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

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Abstract. We present broad-based evidence that the monthly cash needs of institutions induce systematic patterns in global stock returns. First, we document strong reversals in stock index returns around the last monthly trading day that guarantees cash settlement before month end. Second, we present direct evidence that links these reversals to institutional trading activity, fund flows and funding conditions. Third, we find that the reversals are stronger for larger and more liquid stocks, and those more commonly held by mutual funds, a popular implementation vehicle among institutions. Finally, we show that mutual funds' sensitivity to month-end reversals predicts their performance.

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

JEL classification: G10, G12, G13

The views expressed in this paper are those of the authors and do not reflect the positions of Goldman, Sachs & Co or Mandatum Life.

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1. Introduction

It is surprising how little attention academic literature has devoted to understanding 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 historically most of the returns have accrued during a four day period, from the last trading day to the third trading day of the month. Even less attention has been paid to the fact that in more recent samples market returns are also abnormally high on the last three trading days *before* the turn of the month. In fact, combining the two observations, we find that since July 1926, one could have held the US value-weighted stock index (CRSP) for only seven days a month and pocketed the entire market excess return with nearly fifty percent lower volatility compared to a buy and hold strategy. The negative excess returns outside the seven day turn of the month period are driven by dismal stock returns during the five trading days immediately before the high turn of the month return period (see Figure 1).[1] [2]

[INSERT FIGURE 1 HERE]

Following Ogden (1990), we argue that the origin of the turn of the month return patterns lies in the monthly economic payment cycle – the fact that a disproportionate share of monthly payments in the US economy, for instance those by pension funds (pensions) and corporate treasuries (dividends) take place precisely at the turn of the month, as we document in Figure 2 below. Given this payment cycle, every month potentially billions of dollars invested in financial markets, including the stock market, get first liquidated some time prior to the month end, then distributed as cash payments to pensioners and investors at the month end, and finally partially re-invested in the market by the recipients. Indeed, Figure 3A shows how deposits in US commercial banks rise visibly on the last day of the month and decline rapidly after the first day of the month. The monthly payment cycle, and the accompanying scarcity of cash at the month end, is also reflected in Figures 3B and 3C, which show sharp increases in the Federal Funds rate and the Libor rate on the last day of the month.

[INSERT FIGURES 2 AND 3 HERE]

Consistent with the payment cycle, we uncover strong return reversals in the aggregate stock market around key dates near the turn of the month. In addition, we present empirical evidence that links stocks' turn of the month return patterns crisply to institutional investors' buy-sell ratios, mutual fund holdings, fund flows, stock-level liquidity, and to capital market funding conditions. Time-

[1] We will henceforth refer to "trading days" simply as "days."
[2] McConnell and Xu (2008) and Cadsby and Ratner (1992) show that the turn of the month returns are high in most developed markets. Dzhabarov and Ziemba (2010) show that US equity index futures also exhibit a similar turn of the month effect.

varying betas of mutual funds (a popular implementation vehicle among institutions) and hedge funds (arbitrageurs) provide additional supporting evidence. Taken together, our results suggest a coherent heuristic framework that ties the turn of the month return patterns to the institutional payment cycle coupled with market-wide limits of arbitrage.

Our first observation is that, due to the 3-day settlement period in the US equity market (this settlement period has also been the most common internationally), investors' turn of the month liquidity related selling of stocks must take place at least three days prior to the month end. Let us label this critical day *T-3*, where *T* denotes the last day of the month. Under perfectly efficient markets, market makers and speculators would ensure that prices are not affected by such liquidity related sell orders, which do not reflect any investment views. However, in the absence of sufficient speculative capital (see e.g. Grossman and Miller 1988; Gromb and Vayanos, 2002; Brunnermeier and Pedersen, 2009), it is likely that market prices prior to *T-3* get temporarily depressed due to the selling pressure, and that it takes some time for the prices to revert back to their fundamental values. This is the main hypothesis of our paper. As Ogden (1990) argues, in the beginning of the month there should in turn be positive price pressure in the stock market as the recipients of month end cash payments invest new money into the stock market. Our second hypothesis is therefore that the beginning of the month buying pressure temporarily elevates stock prices above fundamentals, and that there is a return reversal after the buying pressure subsides.[3]

Surprisingly, we find that many of the turn of the month return patterns that we document have become *more* pronounced over time, and the strength of these phenomena seems to be related to the proportion of institutional investors in the marketplace. One potential explanation for this is that the payments of institutions are particularly sharply clustered at the month end, as we document below. A complementary explanation is related to intra-month variation in institutional risk appetite – namely the idea that institutional investors avoid risk taking near the month end. We find some support for also this explanation in the data. Taken together, it is possible that the greater proportion of institutional investors has not only led to additional selling pressure prior to *T-3* (by the institutions with month end liquidity needs), but also to a decreased propensity of the aggregate market to accommodate selling pressure near the month end. [4]

[3] Table 1 documents the dates after January 1980 that the 3-day settlement convention was adopted or daily return data became available in different countries. For example, in the US the settlement period was shortened from 5 to 3 days in June 1995. See e.g. Thomas Murray Ltd. 2014 report "CMI In Focus: Equities Settlement Cycles."

[4] Window dressing ahead of reporting dates is a leading explanation for month-end risk reduction by mutual funds (e.g. Lakonishok, Shleifer, Thaler and Vishny, 1991).

