly, the return reversal phenomenon is not equally consistently present in emerging markets. This could be due to different shareholder structure in the emerging markets, where the role of mutual funds and other institutional investors is smaller, or due to liquidity and transaction cost concerns.

[5] As a robustness check to the idea that the payment cycle of institutions contributes to the turn of the month patterns, we show in Table A1 in the Appendix that similar but less pronounced patterns in market returns are observed around another common payment date, the 15th of each month. In addition, we show that in the US, the abnormally negative returns prior to the turn of the month have moved closer to the turn of the month since the shortening of the settlement period in June 1995. Finally, the part of the seven day turn of the month returns that accrue during the days T-3 to T-1 has significantly increased since the shortening of the settlement period (being on average 47% after June 1995 vs. 30% in the sample from January 1980 to May 1995).

2. **Evidence from the cross-section of stocks and mutual fund holdings.** First, we show that there is return reversal around the turn of the month also in the cross-section of stocks: the stocks that decline the most on days *T-8* to *T-4* recover the most on days from *T-3* to *T-1*. Similarly, the stocks that rise the most on the days *T* to *T+3* drop the most on the days *T+4* and *T+8*. Next, we link the cross-section of month end return reversals to mutual fund holdings. Our findings indicate that stocks held in greater proportions by mutual funds exhibit more pronounced turn of the month patterns, including return reversals around *T-3*. In an international sample, the return reversals around *T-3* are also stronger in countries with larger mutual fund sectors. Finally, we show that the strength of *T-3* return reversals in the US aggregate stock market has varied over time with the proportion of the market held by the mutual fund industry.

   Other pieces of evidence lend further support to the link between the turn of the month patterns and mutual funds. For example, consistent with the idea that there are cash transfers in and out of the mutual fund sector around the turn of the month, we find that the average market beta of the mutual fund industry varies near the month end and is significantly lower than average at time *T-3*. Furthermore, consistent with the idea that mutual funds reduce risks towards the end of the month (either to increase their cash holdings in order to meet the end of month payments or for agency reasons), we show that mutual funds' average return volatility also declines towards the end of the month, although there is no observable decline in the volatility of the stock returns in general towards the month end.

   We also find evidence that the turn of the month returns and return reversals vary as a function of stocks' liquidity. In particular, we find that month-end reversals are statistically more significant for larger and more liquid stocks, suggesting that funds and other investors respond to month-end outflows and cash needs conscious of transaction costs. Similarly, we find that following the end of the month, the first three days' returns revert only for liquid stocks. For illiquid stocks, it seems that the investors' purchases are more gradual and continue past the first three days, causing positive, not negative autocorrelation in returns between the first three days' returns and the returns thereafter. This again is consistent with the idea that market participants are conscious of their price impact in the stock market when taking positions in the beginning of each month. Finally, controlling for liquidity, we find that the reversal patterns are stronger for more volatile stocks, which is consistent with the idea that mutual funds reduce their risks towards the end of the month for agency reasons.

3. **Evidence related to hedge funds.** We investigate whether hedge funds play a role in mitigating month-end patterns. Our evidence is mixed. Akin to our results for mutual funds,

we find that the market betas of most hedge funds vary around the turn of the month, being smaller before the month end than at the beginning of the month. These patterns are stronger for funds with less frequent redemption cycles, suggesting that hedge funds also are plagued by month-end cash and agency concerns.[6] Nonetheless, we find that funds in some hedge fund categories seem to provide liquidity to other market participants prior to the turn-of-the month as they increase their market betas significantly at T-3. Finally, our time-series evidence lends support to the idea that hedge funds' funding conditions affect their ability to mitigate month-end return reversals: poor funding conditions, as indicated by an elevated TED-spread (common proxy for hedge funds' ability to leverage their positions), are associated with greater return reversals.

Our results contribute to the vast existing literature on turn of the month effects that dates back at least to the seminal paper of Ariel (1987). Taken together, these studies report abnormally high returns over the four-day period from the last to the third trading day of the month. To the best of our knowledge, our study is the first one to focus on market behavior around the last day of the month that guarantees settlement before the month end. Also, we believe we are the first ones to link our findings crisply to patterns in the cross-section of mutual fund holdings and to the time series of mutual fund capital.

The remainder of the paper is organized as follows. Section 2 describes the data used in our research. Sections 3-5 present our main empirical results that cover the cross-sectional and time-series dimensions of the data. Section 6 concludes.

2. Data

The country index return data are from Datastream, except in the case of the US value-weighted index, which is obtained from CRSP. Our US index return data are from January 1980 through January 2014. Our international sample consists of the benchmark indexes of G10 countries in addition to other important industrialized countries. For many countries the sample period starts later than 1980, when the relevant data becomes available. Most of the international index returns include dividends, but due to lack of data some of them are partly based on price indexes to maximize the country specific sample periods.[7]

[6] We also document a decrease in market trading volume around *T-3* which is consistent with the idea that hedge funds are reluctant to take large risks prior to the end of month, but rather "close their books."
[7] Israeli index returns are an exception as only a price index is available (in Datastream).

Our cross-sectional stock data are from CRSP. The sample period is equal to the index sample except that our individual stock return data ends in December 2013. Our mutual fund holdings data is from Thomson Reuters Mutual Fund Holdings database. The sample period is from January 1980 to December 2013 (as the mutual fund data becomes available in January 1980). MFLINKS is used to combine different mutual fund classes. Mutual fund betas are estimated using daily mutual fund returns from the CRSP Survivor-Bias-Free U.S. Mutual Fund database. In our analysis we aggregate the mutual fund holdings into monthly collective ownership percentages based on the holdings reporting dates under the following assumptions. Mutual funds' (quarterly) holdings are assumed to be valid until the next holdings report date, but a maximum of six months since the reporting date. Holdings of mutual funds that have stopped reporting their holdings are assumed to be valid only during the next quarter. Finally the hedge funds' total assets under management are estimated using the LIPPER TASS and HFR data as described in Jylhä and Suominen (2011). The hedge fund betas are estimated using the LIPPER TASS data.

3. Turn of the month stock returns in the US and abroad

The main focus of this study is the behavior of stock returns surrounding the third business day before the month end. This day, *T-3*, is important because any transactions preceding it are settled before the last business day of the month, meaning that the seller receives the proceeds of their sale in cash before the month end. Month-end liquidity, on the other hand, is important for many institutions that face periodic cash liabilities, as discussed above (see Section 4 for empirical evidence). As a secondary focus, we are interested in the returns around *T+3*, as around that time, judging from market returns alone, the buying pressure from the beginning of the month cash distributions starts to subside.

We begin our investigation by determining the relevant time periods before and after the event date, *T-3*. Theoretically, an institution facing cash liabilities at the month end would like to hold their target stock allocations for as long as possible to continue harvesting the risk premia that accrue to equity investors over time. However, there may be transaction costs and other considerations that deter the institution from selling at the close of *T-4* and encourage distributing the sales over the preceding hours and days. In the spirit of being conservative, we begin our analysis by considering the five business days, *T-8* to *T-4* as the

period over which we expect selling pressure by institutions facing month-end cash liabilities.

Following the month-end settlement, part of the cash distributed to salaried employees and pensioners gets reinvested in the stock market via 401k contributions (often automatic) and self-directed investments. This effect has been studied extensively in the existing literature, which reports above-average stock returns from the last business day of the month until the third business day of the month, i.e. from *T* to *T+3* (see e.g., McConnell and Xu, 2008). We include this period as part of our study but separate it from the days before the month end and the returns after *T+3*.

We illustrate some key events of our study in Figure 2 along with the daily average returns of the CRSP value weighted stock index for each business day surrounding the month end. Consistent with our understanding of the events, average returns are low from *T-8* to *T-4* (selling pressure) and high from *T-3* to *T-1* (return reversal). As money begins to get reinvested in the market at the month end and shortly after the month end, returns are again high from T to *T+3* (buying pressure) and low from *T+4* to *T+8* (return reversal). The differences in returns are economically meaningful: for example, the average annualized S&P 500 return from *T-8* to *T-4* is -3.4% versus 28.6% from *T-3* to *T+3*.[8]

[INSERT FIGURE 2 HERE]

We can observe similar return patterns in other developed markets, as displayed in Table 1. For all of the 24 markets in our sample, returns are statistically indistinguishable from zero over the selling pressure periods (*T-8* to *T-4*) and positive and statistically significant over the reversal/buying pressure period from *T-3* to *T+3*. Importantly, in Table 2 we establish a time-series relationship between low returns over the selling pressure period of *T-8* to *T-4* and the returns over the reversal period *T-3* to *T-1*: in all of the 24 markets the correlation of returns between these two periods is negative and in 18 out of 24 markets the correlation is

[8] Interestingly, the average excess returns that accrue to investors during the seven business days around the turn of the month cannot be explained by exposures to well-known risk factors: the CAPM alpha of the strategy is 5.6% per annum, the Fama and French (1993) three-factor alpha is 6.2% per annum; and the alpha with respect to a five-factor model that also includes the momentum factor of Carhart (1997) and the liquidity factor of Pastor and Stambaugh (2003) is 6.3% per annum. All alphas are statistically significant at the 1% level. Results are qualitatively similar if instead of the CRSP value weighted index returns we use the S&P 500 index returns in the alpha calculations.

statistically significant. This evidence suggests that the below-average returns over the selling pressure periods are associated with above-average subsequent return reversals. Similarly the time-series correlation between the returns on days *T* to *T+3* and the subsequent five days' returns is either insignificant or negative and statistically significant (in 12 of the 24 markets). These negative correlations are consistent with our hypothesis that there is initially selling pressure and then buying pressure from investors around the turn of the month.[9]

[INSERT TABLE 1 AND 2 HERE]

4. Cross-sectional evidence

4.1 Return reversals in the cross-section of stock returns

We begin our cross-sectional investigation with a straightforward extension of our aggregate stock market study. Concretely, we sort the stocks in the CRSP universe each month based on their performance over the period where we expect selling pressure, *T-8* to *T-4*, and observe their average returns over the subsequent three days where we expect reversals, *T-3* to *T-1*, and over the subsequent four days, *T* to *T+3*, which includes the month end and days where we expect reinvestment-driven buying pressure. The results, displayed in Table 3 demonstrate that stocks with the poorest performances over the selling pressure period tend to exhibit best average performances over the subsequent three and seven days. The relationship holds monotonically across our decile portfolios, formed based on stocks' each month's *T-8* to *T-4* returns. The difference in average returns between the lowest and the highest decile portfolios is both statistically and economically significant: 0.8% over the three-day period *T-3* to *T-1*, and 0.5% over the next four-day period *T* to *T+3*.[10]

[INSERT TABLE 3 HERE]

[9] The results from the emerging markets are mixed. We regard this as evidence in favor of our hypothesis that the observed return reversals in developed markets are driven by efficient balance sheet management by institutional investors who are conscious of transaction costs and liquidity issues. We discuss these considerations in the next section. The unreported results from the emerging markets are available from the authors.

[10] In our sample we eliminate penny stocks and the smallest market capitalization stocks out of our cross-sectional sample, by requiring that the stock price is at least $5 and the stock's market capitalization is at least equal to the 10th percentile of the NYSE at the 10th trading day of a month.

For completeness, we also conduct an analogous exercise for the period, *T+4* to *T+8*, where we expect reversal from the beginning of the month buying pressure. The results, displayed also in Table 3, demonstrate that the *T+4* to *T+8* average returns across the decile portfolios sorted based on *T* to *T+3* returns decline in the *T* to *T+3* returns with a large and statistically significant difference in average returns between the extreme deciles.

We conclude that the month-end return patterns we observed for aggregate market indices also hold for portfolios of individual stocks and the strength of return reversals is inversely proportional to the stocks' performance over the selling/buying pressure periods.

4.2 Mutual fund ownership and month-end stock returns

We proposed that the return reversals in aggregate stock returns at the turn of the month are likely driven by sales of stocks by institutional investors with month-end cash liabilities. If so, we would expect the stocks owned in greater proportions by such investors to exhibit stronger return reversals. While we do not directly observe the holdings of pension funds, whose payment obligations are predominantly clustered at the month end (Figure 3A), we do observe the holdings of their agents, mutual funds, which provide an easy and efficient implementation vehicle for diversified equity investments for pension funds. In addition to the pension funds' payment schedule, the dividend payments of mutual funds themselves also tend to cluster around the turn of the month (Figure 3B).[11] Furthermore, the dividends of corporations received by mutual funds are also predominantly paid around the turn of the month (Figure 3C). For all of these reasons we suspect that the turn of the month effects are more pronounced in the stocks that are commonly held by mutual funds.

[INSERT FIGURE 3]

To investigate the link between mutual fund ownership and month-end return patterns, we sort the US stocks in each month by mutual funds' collective ownership percentage in the previous month and form decile portfolios. We then compute the average returns of these portfolios near the turn of the month. The results are displayed in Figure 4. Consistent with our hypothesis, the stocks that are held to a greater extent by mutual funds in a given month tend to experience monotonically lower returns over the selling pressure periods, from *T-8*

[11] The only exception is the month of December where the dividend payments are more evenly distributed.

to *T-4*. These same stocks also experience greater returns over the subsequent three days from *T-3* to *T-1* (and, in fact, also over the seven day period *T-3* to *T+3*), and again monotonically lower average returns from *T+4* to *T+8*. Finally, the correlation between *T-8* to *T-4* and *T-3* to*T-1* returns is more negative for those stocks that are more commonly held by mutual funds.

[INSERT FIGURE 4 HERE]

In addition, the correlation between the *T* to *T+3* and *T+4* to *T+8* returns is negative only for the value weighted portfolios of stocks in the six highest deciles of mutual fund ownership. All these pieces of evidence suggest that mutual funds, and other institutions with a month-end cash cycle, are a major force in the turn of the month phenomenon. It is therefore possible that the increase in the size of the mutual fund industry is an important factor contributing to the fact that the turn of the month anomaly, and the return reversals around the turn of the month, have become if anything *more* pronounced over the years. In what follows, we present some evidence to support this hypothesis.

Figure 5 displays the correlations of *T-8* to *T-4* returns and the *T-3* to *T-1* returns for different equity indices across countries along with the percentage of the market capitalization that is held by mutual funds within each country. It seems that the return reversals around *T-3* are indeed larger in countries where mutual funds are more prevalent. In Figure 6, in turn, we plot the 5-year average of this correlation for US together with the percentage of the market that is held by mutual funds. Again, it seems that the growth of the mutual fund industry has occurred concurrently with the observed strengthening of month-end return reversals over time.

[INSERT FIGURES 5 and 6 HERE]

Finally we use regression analysis to confirm this possible relationship between the size of the mutual fund industry and the amount of return reversal around *T-3*. Our results, presented in Table 4, show that the size of the mutual fund industry (normalized by stock market capitalization) has a statistically significant relationship with the degree of return reversal around the turn of the month. The result holds for both a value weighted stock index of the US market as well as for the S&P 500 index.

[INSERT TABLE 4 HERE]

4.3. Other evidence that mutual funds affect the turn of the month patterns

To further investigate the reasons why return patterns at the turn of the month may be related to mutual fund ownership, we turn to the agency relationship between the mutual fund manager and the end investor. Because of this agency relationship, mutual fund managers might become unwilling to take risk near the month end: If a manager's month-to-date return has been good, he might be tempted to "close the books" and reduce additional risk taking. Similarly, if a manager's month-to-date return has been poor, he might *also* want to reduce additional risk taking to avoid having to report even poorer returns that might spark outflows (see e.g. Sirri and Tufano, 1998). Given such agency problems, it is plausible that mutual funds' willingness to take risk is decreased as the month goes by.

The evidence presented in Table 5 and Figure 7 support this idea of month-end risk reduction. In Table 5, we show that the average betas of mutual funds are abnormally low from *T-5* to *T-3*. This result can arise from the average mutual fund's need to sell assets prior to *T-3* to meet its month-end cash demands, or it can be a reflection of its willingness to take less risk near the end of the month. The finding in Figure 7 that mutual funds' volatility decreases as the month goes by can also be linked to either the average fund's willingness to take less risk or its tendency to accumulate cash to meets its payments near the month end. Irrespective of which one of these forces ultimately drives mutual funds' behavior near the month end, such behavioral patterns can contribute to the predictability of stock market returns around *T-3* that we documented in Section 3.

[INSERT TABLE 5 AND FIGURE 7 HERE]

4.4 The effect of stock characteristics on turn of the month returns

If the behavior of sophisticated investors is indeed inducing patterns in month-end stock returns, they should at least be trying their best to avoid it. That is, any month-end liquidity needs should be met with sales of liquid stocks, with minimal price impact and transaction costs. To investigate this hypothesis, we sort the stocks in the CRSP universe based on different characteristics that could be associated with transaction costs. The results are shown in Table 6.

Consistent with the idea that mutual funds seek to meet their liquidity needs with minimal transaction costs, we find that the correlation between *T-8* to *T-4* and *T-3* to *T-1* returns is most negative for the most liquid, large cap stocks. Similarly, the return reversals around *T+3* are only significant for the largest and most liquid stocks.[12]

Furthermore, if the patterns we observe are in part due to mutual funds' eagerness to reduce risk near the month end, they should do so by reducing their holdings of risky but liquid stocks. We investigate this idea in Table 7, which reports returns and correlations around the month end within quartiles of stocks sorted by volatility, controlling for liquidity. Consistent with our intuition, we find that return reversals around *T-3* are most pronounced for the most volatile, yet liquid stocks.

5. Do hedge funds mitigate turn of the month return reversals?

In this section we investigate the behavior of hedge funds near the month end, looking for evidence on their ability to mitigate the predictable patterns in market returns. Our evidence is mixed. First, in Table 8, we show that the average market beta of hedge funds near the month end behaves similarly to the average beta of mutual funds. This suggests that hedge funds do not provide liquidity to the mutual funds who reduce their risks near the month, as one might have expected. In case of hedge funds, the month end patterns in betas may be related not only to their concerns related to their own monthly return reporting cycles, but also to the fact that their infrequent subscription and redemption times are commonly set at the ends of calendar months. This further increases their concerns about their returns near the end of the month and it leads to a month end cash cycle in hedge funds. Supporting the latter reason for time variation in hedge funds' market betas, we find that the patterns in hedge fund betas are more pronounced for those funds with less frequent redemption periods (and presumably larger in- and outflows at times of subscription and redemption). Therefore, it appears that cash cycle constraints and concerns related to fund flows affect

[12] For smaller and less liquid stocks return correlations between *T* to *T+3* and *T+4* to *T+8* are positive. This suggests that the institutions purchasing the least liquid stocks in the beginning of the month make their purchases gradually, continuing past the first three days of the month. Thus, again, they appear to operate conscious of transaction costs. Previously, a different linkage between liquidity and the turn of the month returns has been studied in Booth et al. (2001). They present evidence that stocks' liquidity increases after the turn of the month, possibly contributing to the positive returns after the turn of the month.

hedge funds' ability and willingness to take risk around the turn of the month very much in the same way as they affected mutual funds.

[INSERT TABLE 8 HERE]

If neither hedge funds nor mutual funds can or want to take risk near the month end, we would expect the stock market turnover to decrease also. We confirm this intuition in Figure 8; trading volume is substantially lower than average during the last few trading days of the month.

[INSERT FIGURE 8 HERE]

While the hedge fund industry in aggregate does not seem to accommodate market-wide selling pressure near the month end, it is possible that a subset of hedge funds do so. Indeed, we study the behavior of different hedge fund strategies and find that Managed Futures and Global Macro funds have abnormally large positive exposures to the market on day *T-3* (see Table 9). This suggests that some hedge funds do provide liquidity at time T-4, counterbalancing the selling pressure from other institutions.

[INSERT TABLE 9 HERE]

Furthermore, we find that the ability of hedge funds to take leverage significantly affects the month-end return patterns (see Table 10). Specifically, the interaction of hedge funds' cost of leverage and the return from *T-8* to *T-4* is a statistically significant predictor of the returns from *T-3 to T-1*. We proxy hedge funds' cost of leverage by the TED spread multiplied by the hedge fund AUM (scaled by the market capitalization of the US stocks). These findings suggest that when TED spread is low, hedge funds are better able to counterbalance month-end selling pressure.

[INSERT TABLE 10 HERE]

6. Conclusion

In this paper, we attempt to provide a comprehensive analysis of month-end equity return patterns and tie them to the literature on limits of arbitrage. We are the first to document a strong return reversal around the most common last settlement day of the month, *T-3*, which guarantees cash for month-end distributions. This return reversal exists both in the time series of US stock index returns, in the cross-section of US stock returns and in the time series of most of the developed markets' stock indices. We argue that the reversal is caused mainly by the month-end cash cycle – which, as previously argued by Odgen (1990), is also the likely cause of the abnormally high returns on the last and the first three trading days of the month. Nonetheless, also institutional investors' agency concerns are likely to play a role.

To shed some light on the underlying market dynamics, we present extensive evidence that links the return reversals around *T-3* to mutual funds' trading. For example, within the cross-section of individual stocks, we show that the turn of the month return reversals are more pronounced among stocks that are more commonly held by mutual funds, and stocks that are arguably easier to use for cash management, such as large and liquid stocks. Controlling for liquidity, we find that the reversals are stronger for more volatile stocks, consistent with the idea that mutual funds may seek to reduce portfolio risk toward the month end for agency reasons. At an aggregate level, we show that the return reversals near the turn of the month have only intensified as mutual funds' AUM as a proportion of the overall stock market has increased. Indeed, in international samples, the return reversals seem to be more pronounced in countries with larger mutual fund sectors.

Our results are of importance as they tie the large existing literature on turn of the month anomalies to rational models of markets with temporally segmented investors. Because of active turn of the month trading by many institutions, we believe our findings have also significant practical implications.

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Figure 1

Cumulative turn of the month returns

This figure shows the cumulative returns from investing in the CRSP value weighted total return stock index only on days *T-3* to *T+3* around the turn of the month and the cumulative returns from investing only on the other days. Sample period is from January 1926 to December 2013. Logarithmic scale.