Our empirical evidence on turn of the month return patterns and the role of institutions in the genesis of these patterns can be divided into four main categories:

1. **Evidence from market returns.** Studying aggregate market prices alone, we find significant predictability in stock market returns around the third business day before the month end. As pointed out above, the average market returns over the five business days preceding *T-3* are negative, in contrast to the subsequent three business days' returns, which are highly positive. One of our main findings 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 market return reversals around *T-3.* Our evidence on return reversals around *T-3* is not limited to the US: In all 25 markets that we survey, there is evidence of return reversals around *T-3,* and in 22 of the 25 markets the return reversals are statistically significant. This evidence on return reversals is consistent with the month-end payment cycle and limits of arbitrage, as discussed earlier. We also investigate the link between the settlement period and the exact timing of month end reversals by applying a difference in differences test to data around a major settlement rule change in Europe.

2. **Evidence from institutional investor trading data.** To investigate the hypothesis that turn of the month return patterns are in part driven by institutional investors' liquidity-related trading, we study a data set that contains trade-level observations for hundreds of different institutional investors (mutual funds, hedge funds, pension funds, and other asset managers). This ANcerno dataset (obtained from Abel Noser Solutions) is considered a highly representative sample of institutional investors' trading in the US stock market (e.g. Puckett and Yan, 2011).

   Our analysis reveals that there are indeed significant seasonalities in the relative tendency of institutions to submit buy and sell orders. Consistent with our hypothesis, it appears that institutions on average are net sellers in the market up to the morning of *T-3* and net buyers on the last day of the month and the first few days of the month. When we divide the institutions to two groups based on their past year's trading behavior, we find that a subset of institutions engage in this type of trading behavior year after year in a systematic manner. Moreover, we document using regression analysis that greater aggregate institutional selling pressure on days *T-8* to *T-4* (normalized by stock market capitalization) is associated with higher subsequent stock market returns on days *T-3* to *T-1*. These findings lend direct support to our hypothesis that institutional trading affects stock return patterns around the turn of the month.

Combining the evidence on market returns and institutional investors' trading patterns leads us to conclude that institutions may incur significant costs from their liquidity-driven trading at the month end. Indeed, we estimate the average costs to institutions associated with such trades at approximately 0.7 billion US dollars per year from 1999 to 2010. These costs are eventually borne by the clients of the institutions.

3. **Evidence related to mutual funds and the cross section of stock returns.** We further study the link between institutional investors and turn of the month return patterns by using data on mutual fund holdings and the cross-section of stock returns. We begin by linking month-end return reversals at the stock level to mutual fund holdings. Our findings indicate that stocks held in greater proportions by mutual funds exhibit more pronounced turn of the month patterns: more negative returns between *T-8* to *T-4* and more positive returns from *T-3* to *T-1*. In addition, those stocks exhibit greater return reversals around *T-3*. We also find evidence that the turn of the month returns and return reversals vary as a function of stock-level liquidity. In particular, month-end reversals are significant only for large and liquid stocks, which is consistent with the idea that turn of the month patterns are tied to investors' liquidity needs, and that investors respond to month-end outflows and cash needs conscious of transaction costs.

   To complement our evidence from institutional investor trading data, we show that mutual fund aggregate outflows significantly predict the strength of month-end reversals. Moreover, 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 is significantly lower than average at *T-3*. Furthermore, consistent with the idea that mutual funds reduce risk toward the month end (either to increase their cash holdings for month-end payments or for agency reasons), we find that mutual funds' average return volatility declines toward the month end although there is no observable coincident decline in market volatility.

   In our international sample, we show that month-end return reversals are stronger in countries with larger mutual fund sectors and demonstrate that the strength of the return reversal in the US stock market has varied over time with the proportion of the market held by the mutual fund industry.

   Finally, we present evidence that mutual funds' turn of the month trading patterns predict their alpha. For instance, we find that the Carhart (1997) four-factor alpha is significantly positive for the decile of funds whose past returns revert the least around *T-3*, and negative

for *all* other funds. We interpret this as complementary evidence (to that obtained from ANcerno's institutional trading data) that most institutions suffer significantly from their month end trading practices.

4. **Evidence related to hedge funds and funding conditions.** We find mixed evidence regarding the impact of hedge fund trading on the month-end return patterns. Akin to our results for mutual funds, we find that hedge funds' stock market betas are on average smaller before the month end than at the beginning of the month. These patterns are stronger for funds with less frequent redemption cycles. Therefore, our results suggest that the aggregate hedge fund industry may, if anything, further *contribute* to the turn of the month return patterns as hedge funds are possibly plagued by similar month-end cash and agency concerns as mutual funds.[5]

   Although on average hedge funds do not seem to provide month end liquidity, it is possible that some hedge funds do. Indeed, if we look at each hedge fund category separately, we find that funds in two categories (managed futures and global macro) do provide liquidity systematically to other market participants prior to the turn of the month: funds in those categories increase their market betas significantly at *T-3* on average. This implies that they make equity purchases either at the end of day *T-4*, which according to our results is the best time to invest in order to capitalize on the abnormally large month end returns, or in the morning of *T-3,* which is exactly the time that we would expect liquidity to start returning to the market (note that investors who expect to receive cash at *T* can start their equity purchases at *T-3*).

   Conditioning on hedge funds' funding conditions – as proxied by the TED spread – we find that hedge funds also on average mitigate the month-end return patterns when their funding conditions are good and only amplify those patterns when their funding conditions are poor. In line with this finding, our time-series evidence indicates that an elevated TED spread is associated with greater return reversals around *T-3*. These results are consistent with the literature on limits of arbitrage and the role of funding constraints (e.g. Brunnermeier and Pedersen, 2009, Nagel 2012, and Jylhä, Rinne and Suominen 2014) in decreasing hedge funds' ability to supply liquidity in the marketplace.

[5] As hedge funds are typically the institutions that supply liquidity in stock markets (see e.g. Aragon and Strahan, 2012), their limited willingness or ability to take long positions near the month end can lead to a decrease in market liquidity. Indeed, we document a drop in aggregate trading volume around *T-3*.