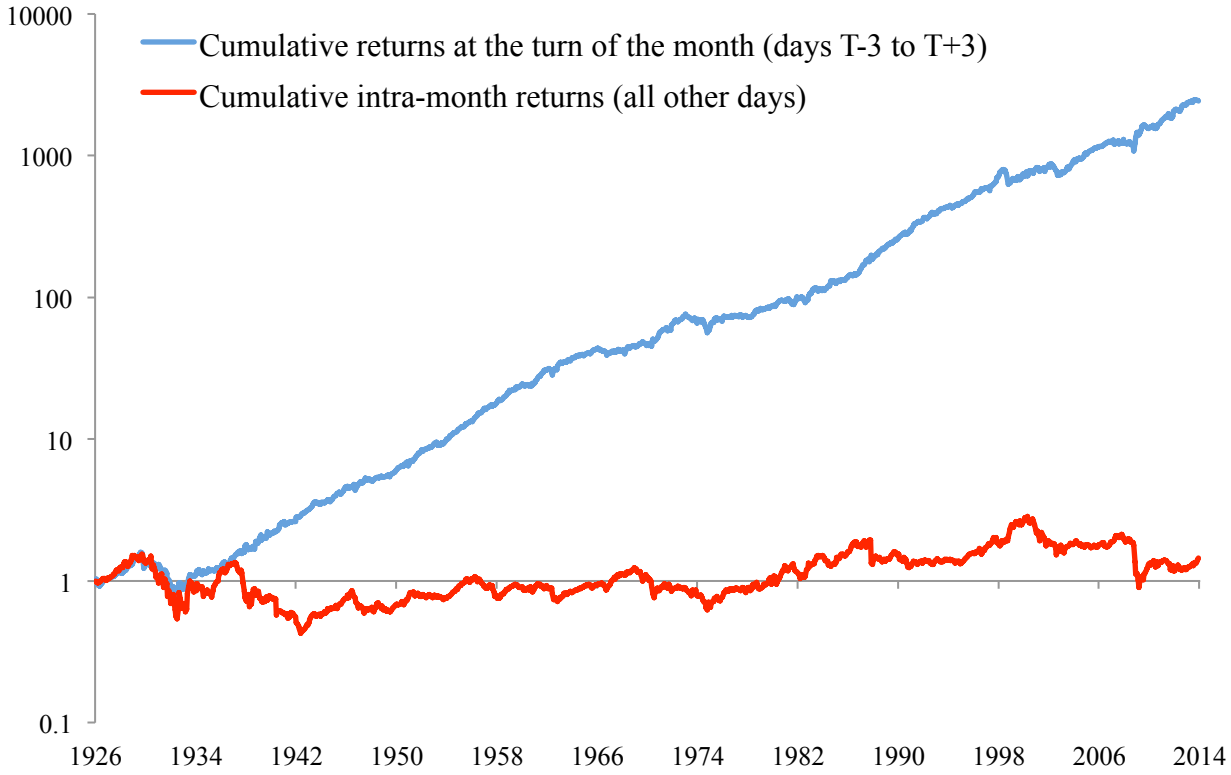


Figure 2

Daily returns around the turn of the month

This figure shows the average daily returns on the CRSP value weighted stock index around the turn of the month. Day zero denotes the last trading day of the month and -1 the trading day preceding that, and so on. The sample period is from January 1980 to the end of 2013.

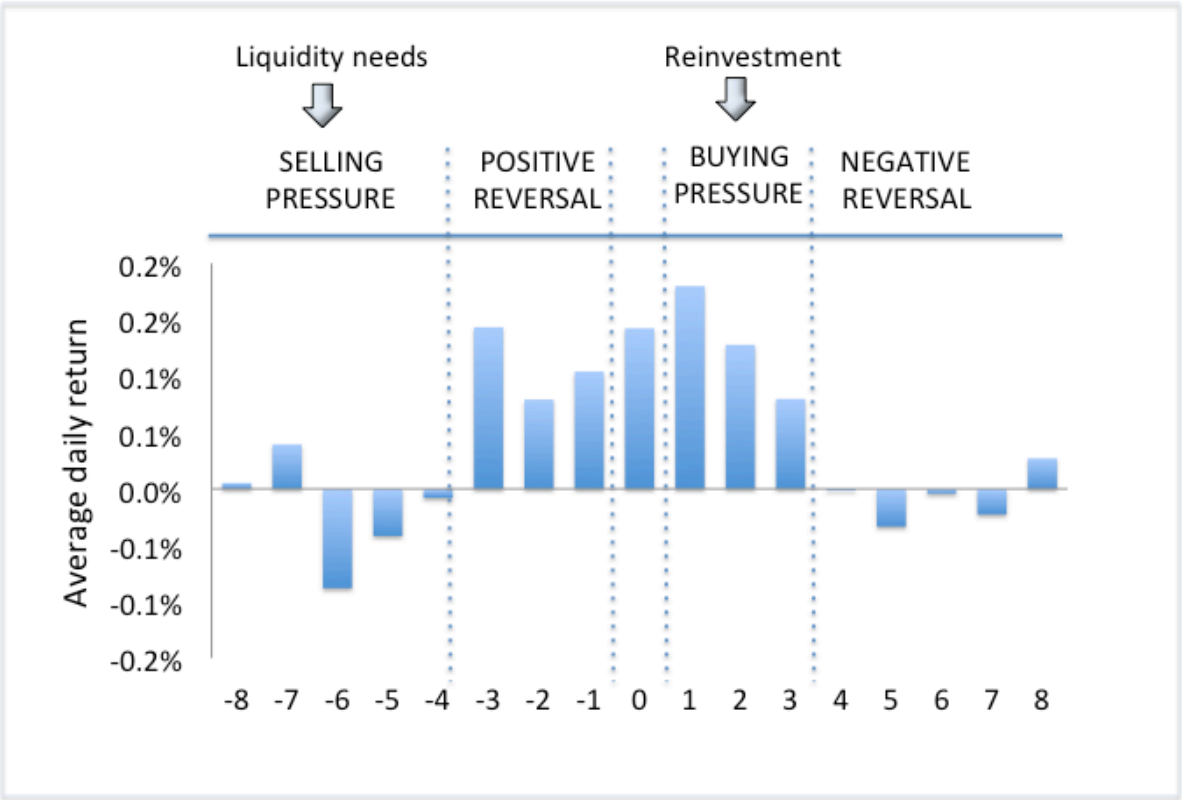


Figure 3A

Pension fund payment dates around the turn of the month

This figure shows the proportion of pension payment dates of the largest US public pension plans around the turn of the month. The data, obtained from Pension & Investment 300 Analysis (2012) by Tower Watson and individual pension fund websites, include 15 of the 19 largest US public pension plans. An assumption has been made that the most recent reported payment dates have remained the same from January 1980 to December 2013.

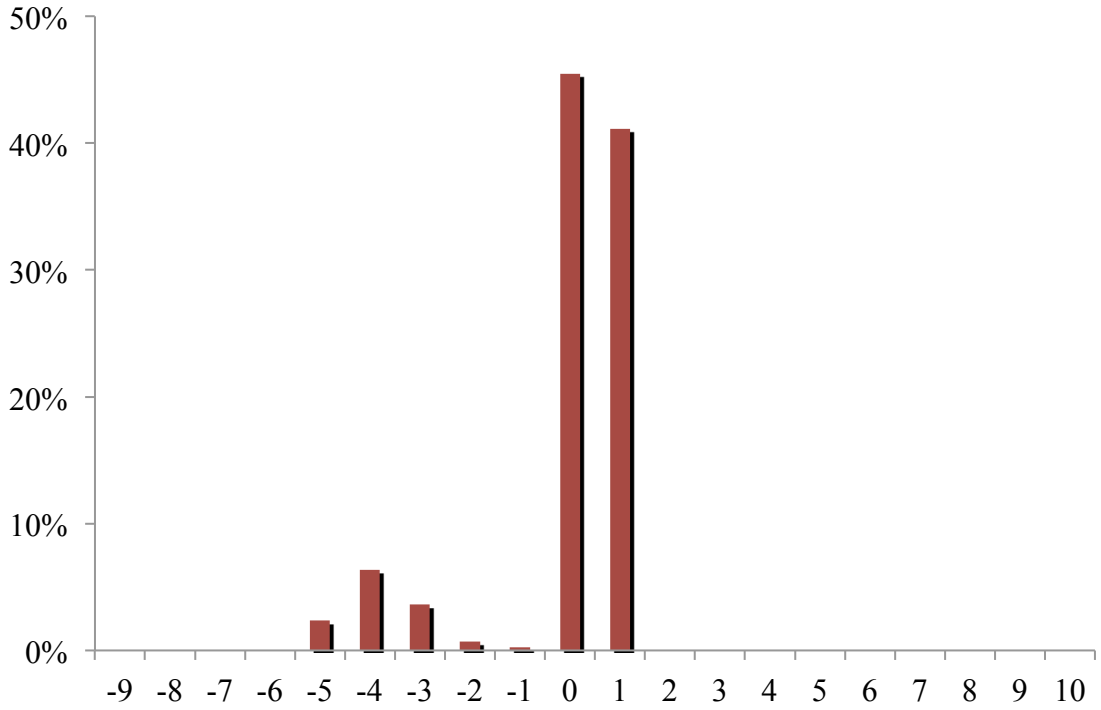
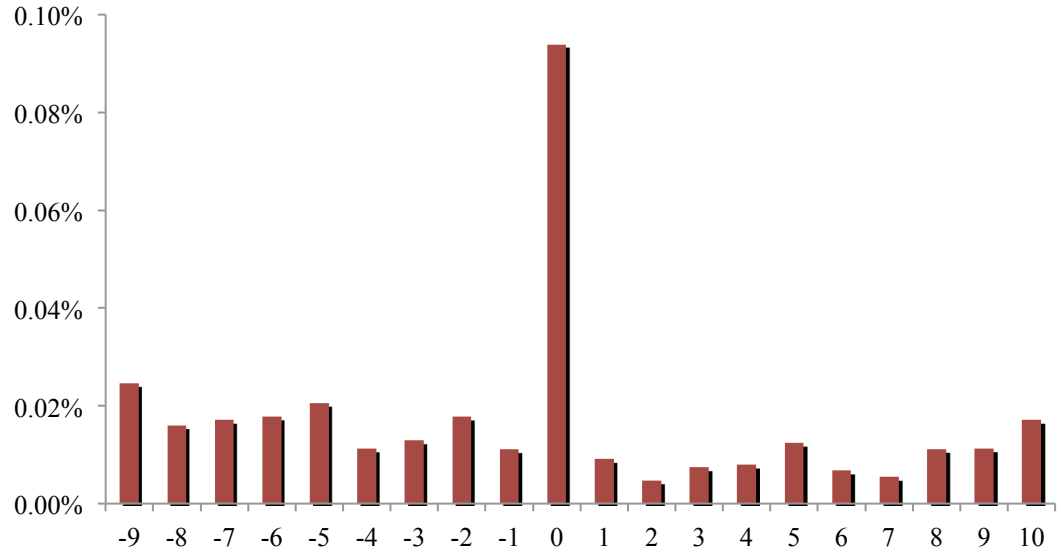


Figure 3B

Mutual fund distributions around the turn of the month

This figure displays mutual funds' distributions around the turn of the month. The distributions are normalized by the aggregate mutual funds' assets under management. The sample consists of all the funds in the CRSP Survivor-Bias-Free US Mutual Fund database. The sample period is from January 1980 to December 2013. The first panel shows the mutual funds' distributions based on all months and the second panel excludes the December observations.