The intuition that asynchronously arriving sellers and buyers to the stock market cause short-term reversals in equity returns was present already in Grossman and Miller (1988). However, only limited empirical support for the idea that investors' aggregate buying and selling pressures would lead to short-term return reversals at the aggregate market level has been presented. To our knowledge, only two papers provide evidence on this. First, Campbell, Grossman and Wang (1993) 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-Rephael, Kandel, and Wohl (2011) provide evidence that aggregate mutual fund flows in Israel create price pressure in the aggregate stock market leading to short-term return reversals. However, they do not tie these return reversals to the turn of the month time period. As a result, our finding that investors' systematic selling and buying pressures around the turn of the month cause short-term return reversals at the aggregate market level is new to the literature. Importantly, our findings help tie the anomalous turn of the month returns to standard theories of imperfectly functioning financial markets and limits of arbitrage. Duffie (2010) reviews existing evidence on return reversals and provides a theoretical framework as to why price pressure due to supply and demand shocks dissipates only gradually over time. Gromb and Vayanos (2012) provide a survey of related literature.[6]

Our results also contribute to the vast existing literature on turn of the month effects that dates back at least to the seminal paper of Ariel (1987). Most of these studies focus on the four-day period from the last to the third trading day of the month where abnormally high returns are documented. To the best of our knowledge, our study is the first to investigate market behavior around the last day of the month that guarantees cash settlement before the month end. Also, we believe we are the first to link the turn of the month return patterns to institutional investors' buy-sell ratios, mutual fund holdings, fund flows, stock liquidity, time variation in mutual fund and hedge fund market betas, and to funding conditions.

The remainder of the paper is organized as follows. Section 2 describes the data used in our research. Sections 3-7 present our main empirical results that cover the time-series and cross-sectional dimensions of the data. Section 8 concludes.

[6] In Campbell, Grossman and Wang (1997), return reversals are associated with large volume as investors' selling pressure in their model varies over time while market-making capacity does not. Interestingly, our empirical results suggests that near the turn of the month, the selling pressure, the buying pressure, and the market making capacity are all time varying, explaining why large reversals may be associated with low volume around *T-3*. Other closely related papers include Mou (2010), which presents evidence of systematic return reversals due to investor rebalancing in commodity markets; Lou, Yan and Zhang (2013), which documents price reversals in Treasury prices around Treasury auctions; and Henderson, Pearson and Wang (2015), which studies the impact of financial investor flows on commodity futures prices.

2. Data on returns, mutual funds and hedge funds

The country index return data are from Datastream, except for the US value-weighted index, which is obtained from CRSP. Our international sample consists of the benchmark indexes of G10 countries in addition to other important industrialized countries. Our sample starts in 1980 but for many countries relevant data do not become available until later. In the international sample we only include data from time periods where the settlement rule in the respective stock exchanges has been 3-days or shorter. 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]

Our cross-sectional stock data are from CRSP. Our mutual fund holdings data are from Thomson Reuters Mutual Fund Holdings database. The sample period is from July 1995 to December 2013.[8] Mutual fund betas are estimated using daily mutual fund returns from the CRSP Survivor-Bias-Free U.S. Mutual Fund database. MFLINKS is used to combine different mutual fund classes. Our weekly mutual fund flow data are from Investment Company Institute and the sample period is from January 2007 to December 2013. The data on hedge fund AUM are estimated using HFR and LIPPER TASS data. Finally, hedge fund betas are estimated using the LIPPER TASS database on individual funds' monthly returns.

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

We begin our investigation by determining the relevant time periods before and after the event date, *T-3*. Theoretically, an institutional manager facing cash liabilities at the month end could sell his stocks as late as at the close of *T-3* and still receive the cash on time for his month end payment. However, illiquidity and risk considerations are likely to deter most institutions with month-end liquidity needs from selling stocks only at the close of *T*-3, but rather encourage them to distribute their sales over the preceding hours and days. Section 4 provides direct evidence from institutional investor trading data to support this assumption. For these reasons, we begin our analysis by considering the five business days from *T-8* to *T-4* as the period over which we expect the most negative price pressure in the stock market due to sales 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

[7] Israeli index returns are entirely based on a price index as this is the only series available in Datastream.
[8] The beginning of the sample is chosen to match the adoption of the 3-day settlement rule in the US.

the month, i.e. from *T* to *T+3* (see e.g., Ogden, 1990; 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 days after *T+3*.

We illustrate some key events of our study in Figure 4 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 since the 1995 adoption of the 3-day settlement rule is *negative* 9.7% for *T-8* to *T-4* and *positive* 24.5% for *T-3* to *T+3*.[9]

[INSERT FIGURE 4 HERE]

We can observe similar return patterns in other developed markets, as displayed in Table 1. For all of the other 24 markets in our sample, returns are on average negative over the selling pressure period (*T-8* to *T-4*) and positive and statistically significant over the reversal/buying pressure period (*T-3* to *T+3*). Importantly, in Table 2 we establish a time-series relationship between low returns over the selling pressure period and the returns over the reversal period: in all of the 25 markets the correlations of returns between these two periods' returns are negative and in 22 of the 25 markets the correlations are statistically significant. This evidence suggests that 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 the buying pressure days (*T* to *T+3*) and the returns on the subsequent five days is either negative and statistically significant (in 12 of the 25 markets) or insignificant. These negative correlations are consistent with our hypothesis that there is first selling pressure and then buying pressure around the turn of the month.[10] [11]

[9] 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 from investing only during these seven days is 5.0% per annum, the Fama and French (1993) three-factor alpha is 5.1% per annum; and the alpha with respect to a four-factor model that also includes the momentum factor of Carhart (1997) is 5.2% per annum. All alphas are statistically significant at the 5% level. Results are qualitatively similar if instead of the CRSP value-weighted index we use the S&P 500 index in the alpha calculations.

[10] The results for 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 institutional investors who are conscious of transaction costs and liquidity issues. We discuss these considerations in the next section. The unreported results for emerging markets are available from the authors.

[11] The return patterns around *T-3* documented in Tables 1 and 2 in the case of US stocks are robust to excluding from the sample the observations that coincide with year ends and quarter ends, observations that coincide with Fed's announcements (that have been found to significantly impact average returns by Lucca and Moench, 2015) or observations overlapping with macro-economic announcement dates (that have been found to significantly impact average returns by Savor and Wilson, 2013).

[INSERT TABLE 1 AND 2 HERE]

To compare the magnitude of the return reversals around *T-3* to potential return reversals around other days of the month, Figure 5 plots the correlation of past 5-day returns and future 3-day returns for every day of the month in the US stock market. The results show that the negative correlation observed between *T-8* to *T-4* and *T-3* to *T-1* returns is significantly greater in magnitude than the reversals observed around other days. The only other time the correlation dips to the negative territory in a statistically significant way occurs on *T+7*, which coincides with the reversal expected near a second common payment date – the 15th of the month – that tends to fall on the 10th or 11th business day of the month.[12]

[INSERT FIGURE 5 HERE]

As a robustness check, we investigate the impact of a recent concerted change in the settlement window in several countries on the timing of return reversals. Specifically, on October 6th, 2014, a group of European countries (Austria, Belgium, Denmark, Finland, France, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Sweden, Switzerland, and UK) changed their stock market settlement rule from 3 business days to 2 business days. We use this settlement rule change for a difference in differences study. Our control group consists of the rest of the countries in our international sample that were not affected by this change (Australia, Canada, Japan, New Zealand, Singapore, and Spain) and continued to follow a 3-day settlement rule. We would expect the shortening of the settlement window to decrease the stock market's daily return autocorrelation at T-2 as the return reversal should move closer to the month end. The results, displayed in Table 3 show that the autocorrelation at *T-2* decreases in a statistically significant way following the change in the countries affected by the change compared to control group countries. The magnitude of the change (-0.78) is also meaningful economically.

[INSERT TABLE 3 HERE]

4. Direct evidence from institutional investors' trades

To investigate the selling pressure hypothesis as an explanation for the observed turn of the month return patterns, we turn to the ANcerno dataset that contains trade-level observations for hundreds of

[12] Table A1 in the Appendix complements Table 1's results by demonstrating that similar but less pronounced patterns in market returns in the US and elsewhere are observed around another common payment date, the 15th of the month.

different institutions including hedge funds, mutual funds, pension funds, and other money managers. Our data covers the period 1999-2013. According to Puckett and Yan (2011) this dataset includes the trades of many of the largest institutional investors such as CalPERS, the YMCA retirement fund, Putman Investments, and Lazard Asset Management that in total account for 8% of the daily volume in CRSP.[13]

The ANcerno data reveal significant seasonalities in institutions' buy ratios. Consistent with our hypothesis, the institutions in the sample seem to submit more sell than buy orders in the week that precedes *T-3*, and more buy than sell orders in the days *T-1* to *T+3*. On several days, such as *T-5* to *T-3*, *T-1* to *T*, and *T+3*, the buy ratios differ statistically significantly from the unconditional mean. These daily average excess buy ratios are displayed in Figure 6. For day *T-3*, the figure also displays the *hourly* average excess buy ratios, allowing us to study the behavior of institutions within the last day that guarantees cash settlement before the month end. Consistent with our expectations, institutional selling pressure is strongest in the first hours of the trading day *T-3*, and by early afternoon, the institutions' excess buy ratios become indistinguishable from zero. Thus, the negative price pressure from institutional investors' liquidity-related selling diminishes rapidly during *T-3*, helping explain the high *T-3* market returns observed in the data.[14]

[INSERT FIGURE 6 HERE]

We next investigate if there is a subset of institutions that consistently demands liquidity at or prior to *T-3* by selling stocks on days that the institutional selling pressure is abnormally large (according to Figure 6, days *T-5* to *T-3* meet this requirement). To do that, we define an institution-specific variable called signed trading volume as the difference between the value of its stock purchases and sales and label an institution a liquidity demander if its signed trading volume from *T-5* to *T-3* measured over the previous year is negative. Figure 7 shows the sum of signed volumes for liquidity demanders and other institutions, normalized by the CRSP market trading volume for the relevant days. It appears that some of the institutions systematically demand liquidity in the stock market at and prior to *T-3*. Note that the ANcerno institutions' combined signed trading volume is 0.15% to 0.25% of the total CRSP trading volume during the relevant days. When evaluating the economic significance of the ANcerno institutions' signed trading volume note furthermore that according to Puckett and Yan (2011) the ANcerno institutions represent only about 10% of all institutional trading

[13] Unfortunately Abel Noser Solutions is no longer providing a file that allows the matching of ANcerno client codes to corresponding investor names. As a result, we are unable to disentangle different institutional investor types.

[14] In Section 6, we present evidence that certain hedge fund categories (and when funding conditions are good, hedge funds on average) have abnormally high market betas at *T-3* suggesting that liquidity supplying hedge funds arrive in the market around *T-4* to *T-3*. This can also contribute to the high returns at *T-3*.

volume. This implies that the combined signed volume of all institutional investors on the above days can potentially comprise as much as 1.5% to 2.5% of total trading volume.