All months



Excluding Decembers

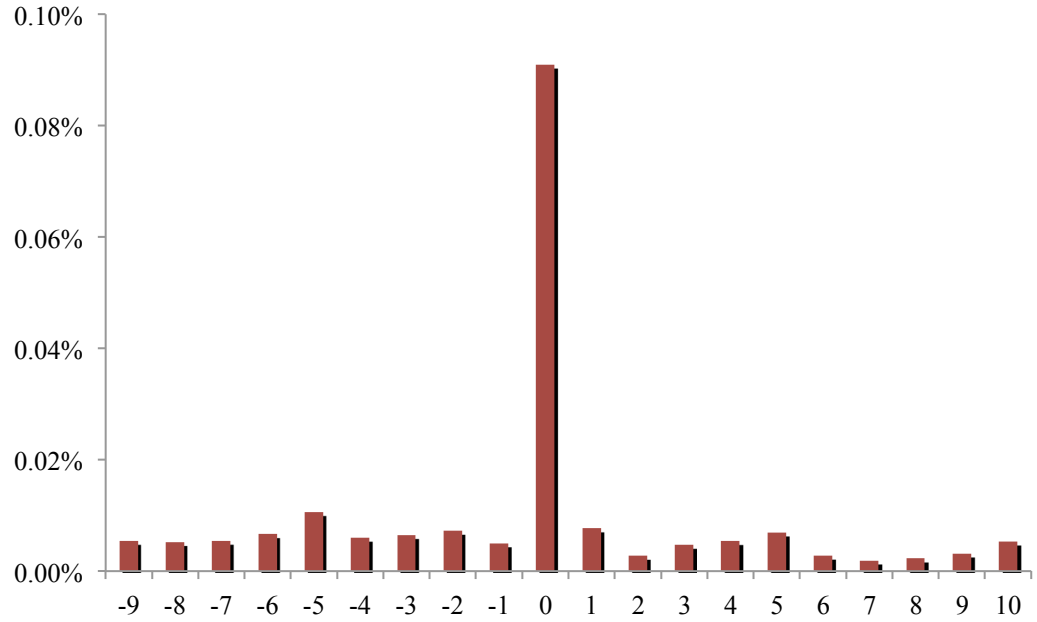


Figure 3C

Corporate dividend payment dates around the turn of the month

The figure shows the proportion of dividend payments by CRSP companies occurring around the turn of the month. The sample period is from January 1980 to December 2013.

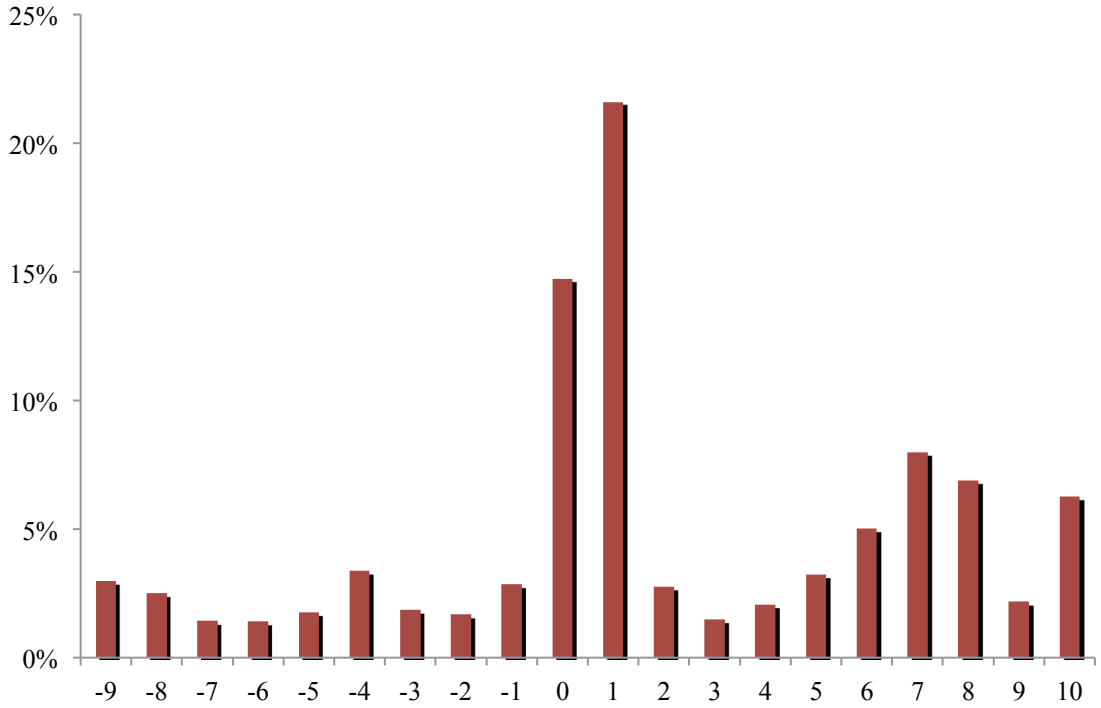


Figure 4

The effect of mutual fund holdings on the turn of the month patterns

This figure shows value- and equal-weighted returns around the turn of the month in deciles of stocks sorted by our estimates of the mutual funds' total ownership percentages of stocks in the previous month. Our sample consists of all CRSP stocks owned by at least one mutual fund (in Thomson Reuters Mutual Fund Holdings database). Sample period is from January 1980 until December 2013. Panel A documents the returns from T-8 until T-4, Panel B the returns from T-3 to T-1, Panel C the returns from T to T+3 and Panel D the returns from T+4 to T+8. Panel E shows the correlation of T-8 to T-4 and T-3 to T-1 returns and Panel F the correlation of T to T+3 and T+4 to T+8 returns in different mutual fund ownership deciles. 10 = highest ownership decile.

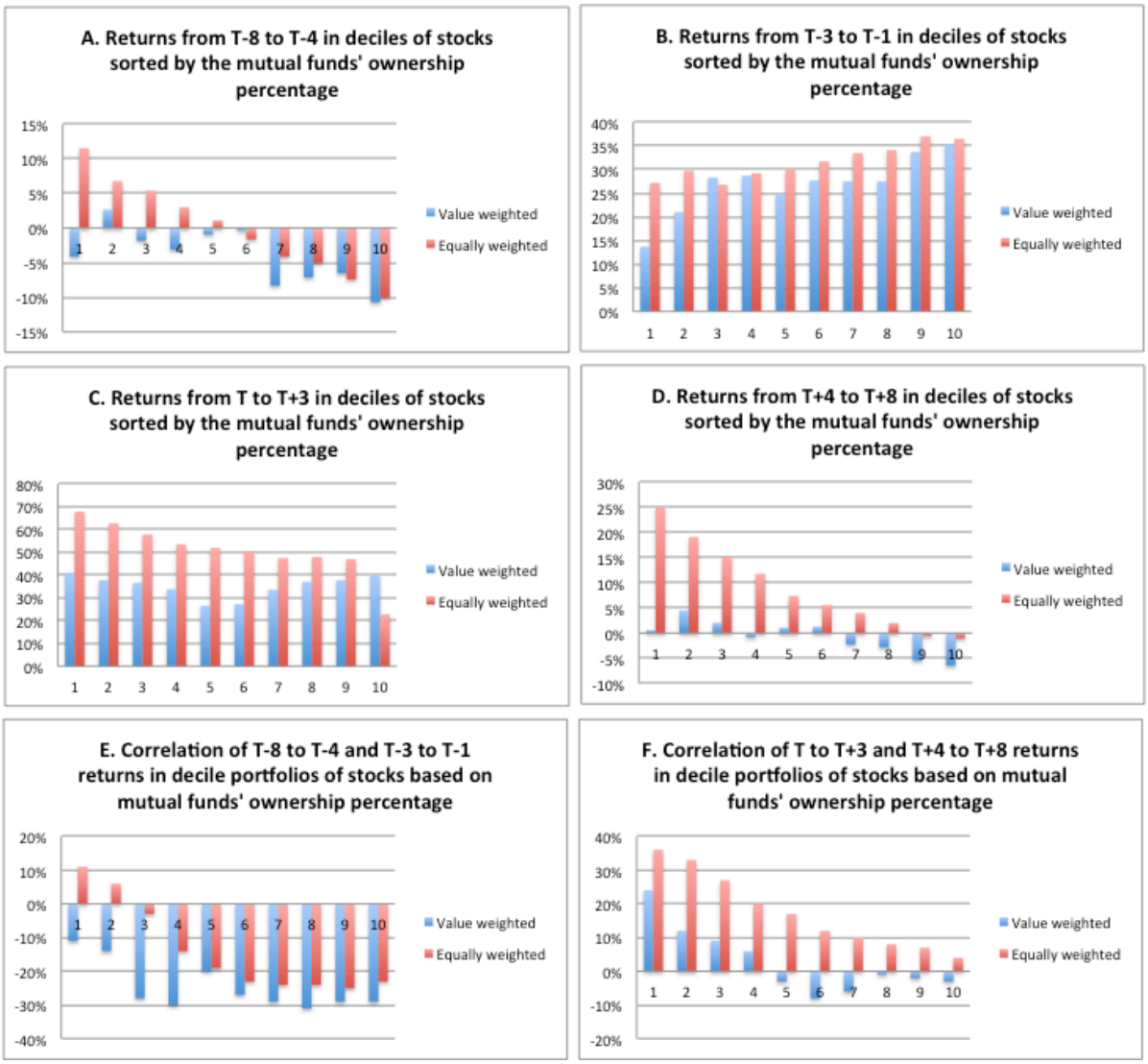
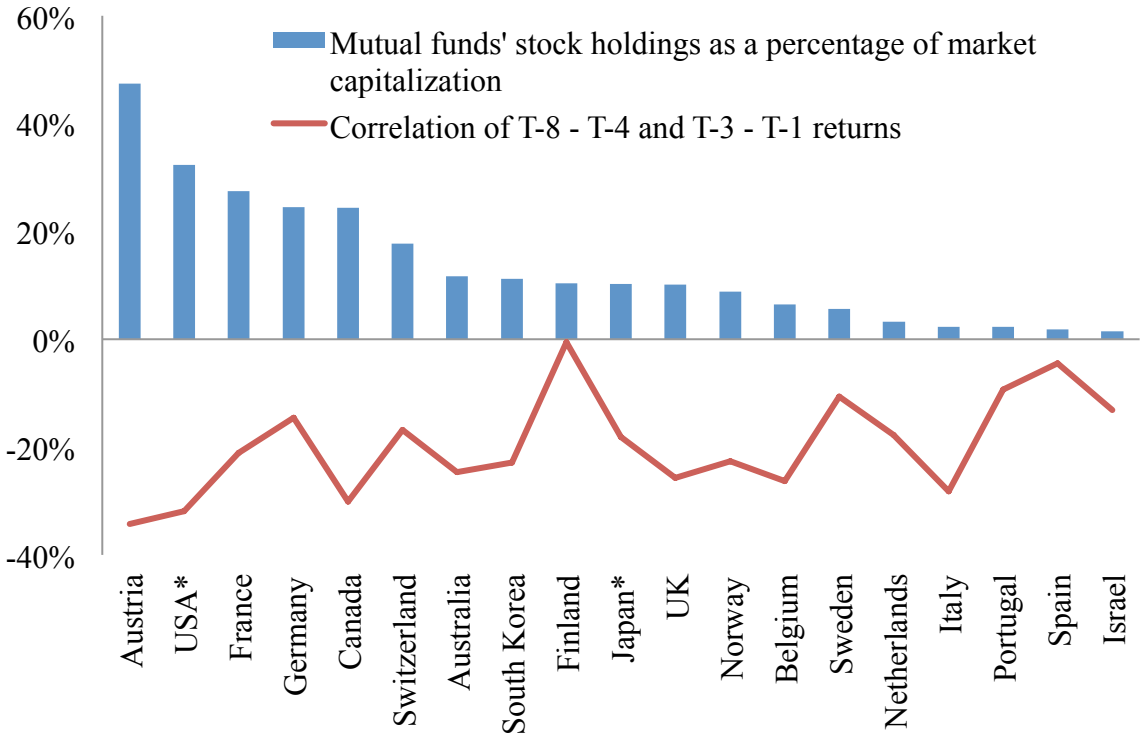


Figure 5

Mutual fund stock holdings as a percentage of stock market capitalization and the correlation of *T-8* to *T-4* and *T-3* to *T-1* returns across countries

This figure shows the mutual funds' domestic stock holdings as a percentage of total market capitalization of the country and the correlation of *T-8* to *T-4* and *T-3* to *T-1* returns, reprinted from Table 2. The stock holdings percentage is an average of annual observations from 2008 until 2012. Our sample includes all countries from Table 2 for which the relevant data are available from OECD's Institutional Investor assets dataset. Total market capitalization data are from World Bank. For some countries, only total stock holdings (i.e. holdings including both domestic and foreign stock holdings) by mutual funds is available. Out of these countries, we have included USA and Japan (denoted with star in figure) in our sample due to their large domestic equity markets. Denmark and Ireland, where only the mutual funds' total stock holdings are available are excluded. Finally, Luxembourg is excluded as the domestic stock holdings reported exceed the total market capitalization of the Luxembourg stock exchange.



* Includes both stocks issued by residents and non-residents

Figure 6

Mutual funds' share of the US stock market and the rolling correlation of *T-8* to *T-4* and *T-3* to *T-1* market returns

This figure shows the correlation of *T-8* to *T-4* and *T-3* to *T-1* returns over time using a 5-year moving window. In addition, the figure shows mutual funds' aggregate assets under management as a percentage of the US stock market capitalization.

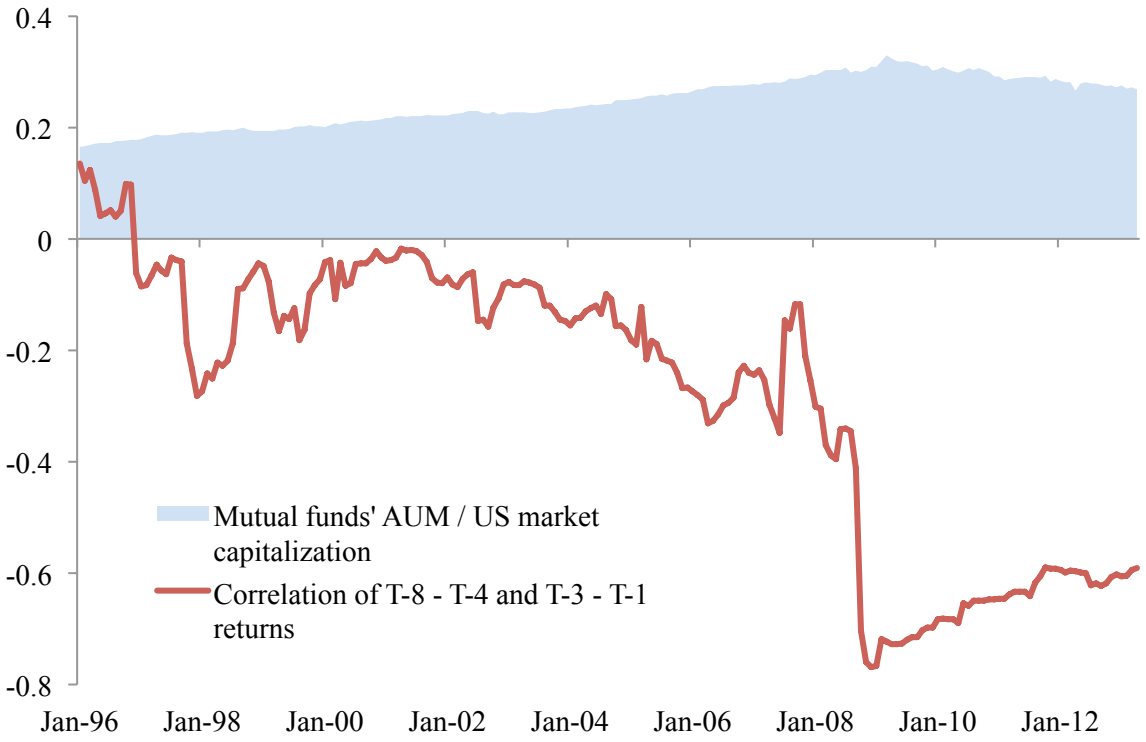


Figure 7

Mutual fund return volatility in different days of the month relative to average daily return volatility

This figure shows how mutual funds' return volatility behaves throughout the month by showing the funds' average volatilities observed during each day of the month, normalized by the funds' average daily return volatility. The daily mutual fund returns are from CRSP. The sample period is from September 1998 until December 2013. Note that the number of observations decreases when the number of business days from the start of the month increases.

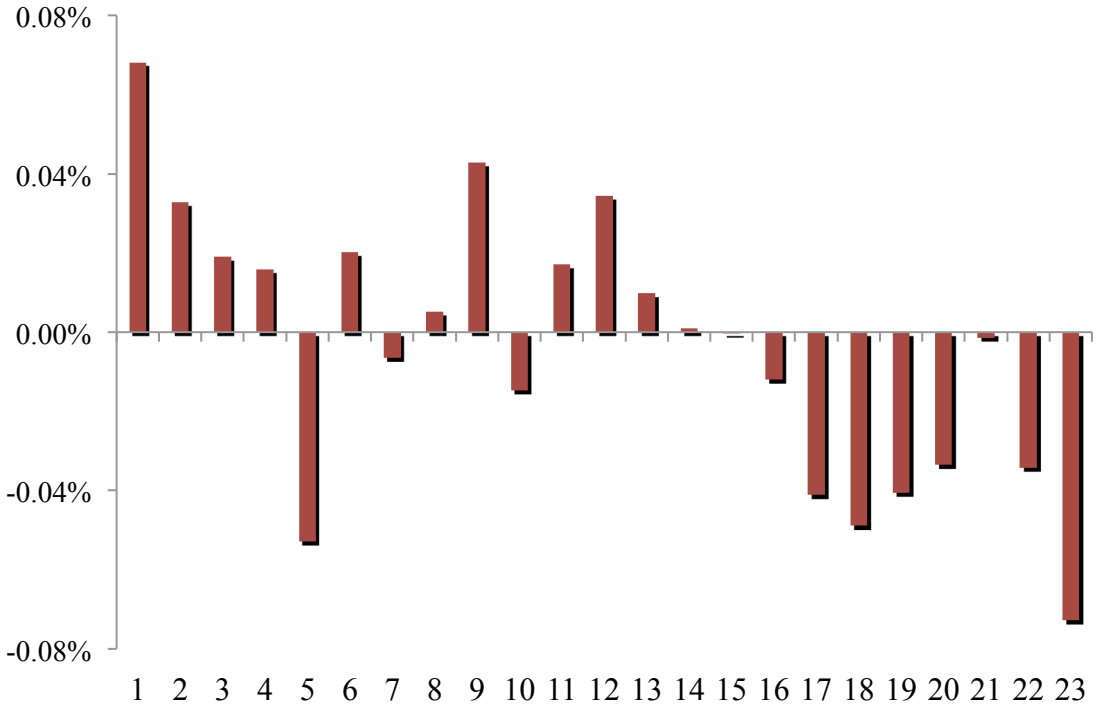


Figure 8

Turnover around the turn of the month

This figure shows the stocks' average daily turnover on days around the turn of the month in excess of the average daily turnover outside the turn of the month. The average daily turnover outside the turn of the month refers to the average turnover on days from T+11 of the ending month to T-8 of that month, and from T+5 to T+10 of the month that begins. Turnover is estimated as the CRSP total trading volume in USD divided by the CRSP total market capitalization of the previous day. Our sample period is from January 1980 to December 2013.

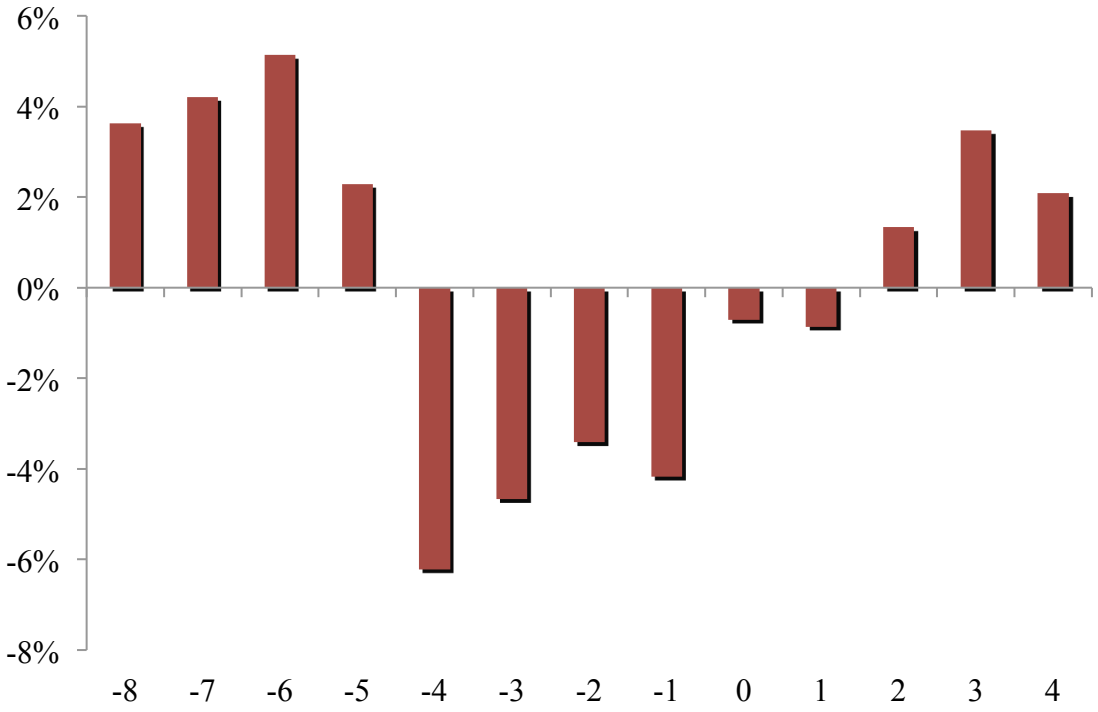


Table 1

Annualized returns around the turn of the month

This table presents the annualized returns around the turn of the month in G-10 countries as well as in several other industrialized countries. Our sample starts in January 1980 or later when the relevant data becomes available, and runs until the end of 2013 (to be precise, until the 8th trading day of 2014). All figures that statistically significantly differ from zero at a 5% significance level are bolded.