[INSERT FIGURE 7 HERE]

ANcerno's trade-level data also allows us to estimate the costs incurred by ANcerno institutions due to bad timing of their month-end trades. To do that, we compare the actual trading of ANcerno institutions to hypothetical trading by them of equal volume but with improved market timing. Concretely, we consider a scenario where the institutions make at *T* all of the sales that they in reality made between *T-5* to *T-3*. This calculation suggests that, over the sample period 1999-2010, the institutions in ANcerno alone would have lost almost 0.8 billion US dollars due to bad timing of their trades. Assuming as in Puckett and Yan (2011) that the institutions in ANcerno's sample represent 10% of all institutional trading volume, the total cost of month-end liquidity related trading to this type of institutions could be tenfold, 8 billion US dollars during our sample period, or approximately 0.7 billion US dollars per year.[15]

We can also use the ANcerno database in a regression-based study to examine the market impact of these institutions' selling prior to *T-3*. The results in Table 4 show that the cumulative net selling of the ANcerno institutions from *T-8* to *T-4* and particularly from *T-5* to *T-4* (normalized by the US stock market capitalization) predict higher stock market returns on days *T-3* to *T-1*. The economic magnitude of this institutional selling pressure is meaningful: a one standard deviation increase in selling pressure is predicted to increase *T-3* to *T-1* market returns by as much as 0.32 to 0.67 percentage points depending on the regression specification. This finding lends additional direct support to our hypothesis that institutional trading generates predictable variation in stock returns near the turn of the month.[16]

[INSERT TABLE 4 HERE]

In the next section, we will present further evidence on the role of institutions in the creation of the turn of the month return reversals by studying cross-sectional data on mutual fund holdings. We will also investigate which types of stocks exhibit the strongest turn of the month reversals.

5. Cross-sectional evidence

[15] ANcerno provides client codes only until 2010. This limits the sample used in the cost calculations. Note also that our calculations cannot account for the impact of possible futures market transactions on month-end performance. Some of the ANcerno institutions might use futures to offset the temporary reduction in their market exposures before the month end.

[16] To avoid the use of overlapping data, we have left out net selling during T-3 from these regressions.

5.1 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. Specifically, 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 measure 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 days where we expect reinvestment-driven buying pressure. The results, displayed in Table 5, demonstrate that the worst-performing stocks over the selling pressure period tend to exhibit best average performance 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 highest decile portfolios is both statistically and economically significant: 0.7% over the three-day period *T-3* to *T-1*, and 0.3% over the next four-day period *T* to *T+3*.

[INSERT TABLE 5 HERE]

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 in Panel B of Table 5, demonstrate that the *T+4* to *T+8* average returns across the decile portfolios sorted on *T* to *T+3* returns also exhibit 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.

5.2 Mutual fund ownership and turn of the month stock returns

We proposed that the return reversals in aggregate stock returns at the turn of the month are likely to be 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 as shown in Figure 2A), we do observe the holdings of their agents, mutual funds, which provide an easy and efficient implementation vehicle for pension funds' diversified equity investments.[17] For these reasons, we suspect that the turn of the month effects are more pronounced in the stocks that are commonly held by mutual funds.

[17] According to Investment Company Institute, approximately one half of US long-term mutual fund assets excluding money market funds are delegated by pension funds (http://www.ici.org/research/stats/retirement).

To investigate the link between mutual fund ownership and month-end return patterns, we sort US stocks in each month by mutual funds' collective ownership percentage in the previous month and form decile portfolios. We then compute value-weighted average returns of these portfolios near the turn of the month. The results are displayed in Figure 8. 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 period, from *T-8* to *T-4*. These same stocks also experience greater returns over the subsequent three days from *T-3* to *T-1*, 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 the stocks that are more commonly held by mutual funds.

[INSERT FIGURE 8 HERE]

In addition, the correlation between *T* to *T+3* and *T+4* to *T+8* returns is negative only for the portfolios of stocks in the six highest deciles of mutual fund ownership. All of these pieces of evidence suggest that mutual funds, and other institutions with month-end payment cycles, are a major force behind the turn of the month phenomenon. It is therefore possible that the growth of the mutual fund industry as a proportion of total stock market capitalization may have contributed to the *strengthening* of the turn of the month return patterns over time – a result that we document below.

Before turning to the time series dimension, let us investigate the strength of month-end return reversals across countries. Figure 9 displays the correlations of *T-8* to *T-4* returns and *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. Using regression analysis we confirm that this negative relationship between mutual fund ownership and the degree of market return reversals around *T-3* is statistically significant at the 1% level (results are available upon request). The correlations presented in Figure 9 are negative for all country indexes.[18]

[INSERT FIGURE 9 HERE]

Finally, we use regression analysis to study if there is a time-series relationship between the return reversals around *T-3* and the size of the US mutual fund industry. Our results, presented in Table 6,

[18] They are least negative in Finland. Interestingly, Finnish pension payments are not clustered at the end of the month. Until 2013, a significant part of pension payments was made in alphabetical order to pensioners throughout the month.

show that the size of the mutual fund industry normalized by stock market capitalization is indeed associated with the strength of market-wide return reversals around *T-3*: the interaction of the size of the mutual fund industry with *T-8* to *T-4* returns is negative and statistically significant (at 5% significance level) when we include a time trend in the regression.

[INSERT TABLE 6 HERE]

5.3. Mutual fund outflows and turn of the month stock returns

To complement our direct evidence on the impact of institutional trading on month-end return reversals, we investigate the impact of mutual fund outflows on stock index returns. Specifically, we regress US stock market returns over the selling pressure period (*T-8* to *T-4*) and over the reversal period (*T-3* to *T-1*) on mutual fund aggregate outflows up to those dates controlling for past market returns. Mutual fund aggregate outflow is defined as the sum of negative net fund flows from the first Wednesday of the month until the last Wednesday before *T-8* (normalized by the US total stock market capitalization) or T-3 depending on the regression. The results displayed in Table 7 provide evidence that mutual fund flows significantly impact market returns at the turn of the month: a one standard deviation increase in outflows (0.008%) predicts a 1.32 percentage point decrease in *T-8* to *T-4* returns and a 0.93 percentage point increase in *T-3* to *T-1* returns. These results lend additional support to our hypothesis that institutions' cash needs drive aggregate stock returns near the month end. Note the exceptionally high explanatory powers of these regressions.