Country	Index	Sample starts	Annualized return T-3 - T-1	Annualized return T	Annualized return T+1 - T+3	Annualized return T-8 - T-4	Annualized return T+4 - T+8	Annualized return on other days
United States	S&P500	Jan-80	**27.1%**	20.3%	**33.1%**	-3.4%	-1.9%	**17.5%**
United States	CRSP VW	Jan-80	**27.3%**	**35.6%**	**32.4%**	-4.7%	-2.1%	**14.6%**
Other G10 countries								
Belgium	BEL20	Jan-90	16.1%	**50.0%**	**37.0%**	-13.0%	-6.4%	15.4%
Canada	S&P/TSX C	Jan-86	16.6%	**58.8%**	**24.9%**	-5.0%	-1.8%	7.6%
France	CAC40	Jan-88	**35.4%**	**49.2%**	**33.7%**	-5.8%	-12.2%	14.7%
Germany	DAX	Jan-80	14.0%	**39.0%**	**53.2%**	-8.6%	-10.4%	**18.4%**
Italy	FTSE MIB	Jan-98	30.0%	21.9%	21.2%	-13.8%	-17.7%	15.5%
Japan	NIKKEI225	Jan-80	**28.4%**	27.6%	18.3%	1.6%	-14.0%	2.1%
Netherlands	AEX	Jan-83	**17.9%**	**36.4%**	**45.2%**	-1.3%	-5.7%	**19.5%**
Sweden	OMXS30	Jan-86	**29.6%**	**39.5%**	**51.5%**	-8.1%	-0.6%	11.9%
Switzerland	SMI	Jul-88	**23.0%**	27.1%	**37.1%**	-10.4%	-1.9%	14.3%
UK	FTSE100	Jan-86	**26.6%**	23.7%	**37.4%**	-11.7%	-0.8%	**19.2%**
Other industrialized countries								
Australia	S&P/ASX200	Jun-92	**29.2%**	**37.8%**	**21.3%**	2.7%	-7.3%	11.4%
Austria	ATX	Jan-91	**34.3%**	**43.1%**	**45.3%**	0.2%	-15.5%	-10.2%
Denmark	OMXC20	Dec-89	18.4%	**34.4%**	**44.3%**	-14.5%	0.8%	19.0%
Finland	OMXH25	Jan-91	29.7%	**81.7%**	**41.2%**	-3.5%	-4.9%	11.9%
Hong Kong	HSI	Jan-80	20.3%	**65.8%**	**39.0%**	-2.5%	7.9%	**28.6%**
Ireland	ISEQ OVER	Jan-88	8.3%	**64.1%**	**41.5%**	-6.0%	-4.1%	13.6%
Israel	TA-25	Jan-92	19.8%	41.5%	**43.6%**	-0.9%	10.4%	-0.1%
Luxembourg	LUXX	Jan-99	25.5%	**51.7%**	21.9%	-8.6%	1.1%	-7.3%
New Zealand	NZX50	Jan-01	**29.8%**	**63.7%**	16.6%	-0.5%	-10.8%	4.8%
Norway	OBX	Jan-87	18.6%	**64.3%**	**42.5%**	-4.1%	-3.7%	12.5%
Portugal	PSI-20	Jan-93	9.6%	17.7%	**41.3%**	-11.2%	6.7%	2.2%
Singapore	STI	Sep-99	24.0%	**42.2%**	**37.4%**	-5.7%	2.3%	-19.2%
South Korea	KOSPI	Jan-80	3.2%	**84.0%**	**42.2%**	1.2%	9.1%	-12.7%
Spain	IBEX35	Mar-87	20.5%	**38.6%**	**36.3%**	-10.4%	-1.8%	**30.3%**
Average of all indexes			22.4%	44.6%	36.1%	-5.7%	-3.3%	9.8%

Table 2

Correlations around the turn of the month

This table presents the correlation of the returns from T-8 to T-4 and T-3 to T-1; as well as the correlation of the returns from T to T+3 and T+4 to T+8. Our sample period starts in January 1980 or when the relevant data becomes available. The sample runs until end of 2013 (to be precise, until the 8th trading day of 2014). All figures that statistically significantly differ from zero at a 5% significance level are bolded.

Country	Index	Sample starts	Correlation of T-8 - T-4 and T-3 - T-1 returns	Correlation of T - T+3 and T+4 –T+8 returns	Daily return auto-correlation	Weekly return auto-correlation
United States	S&P500	Jan-80	**-0.30**	-0.09	**-0.03**	**-0.05**
United States	CRSP VW	Jan-80	**-0.32**	-0.03	0.01	-0.02
Other G10 countries						
Belgium	BEL20	Jan-90	**-0.26**	**-0.23**	**0.07**	-0.03
Canada	S&P/TSX C	Jan-86	**-0.30**	0.05	**0.03**	-0.05
France	CAC40	Jan-88	**-0.21**	**-0.20**	-0.01	-0.04
Germany	DAX	Jan-80	**-0.15**	**-0.15**	0.00	-0.02
Italy	FTSE MIB	Jan-98	**-0.28**	-0.04	0.00	-0.01
Japan	NIKKEI225	Jan-80	**-0.18**	0.00	-0.02	-0.02
Netherlands	AEX	Jan-83	**-0.18**	**-0.21**	0.00	0.03
Sweden	OMXS30	Jan-86	-0.11	**-0.11**	**0.04**	-0.02
Switzerland	SMI	Jul-88	**-0.17**	**-0.24**	**0.03**	**-0.07**
United Kingdom	FTSE100	Jan-86	**-0.26**	**-0.20**	0.00	-0.05
Other industrialized countries						
Australia	S&P/ASX200	Jun-92	**-0.25**	**-0.12**	-0.01	-0.04
Austria	ATX	Jan-91	**-0.34**	-0.07	**0.08**	0.01
Denmark	OMXC20	Dec-89	**-0.38**	-0.02	**0.06**	-0.05
Finland	OMXH25	Jan-91	-0.01	**-0.19**	**0.04**	0.02
Hong Kong	HSI	Jan-80	**-0.19**	-0.04	**0.03**	**0.08**
Ireland	ISEQ OVER	Jan-88	-0.11	**-0.25**	**0.07**	0.00
Israel	TA-25	Jan-92	**-0.13**	-0.08	0.02	**-0.07**
Luxembourg	LUXX	Jan-99	**-0.23**	-0.14	**0.07**	0.07
New Zealand	NZX50	Jan-01	-0.03	0.05	**0.05**	0.04
Norway	OBX	Jan-87	**-0.23**	-0.10	**0.03**	0.02
Portugal	PSI-20	Jan-93	-0.09	**-0.15**	**0.11**	**0.07**
Singapore	STI	Sep-99	**-0.35**	-0.06	0.03	0.03
South Korea	KOSPI	Jan-80	**-0.23**	-0.07	**0.06**	**-0.07**
Spain	IBEX35	Mar-87	-0.04	**-0.20**	**0.05**	-0.02
Average of all indexes			-0.20	-0.11	0.03	-0.01

Table 3

Cross-sectional evidence on return reversal around the turn of the month

Panel A shows evidence of cross-sectional return reversals around the turn of the month by showing the returns from T –3 to T – 1 and from T to T+3 for the deciles of stocks sorted by their T-8 to T-4 returns. In Panel B, the table shows the stocks' returns from T+4 to T+8 in the deciles of stocks sorted by their T to T+3 returns. Our sample includes all US stocks in CRSP that have a share price above USD 5, and a market capitalization that exceeds the NYSE 10th market capitalization percentile on the 10th trading day of the relevant month. The sample period is from January 1980 until December 2013. The last column shows the difference in the returns between the two extreme deciles. T-statistics are provided in the parenthesis. All figures that statistically significantly differ from zero at a 5% significance level are bolded.

A: Deciles based on returns from T-8 to T-4

	1	2	3	4	5	6	7	8	9	10	1-10
Return	**0.92%**	**0.54%**	**0.43%**	**0.39%**	**0.37%**	**0.34%**	**0.33%**	**0.31%**	**0.27%**	0.09%	**0.84%**
T-3 - T-1	(5.79)	(4.37)	(3.91)	(3.94)	(4.00)	(3.79)	(3.65)	(3.41)	(2.83)	(0.75)	(8.14)
Return	**0.98%**	**0.80%**	**0.73%**	**0.64%**	**0.61%**	**0.59%**	**0.59%**	**0.54%**	**0.56%**	**0.49%**	**0.49%**
T - T+3	(5.28)	(5.57)	(5.85)	(5.71)	(5.66)	(5.64)	(5.63)	(4.93)	(4.74)	(3.36)	(4.33)

B: Deciles based on returns from T to T+3

	1	2	3	4	5	6	7	8	9	10	1-10
Return	**0.38%**	0.08%	0.03%	0.00%	0.03%	0.01%	0.03%	-0.01%	-0.09%	**-0.37%**	**0.75%**
T+4 - T+8	(2.07)	(0.55)	(0.23)	(0.03)	(0.21)	(0.11)	(0.23)	(-0.06)	(-0.67)	(-2.29)	(7.19)

Table 4

Mutual funds' market betas around the turn of the month

This table shows mutual funds' market betas on various days around the turn of the month relative to their market betas on all other days. The betas are averages from regressions where mutual funds' daily returns are regressed on daily S&P 500 index returns, dummies for days corresponding to their location relative to the turn of the month, and their interactions. In the second column, days 0 and 1 are pooled as there is evidence of abnormally significant return reversal (potentially due to price manipulation) following the last day of the month that otherwise biases downwards the estimates of the daily betas for those days. The mutual funds' daily returns are from the CRSP mutual fund database. The sample period is from September 1998 to December 2013. All figures that statistically significantly differ from zero at a 5% significance level are bolded.

		Coefficient	t-stat	Coefficient	t-stat
Interactions of time period dummies and daily S&P500 returns	T-5	**-0.019**	(-12.54)	**-0.019**	(-12.53)
	T-4	**-0.026**	(-15.41)	**-0.026**	(-15.51)
	T-3	**-0.056**	(-36.43)	**-0.056**	(-36.58)
	T-2	-0.001	(-0.79)	-0.002	(-0.84)
	T-1	**-0.004**	(-3.03)	**-0.004**	(-3.31)
	T	**-0.076**	(-54.38)	0.000	(0.05)
	T+1	0.006	(1.74)		
	T+2	**0.040**	(18.24)	**0.039**	(18.23)
	T+3	**0.019**	(9.00)	**0.019**	(8.99)
	T+4	**-0.008**	(-5.51)	**-0.008**	(-5.52)
	T+5	**-0.029**	(14.17)	**-0.029**	(-14.41)
Daily S&P500 return		**0.836**	(181.40)	**0.837**	(183.51)
Intercept		**0.000**	(-12.37)	**0.000**	(-12.38)
Time period dummies		**Yes**		**Yes**	
Number of funds		6715		6709	

Table 5

Regression analysis on the effect of mutual funds on the turn of the month patterns

This table shows the results from a regression in which the US equity market index returns from T-3 to T-1 are regressed on the T-8 to T-4 returns to the same index, and on the mutual fund industry's assets under management, and its interaction with the T-8 to T-4 index returns. Mutual fund industry's assets under management is the sum of all equity mutual funds' assets under management based on the CRSP mutual fund database, normalized by the US total stock market capitalization. The returns in the first and the third column are the CRSP value-weighted index returns, while in the second and the fourth column they are those of the S&P 500 index. T-statistics based on Newey-West standard errors are shown below the coefficients. All figures that statistically significantly differ from zero at a 5% significance level are bolded.

y = returns T-3 - T-1				
Market return T-8 - T-4	**-0.255**	**-0.241**	**0.535**	0.477
	(-2.63)	(-2.72)	(1.99)	(1.79)
Mutual fund industry AUM			-0.002	-0.006
			(-0.17)	(-0.44)
Interaction of mutual fund industry AUM and market return T-8 - T-4			**-3.289**	**-3.076**
			(-2.43)	(-2.31)
Intercept	**0.003**	**0.003**	0.004	0.005
	(3.69)	(3.65)	(1.38)	(1.52)
R^2	0.102	0.088	0.184	0.170
Index	CRSP VW	S&P 500	CRSP VW	S&P 500
Sample	1/1980-12/2013	1/1980-12/2013	2/1991-4/2013	2/1991-4/2013

Table 6

Liquidity, size and return reversals around the turn of the month

A. This table shows the effect of liquidity on the turn of the month return patterns. Our sample, covering data from January1980 to December 2013, includes all stocks in CRSP listed in the NYSE and the Amex, that have share price above USD 5 on the 10th trading day of the month and a market capitalization that exceeds the NYSE 10th market capitalization percentile. Amihud (2002) ILLIQ measure is calculated as a rolling one year average until the 10th trading day of the month. For stocks sorted into deciles based on their Amihud measure (10 being the most illiquid), the table shows the annualized value-weighted returns on the relevant dates, and the correlations between T-8 to T-4 and T-3 to T-1 returns and T to T+3 and T+4 to T+8 returns, respectively. All figures that statistically significantly differ from zero at a 5% significance level are bolded.

Amihud Decile	Annualized return T-3 - T-1	Annualized return T	Annualized return T+1 - T+3	Annualized return T-8 - T-4	Annualized return T+4 - T+8	Annualized return on other days	Correlation of T-8 - T-4 and T-3 - T-1 returns	Correlation of T - T+3 and T+4 - T+8 returns
1	**27.5%**	13.4%	**31.6%**	-3.9%	-1.3%	**17.1%**	**-0.29**	-0.10
2	**32.4%**	**46.2%**	**32.4%**	-5.4%	-3.3%	**16.0%**	**-0.29**	-0.04
3	**34.8%**	**53.6%**	**35.1%**	-8.2%	-3.0%	**18.2%**	**-0.29**	-0.03
4	**35.2%**	**60.8%**	**31.4%**	-10.4%	-0.6%	**18.4%**	**-0.28**	0.04
5	**37.4%**	**65.5%**	**33.2%**	-8.9%	-1.2%	**14.0%**	**-0.28**	0.03
6	**40.1%**	**73.7%**	**32.6%**	-9.3%	-1.6%	**15.1%**	**-0.28**	0.02
7	**32.7%**	**72.9%**	**32.4%**	-9.0%	0.8%	11.6%	**-0.23**	0.07
8	**35.6%**	**76.2%**	**28.6%**	-8.1%	2.7%	**14.5%**	**-0.26**	0.08
9	**33.7%**	**76.4%**	**31.0%**	-5.5%	3.6%	**15.1%**	**-0.24**	0.07
10	**30.3%**	**72.7%**	**31.9%**	-2.1%	3.9%	9.6%	**-0.18**	**0.10**
Average	34.0%	61.1%	32.0%	-7.1%	0.0%	14.9%	-0.26	0.02

B. This table shows the effect of market capitalization on the turn of month patterns. Our sample, covering data from January 1980 to December 2013, includes all stocks from CRSP that have a share price above USD 5 on the 10th trading day of the month and a market capitalization that exceeds the NYSE 10th market capitalization percentile. For stocks sorted into deciles based on their market capitalization (10 being the largest), the table shows the annualized value-weighted returns on the relevant dates, and the correlations between T-8 to T-4 and T-3 to T-1 returns and T to T+3 and T+4 to T+8 returns, respectively. All figures that statistically significantly differ from zero at a 5% significance level are bolded.

Size Decile	Annualized return T-3 - T-1	Annualized return T	Annualized return T+1 - T+3	Annualized return T-8 - T-4	Annualized return T+4 - T+8	Annualized return on other days	Correlation of T-8 - T-4 and T-3 - T-1 returns	Correlation of T - T+3 and T+4 - T+8 returns
1	**25.8%**	**77.0%**	**19.6%**	-4.1%	2.8%	10.1%	**-0.18**	**0.11**
2	**27.6%**	**76.7%**	**22.5%**	-6.5%	2.7%	11.9%	**-0.16**	**0.12**
3	**32.1%**	**84.7%**	**25.1%**	-7.9%	1.3%	9.1%	**-0.16**	**0.13**
4	**33.5%**	**76.2%**	**25.3%**	-5.9%	0.6%	11.5%	**-0.18**	**0.12**
5	**31.1%**	**73.1%**	**29.8%**	-8.2%	0.3%	11.1%	**-0.17**	0.08
6	**35.2%**	**75.0%**	**31.1%**	-10.7%	1.0%	12.1%	**-0.21**	0.05
7	**34.6%**	**73.1%**	**33.9%**	-9.8%	-1.0%	13.0%	**-0.22**	0.03
8	**34.6%**	**60.8%**	**35.9%**	-9.7%	-0.8%	14.0%	**-0.28**	0.04
9	**32.2%**	**56.4%**	**35.2%**	-8.1%	-1.8%	14.0%	**-0.28**	-0.01
10	**26.5%**	18.0%	**33.4%**	-3.5%	-2.1%	**17.1%**	**-0.29**	-0.08
Average	31.3%	67.1%	29.2%	-7.4%	0.3%	12.4%	-0.21	0.06

Table 7

The effect of volatility on the turn of the month patterns

This table shows the effect of the past 6-month volatility on the turn of month patterns. To control for the fact that liquidity and volatility are correlated we condition our volatility estimates on liquidity. Our sample, covering data from 1980 to 2013, includes all stocks in CRSP listed in NYSE and Amex that have share price above USD 5 on the 10th trading day of the month, and a market capitalization that exceeds the NYSE 10th market capitalization percentile. Amihud (2002) ILLIQ measure is calculated as a rolling one year average until the 10th trading day of the month. Stocks fulfilling the requirements stated above are first dividend into Amihud-illiquidity quartiles; quartile 1(4) denoting the most liquid (illiquid) stocks. Then every Amihud-illiquidity quartile is divided into volatility quartiles; quartile 1 (4) denoting the least (most) volatile stocks within the Amihud-illiquidity quartile. The results reported relate to the value-weighted returns of the Amihud-Volatility sorted portfolios. All figures that statistically significantly differ from zero at a 5% significance level are bolded.

Amihud	Volatility	Annualized return T-3 - T-1	Annualized return T	Annualized return T+1 - T+3	Annualized return T-8 - T-4	Annualized return T+4 - T+8	Annualized return on other days	Correlation of T-8 - T-4 and T-3 - T-1 returns	Correlation of T - T+3 and T+4 - T+8 returns
1	1	**23.1%**	15.0%	**25.2%**	-1.4%	1.3%	**18.1%**	**-0.18**	**-0.12**
1	2	**33.9%**	16.0%	**30.8%**	-2.7%	0.0%	**20.9%**	**-0.24**	-0.09
1	3	**31.7%**	24.7%	**35.7%**	-6.5%	-3.0%	14.8%	**-0.33**	-0.02
1	4	**30.5%**	**41.6%**	**41.2%**	-10.2%	-8.4%	8.4%	**-0.40**	-0.04
2	1	**32.7%**	**47.1%**	**29.5%**	-3.2%	1.3%	**20.4%**	**-0.22**	0.07
2	2	**36.2%**	**61.8%**	**29.6%**	-7.5%	-0.9%	**19.1%**	**-0.24**	0.05
2	3	**38.0%**	**67.5%**	**34.9%**	-11.0%	-3.8%	**16.5%**	**-0.30**	0.03
2	4	**41.2%**	**73.7%**	**38.4%**	-17.8%	-4.5%	13.6%	**-0.33**	-0.01
3	1	**31.5%**	**52.6%**	**30.2%**	-1.6%	2.0%	**16.0%**	**-0.23**	0.07
3	2	**36.7%**	**65.4%**	**30.4%**	-10.0%	3.0%	**18.6%**	**-0.26**	0.06
3	3	**43.5%**	**83.1%**	**33.1%**	-11.8%	-3.1%	11.9%	**-0.25**	0.04
3	4	**37.7%**	**105.1%**	**35.1%**	-16.7%	-7.4%	4.1%	**-0.29**	0.06
4	1	**25.2%**	**53.3%**	**27.4%**	0.5%	7.8%	**17.6%**	**-0.17**	**0.14**
4	2	**36.6%**	**68.1%**	**28.9%**	-3.6%	5.4%	**16.7%**	**-0.24**	0.09
4	3	**32.2%**	**91.9%**	**30.4%**	-6.7%	1.9%	**17.1%**	**-0.27**	0.06
4	4	**42.8%**	**100.0%**	**30.0%**	-10.3%	-0.2%	2.3%	**-0.21**	0.06
Average		34.6%	60.4%	31.9%	-7.5%	-0.5%	14.7%	-0.26	0.03

Table 8

Hedge funds' excess market betas and redemption frequency

This table shows the hedge funds' excess market betas around the turn of the month depending on the hedge funds' redemption frequency (we have excluded all categories with less than 200 observations). Hedge funds' market betas are averages based on fund-specific regressions in which hedge fund's (monthly) return is regressed on daily S&P 500 returns around the turn of the month and the return on the S&P500 index during the remaining days of the month. Excess market betas are calculated as a difference of the estimated betas for any given day and the betas for the remaining days. Hedge fund data is from TASS and our sample period is from January 1994 to December 2013. T-statistics are shown below the coefficients. All figures that statistically significantly differ from zero at a 5% significance level are bolded.

	Monthly	Quarterly	Semi-Annually	Annually
-5	**-0.123**	**-0.11**	-0.039	**-0.103**
	(-11.60)	(-9.32)	(-0.99)	(-4.04)
-4	**-0.081**	**-0.118**	-0.092	**-0.113**
	(-7.54)	(-10.43)	(-1.78)	(-3.65)
-3	0.012	**-0.058**	**-0.121**	**-0.112**
	-1.22	(-5.61)	(-2.87)	(-3.40)
-2	**-0.097**	**-0.083**	-0.057	-0.01
	(-9.96)	(-8.27)	(-1.23)	(-0.39)
-1	**-0.041**	**-0.065**	**-0.097**	**-0.132**
	(-5.05)	(-7.28)	(-2.37)	(-5.28)
0	**-0.173**	**-0.176**	**-0.121**	**-0.093**
	(-14.81)	(-12.98)	(-2.54)	(-2.98)
1	**0.134**	**0.171**	**0.112**	**0.163**
	-14.56	-16.35	-2.85	-7.11
2	**0.227**	**0.26**	**0.355**	**0.348**
	-20.42	-22.47	-6.58	-10.32
3	**0.141**	**0.188**	**0.241**	**0.238**
	-13.78	-17.81	-5.26	-7.74
4	**0.079**	**0.145**	**0.125**	**0.121**
	-8.73	-12.65	-2.96	-3.36
5	0.017	**0.071**	**0.091**	**0.146**
	-1.54	-5.85	-2.1	-3.55
Average T-5 - T-3	-0.064	-0.095	-0.084	-0.109
Average T-2 - T+5	0.036	0.064	0.081	0.098
Difference in averages	0.100	0.159	0.165	0.207
N	3,817	2,714	208	322

Table 9

Hedge funds' excess market betas and style

This table shows the hedge funds' excess market betas around the turn of the month in certain hedge fund style categories. Hedge funds' market betas are averages based on fund-specific regressions in which hedge fund's (monthly) return is regressed on daily S&P 500 returns around the turn of the month and the return on the S&P500 index during the remaining days of the month. Excess market betas are calculated as a difference of the estimated betas for any given day and the betas for the remaining days. Hedge fund data is from TASS and our sample period is from 01/1994 to 12/2013. T-statistics are shown below the coefficients. All figures that statistically significantly differ from zero at a 5% significance level are bolded.