[INSERT TABLE 7 HERE]

5.4. Other evidence that mutual funds affect turn of the month return 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 and a monthly reporting cycle, mutual fund managers worried about sparking outflows might become less willing to take risk near the month end. (see e.g. Sirri and Tufano, 1998). Month-end decreases in mutual fund risk appetite would not only lead to additional selling pressure prior to *T-3* but they would also explain why funds without month-end liquidity needs might be unwilling to trade against liquidity-driven sellers near the month end.

Our evidence presented in Table 8 and Figure 10 support this idea of month-end risk reduction. In Table 8, we show that the average betas of mutual funds are abnormally low from *T-5* to *T-3*. As discussed, 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 funds willingness to take less risk near the end of the month. The finding in Figure 10 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 meet its payments near the month end. Irrespective of which one of these two forces has a greater impact on 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 8 AND FIGURE 10 HERE]

5.4 Stock characteristics and turn of the month returns

If the behavior of sophisticated investors is indeed inducing patterns in turn of the month stock returns, these investors 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 Figure 11.

[INSERT FIGURE 11 HERE]

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 liquid and large cap stocks and not so for illiquid and small cap stocks.[19]

6. Hedge funds and funding constraints

6.1 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 9, 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 therefore that hedge funds on average do not provide liquidity to mutual funds that sell near the month end, as one might have expected. In case of hedge funds, the month-end patterns in betas may be related to the fact that their infrequent subscription and redemption times are commonly set at month ends. This is likely to cause large liquidity needs for hedge funds near the month end and also increase their performance concerns at

[19] 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. Consistent with our intuition, we find that return reversals around *T-3* are most pronounced for the most volatile, yet liquid stocks. These results are available from authors upon request.

that time. Indeed, we find some support for this reasoning as the time-variation in betas seems to be more pronounced for those funds with less frequent redemption periods (and presumably larger in- and outflows at times of subscription and redemption); see Table 9. Therefore, it appears that the cash cycle and concerns related to fund flows affect hedge funds' ability and willingness to take risk near the month end – much in the same way they seem to have reduced month end risk taking among mutual funds. [20] [21]

[INSERT TABLE 9 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 12, which shows that trading volume is substantially lower than average during the last few trading days of the month.

[INSERT FIGURE 12 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 at least some hedge funds do provide liquidity around *T-3*, counterbalancing the selling pressure from other institutions. The evidence regarding liquidity supply is especially strong for Managed Futures funds whose betas increase significantly on *T-3*.

In addition, although the hedge funds on average do not provide liquidity, it is possible that there are some time periods when they do. In fact, there seems to be significant time variation in the hedge funds' provision of liquidity: When we look at hedge funds' propensity to provide liquidity at times of below and above median TED spread, we see that hedge funds on average supply liquidity at month ends when their funding liquidity is good (low TED spread) but significantly demand liquidity when the TED spread is high. This is reflected in their abnormally high (low) market beta at T-3 during periods with low (high) TED spread. Interestingly, in times of high funding liquidity, hedge funds seem to increase their stock market betas exactly at T-3, suggesting that they purchase equity either at T-4 (which has historically been the best time to buy) or in the morning of T-3 (when

[20] Patton and Ramadorai (2013) study day-of-the-month effects in hedge fund risk exposures by including a flexible parametric function in their regression specification. Consistent with our results, they find that hedge fund risk exposures are high at the beginning of the month and low at the end of the month.
[21] The methodology to identify daily betas from hedge funds' monthly returns is similar to that in Jylhä, Rinne and Suominen (2014).

our evidence suggests the demand for end of month liquidity is at its highest). Only at times of poor funding liquidity do the hedge funds also become demanders of liquidity. It is also during those times that the hedge funds' ability to take risk near the month end can be expected to be low.

[INSERT TABLE 10 HERE]

6.2. Funding constraints and turn of the month returns

Consistent with our finding that hedge funds' ability to supply liquidity fluctuates with market-wide funding conditions, we find evidence that month-end return reversals get amplified when funding conditions are tight. Figure 13 illustrates this result by plotting *T-3* to *T-1* returns against *T-8* to *T-4* returns in a scatter plot that highlights the observations where TED spread exceeds its 97.5th percentile. The regression analysis in Table 11 shows that the interaction of TED spread with *T-8* to *T-4* returns is indeed a significant predictor of *T-3* to *T-1* returns. This finding lends support to the idea that funding constraints of institutional investors are an important contributor to return reversals around *T-3*.

The TED spread is perhaps the most commonly used proxy for speculator funding liquidity (e.g. Brunnermeier, Nagel and Pedersen, 2009). It is therefore conceivable that the TED spread affects month-end return reversals primarily via hedge funds. To investigate this channel, we consider a related variable, "hedge fund cost of leverage," which we define as the TED spread multiplied by aggregate hedge fund AUM (scaled by US stock market capitalization). We find that the interaction of hedge fund cost of leverage and the return from *T-8* to *T-4* is a statistically significant predictor of *T-3* to *T-1* returns, although only slightly more significant than the TED spread interaction term alone. These results are also reported in Table 11.