	Global Macro	Managed Futures	Other styles
-5	-0.024	**0.147**	**-0.134**
	(-0.62)	-3.85	(-18.66)
-4	-0.077	**0.102**	**-0.104**
	(-1.63)	-2.35	(-14.40)
-3	**0.106**	**0.424**	**-0.057**
	-2.36	-9.95	(-8.94)
-2	-0.062	-0.052	**-0.092**
	(-1.88)	(-1.49)	(-13.56)
-1	**0.091**	-0.065	**-0.068**
	-2.35	(-1.77)	(-12.01)
0	**-0.143**	**-0.092**	**-0.185**
	(-3.03)	(-2.14)	(-22.61)
1	0.052	**0.191**	**0.142**
	-1.39	-4.74	-22.06
2	0.066	**0.213**	**0.261**
	-1.42	-5.44	-33.99
3	**0.1**	**0.089**	**0.173**
	-2.21	-2.14	-25.98
4	0.044	-0.053	**0.121**
	-1.09	(-1.40)	-18.54
5	-0.025	-0.046	**0.047**
	(-0.67)	(-0.93)	-6.19
Average T-5 - T-3	0.002	0.224	-0.098
Average T-2 - T+5	0.015	0.023	0.050
Difference in averages	0.014	-0.201	0.148
N	314	538	6,958

Table 10

The effect of hedge fund risk capital on the turn of the month returns

This table shows the results from a regression in which the T-3 to T-1 stock market returns are regressed on the T-8 to T-4 market returns, a measure of hedge funds' cost of leverage, and its interaction with the T-8 to T-4 returns. Cost of leverage is measured by multiplying the TED spread (the difference between the 3-month Eurodollar and the Treasury rates) by the hedge fund industry's assets under management. In the first and the third column hedge funds' assets under management is the sum of all hedge funds' assets under management based on TASS database divided by US stock market capitalization. In the second and the fourth column we include only the Global Macro and Managed Futures categories' AUM in our estimates of hedge funds' assets under management. The returns in the first and the second column are those of the CRSP value-weighted index, while in the third and the fourth column they are those of the S&P 500 index. T-statistics based on Newey-West standard errors are shown below the coefficients. All figures that statistically significantly differ from zero at a 5% significance level are bolded.

y = Return T-3 - T-1				
Return T-8 - T-4	-0.075	-0.067	-0.082	-0.076
	(-1.36)	(-1.16)	(-1.44)	(-1.28)
Cost of Leverage	0.020	0.139	0.015	0.109
	(0.69)	(0.84)	(0.53)	(0.68)
Interaction of Cost of Leverage and the return T-8 - T-4	**-1.566**	**-10.514**	**-1.628**	**-10.859**
	(-5.96)	(-6.43)	(-5.93)	(-6.40)
Intercept	**0.003**	**0.003**	**0.002**	**0.002**
	(2.25)	(2.22)	(2.12)	(2.09)
R2	0.283	0.286	0.263	0.267
AUM includes	All hedge funds	Global Macro & Managed Futures	All hedge funds	Global Macro & Managed Futures
Index	CRSP VW	CRSP VW	S&P 500	S&P 500
Sample	2/1991-12/2013	2/1991-6/2013	2/1991-12/2013	2/1991-6/2013

APPENDIX

Figure A1

Deposits around the turn of the month

This figure shows the deposits in US Commercial banks relative to their two month average surrounding the observation date, on various trading days around the turn of the month. The sample period is from January 1980 to December 2013.

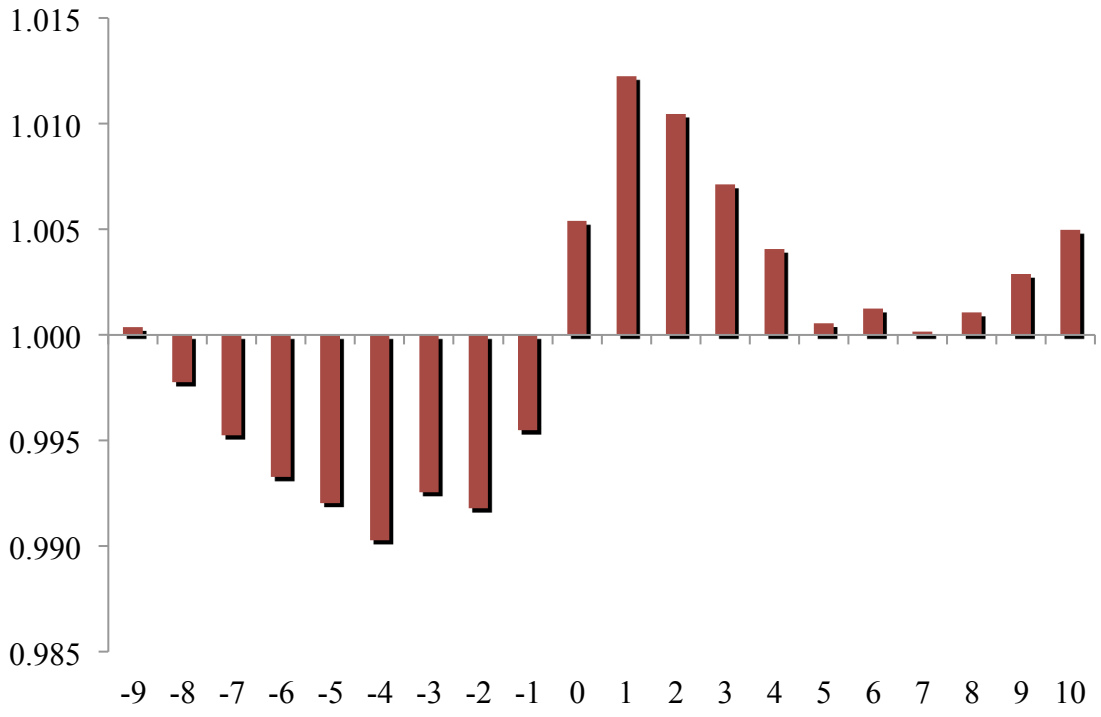


Table A1

Return patterns around the 15th of the month

This table presents annualized returns around the 15th day of the month in G-10 countries as well as in several other industrialized countries. In addition, the table presents the correlation of the returns from T-8 to T-4 and T-3 to T-1; as well as the correlation of the returns from T to T+3 and T+4 to T+8. Our sample starts in January 1980 or later when the relevant data becomes available, and runs until the end of 2013 (to be precise, until the 8th trading day of 2014). All figures that statistically significantly differ from zero at a 5% significance level are bolded.

Country	Index	Sample starts	Annualized return T-3 - T-1	Annualized return T	Annualized return T+1 - T+3	Annualized return T-8 - T-4	Annualized return T+4 - T+8	Correlation of T-8 - T-4 and T-3 - T-1 returns	Correlation of T - T+3 and T+4 - T+8 returns
United States	S&P500	Jan-80	**18.7%**	3.5%	11.4%	1.6%	7.0%	**-0.17**	-0.04
United States	CRSP VW	Jan-80	**16.6%**	1.1%	7.9%	2.0%	7.1%	**-0.16**	-0.01
Other G10 countries									
Belgium	BEL20	Jan-90	5.5%	8.6%	5.1%	4.4%	-7.6%	-0.11	0.09
Canada	S&P/TSX C	Jan-86	1.3%	-3.6%	7.4%	3.7%	5.9%	-0.10	-0.02
France	CAC40	Jan-88	-5.8%	1.9%	3.1%	7.8%	4.0%	**-0.15**	-0.01
Germany	DAX	Jan-80	2.4%	13.6%	14.5%	11.4%	-4.3%	**-0.12**	0.04
Italy	FTSE MIB	Jan-98	9.1%	-25.2%	12.7%	-9.2%	-5.1%	**-0.28**	0.06
Japan	NIKKEI225	Jan-80	-11.1%	**35.3%**	-4.3%	3.9%	6.5%	**-0.10**	0.03
Netherlands	AEX	Jan-83	2.1%	16.4%	12.2%	12.7%	1.5%	**-0.17**	0.10
Sweden	OMXS30	Jan-86	6.3%	-4.2%	8.8%	17.7%	6.4%	**-0.16**	0.00
Switzerland	SMI	Jul-88	3.2%	6.6%	2.2%	11.0%	-1.7%	**-0.17**	0.10
United Kingdom	FTSE100	Jan-86	0.8%	5.3%	7.8%	11.2%	-1.1%	**-0.19**	0.10
Other industrialized countries									
Australia	S&P/ASX200	Jun-92	-5.6%	16.6%	8.1%	0.7%	9.9%	-0.02	-0.01
Austria	ATX	Jan-91	-13.9%	-13.8%	8.4%	9.6%	7.5%	**-0.12**	-0.03
Denmark	OMXC20	Dec-89	9.2%	11.2%	6.1%	8.5%	-6.6%	-0.10	0.05
Finland	OMXH25	Jan-91	-5.1%	-4.7%	23.2%	17.2%	7.8%	-0.11	-0.05
Hong Kong	HSI	Jan-80	4.8%	38.2%	4.6%	**20.9%**	8.5%	0.00	0.10
Ireland	ISEQ OVER	Jan-88	-10.8%	8.1%	16.6%	12.4%	-4.3%	**-0.13**	0.03
Israel	TA-25	Jan-92	-9.2%	37.7%	13.1%	**23.3%**	5.9%	-0.02	**-0.15**
Luxembourg	LUXX	Jan-99	-1.2%	-20.0%	-4.3%	-1.5%	1.6%	-0.05	0.04
New Zealand	NZX50	Jan-01	-3.1%	-1.7%	4.4%	0.9%	10.0%	-0.02	0.01
Norway	OBX	Jan-87	7.1%	-0.3%	-0.5%	5.6%	7.0%	**-0.12**	-0.04
Portugal	PSI-20	Jan-93	0.6%	-13.0%	3.1%	**22.8%**	-9.9%	-0.03	0.03
Singapore	STI	Sep-99	-1.8%	-17.3%	-22.6%	7.9%	3.1%	0.05	**0.18**
South Korea	KOSPI	Jan-80	-0.6%	-2.9%	-2.6%	**19.7%**	-7.4%	**-0.12**	0.03
Spain	IBEX35	Mar-87	8.7%	-2.9%	19.8%	16.3%	-7.5%	-0.11	0.07
Average of all indexes			1.1%	3.6%	6.4%	9.3%	1.7%	-0.11	0.03