[INSERT FIGURE 13 AND TABLE 11 HERE]

7. Mutual fund alphas and exposure to month-end return reversals

In this section, we present evidence that links equity mutual fund performance to fund-specific exposures to month-end return reversals. Specifically, we sort US equity funds by the trailing two-year correlation of their *T-8* to *T-4* and *T-3* to *T-1* returns and find that the funds in the highest correlation decile have significantly positive subsequent four-factor alphas, while the alphas for *all* of the other fund deciles are negative or insignificant (see Figure 14 and Table 12). That is, funds that are less sensitive to month-end return reversals – due to better month-end liquidity management practices or other reasons – seem to be significantly more skilled than others. Exposure to market's return reversals *predicts* mutual fund performance.

[INSERT FIGURE 14 AND TABLE 12 HERE]

In Table 13, we seek to better understand this relationship by investigating the characteristics of mutual funds within our correlation deciles. Consistent with our hypothesis that month-end liquidity needs drive fund behavior, we find that the funds in the highest correlation decile have the highest average cash holdings and may therefore depend less on stock sales to fulfill their month-end cash needs. These funds also have the lowest institutional ownership share, suggesting that they are less exposed to month end liquidity related selling in the first place. Finally, we find that the funds in the highest correlation decile tend to generate higher returns not only during the turn of the month period but also other days. That is, their outperformance cannot be fully attributed to their returns at the turn of the month but they exhibit greater skill during the rest of the month also. Nonetheless, their rate of outperformance is clearly higher during the last 8 trading days of the month.[22] [23]

[INSERT TABLE 13 HERE]

8. 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 in the time series of US stock index returns, in the cross-section of US stock returns, and in the time series of most developed market stock index returns. We argue that the reversal is driven mainly by the month-end cash cycle – which, as previously argued by Ogden (1990), is also the likely cause of the abnormally high returns on the last and the first three trading days of the month. The month-end cash cycle may therefore be the unifying explanation for the exceptionally high returns observed during the seven days around the

[22] We also study other fund characteristics often associated with performance (see e.g., Cremers and Petajisto, 2009) and find that the funds in our highest correlation decile are smallest by AUM, have the highest turnover and expense ratios, and the highest measured active shares (active share measures are described in Petajisto (2013) and are downloaded from http://www.petajisto.net). Motivated by Frazzini, Friedman and Pomorski (2015), we find also that the funds' exposure to month-end reversals is linked to their benchmark type: nearly 20% of small cap funds benchmarked to Russell 2000 are in the highest correlation decile while less than 4% of large cap funds benchmarked to Russell 1000 are in this decile.

[23] Supplemental results (available from the authors), show that: (i) Correlation ranks are persistent among funds in the extreme correlation deciles. For example, 40% of the funds in the highest correlation decile (highest alpha) remain in that decile and 65% of the funds remain in the three highest deciles in the following year. (ii) A double sort based on the trailing two-year volatility of fund flows reveals that the differences across correlation deciles are larger for funds with higher flow volatility. (iii) Funds' four-factor alphas rise linearly in their trailing two-year average returns measured over either *T-8* to *T-4* or *T+4* to *T+8*. This related finding suggests that both the sales prior to the month end and the purchases at the beginning of the month have a negative impact on fund alphas.

turn of the month.

To shed some light on the underlying market dynamics, we present extensive evidence that links the return reversals around *T-3* to institutional investors' trading, their reduced risk taking near the month end, and to hedge funds' appetite to arbitrage this predictability. Our most direct evidence is based on ANcerno's institutional trade data, which reveals that institutions are on average net sellers prior to *T-3*, but net buyers at the end of the month and on the first few days of the month. Indeed, we estimate that institutions may incur significant costs from their liquidity-related trading at the month end. Moreover, using regression analysis, we demonstrate that these institutions' net sales on days *T-8* to *T-4* (normalized by stock market capitalization) significantly strengthens the market-wide return reversals at the month end. We find also additional, indirect evidence to support the idea that institutions' month end liquidity needs contribute to return predictability. In particular, we show that 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. We find also that mutual fund flows prior to T-3 significantly affect the size of the market return reversals. 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. Also in international samples, the return reversals seem to be more pronounced in countries with larger mutual fund sectors. Finally, we present evidence that mutual funds' return patterns around the turn of the month (which presumably reflect their liquidity management or other skills) significantly predict their future alphas.

Our results contribute to the literature by tying the vast body of existing research on turn of the month return anomalies to rational models of markets with temporally segmented investors. In addition, our findings have significant practical implications for institutions that currently mismanage their turn of the month liquidity related trading.

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Figure 1

Cumulative returns around the turn of the month

This figure shows the cumulative excess 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, where *T* refers to the last day of the month, *T+3* to the third business day of the month, and so on. It shows also the returns from investing in the same index only on days *T-8* to *T-4,* only on days *T+4* to *T+8,* and only on days outside *T-8* to *T+8*. The sample period is from July 1926 to December 2013. Note logarithmic scale.

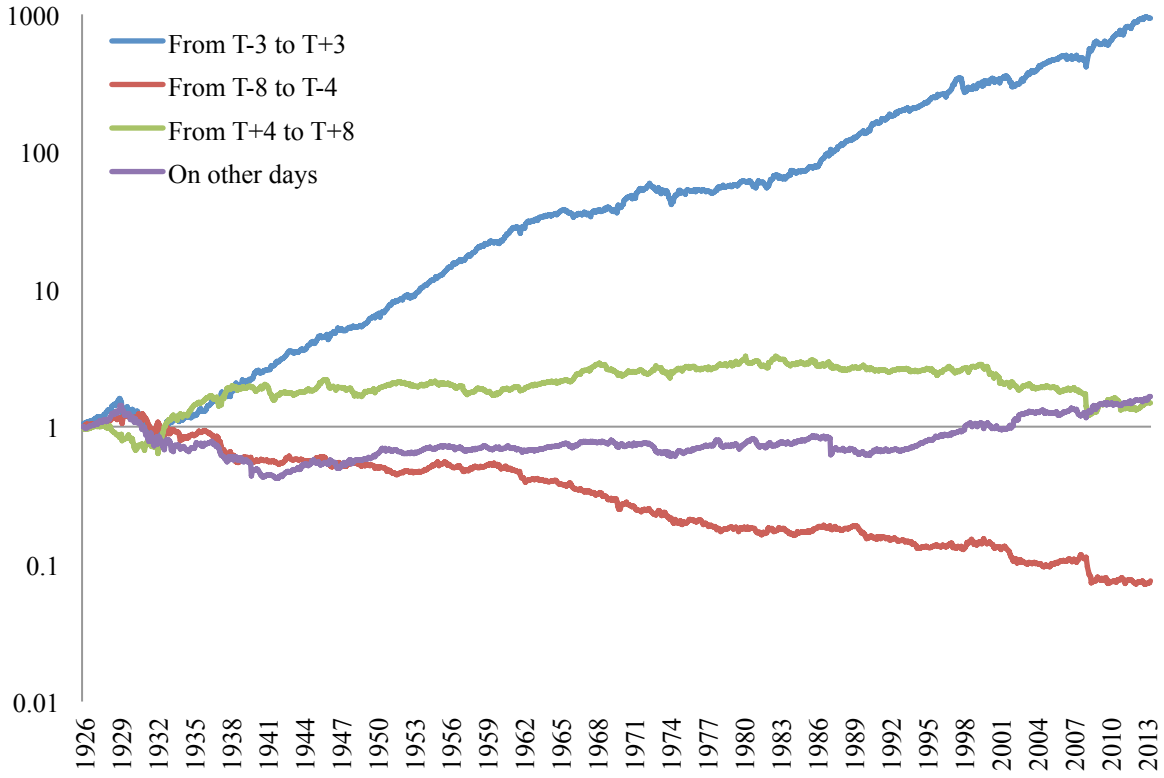


Figure 2A

Pension fund payment dates around the turn of the month

This figure shows the proportion of pension payment dates around the turn of the month. Day *T* denotes the last trading day of the month, *T-1* the trading day preceding that, and so on. 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.

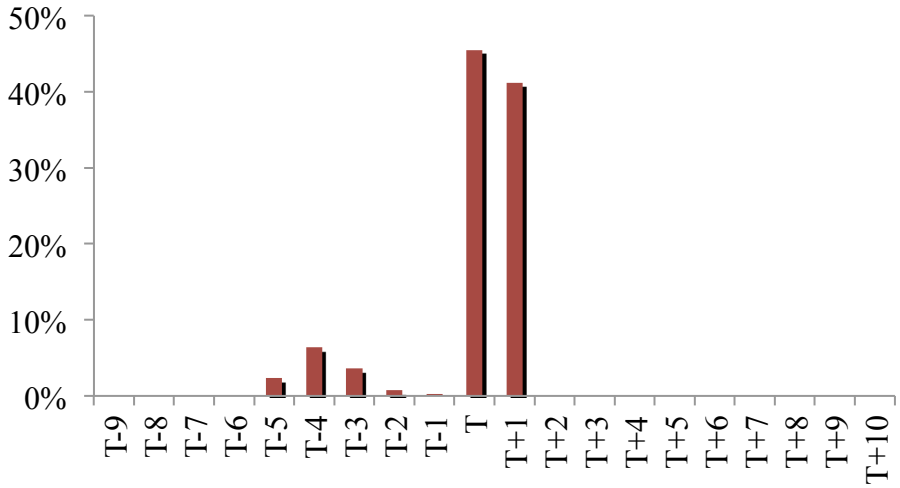


Figure 2B

Corporate dividend payment dates around the turn of the month

The figure shows the proportion of annual dividend payments (in dollars) by CRSP companies occurring around the turn of the month. Day *T* denotes the last trading day of the month, *T-1* the trading day preceding that, and so on. The sample period is from January 1980 to December 2013.

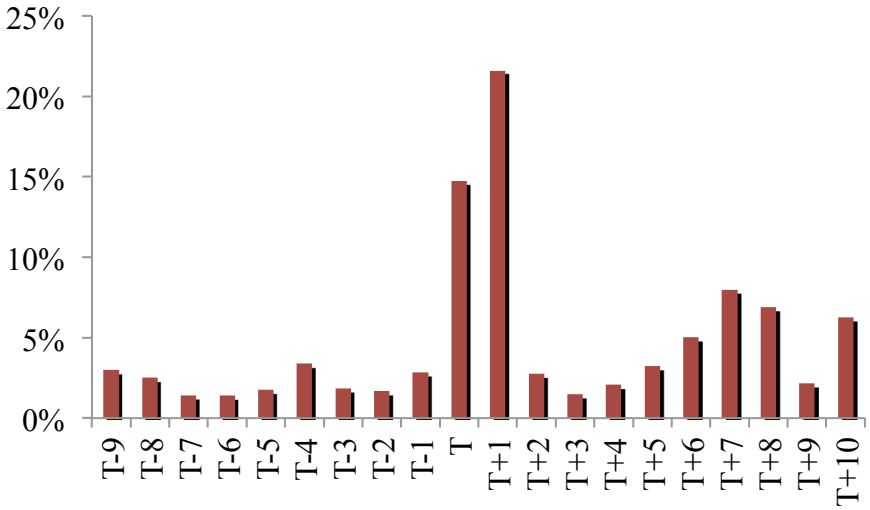


Figure 3A

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. *T* is the last day of the month. The sample period is from January 1980 to December 2013. Source: FRED database.

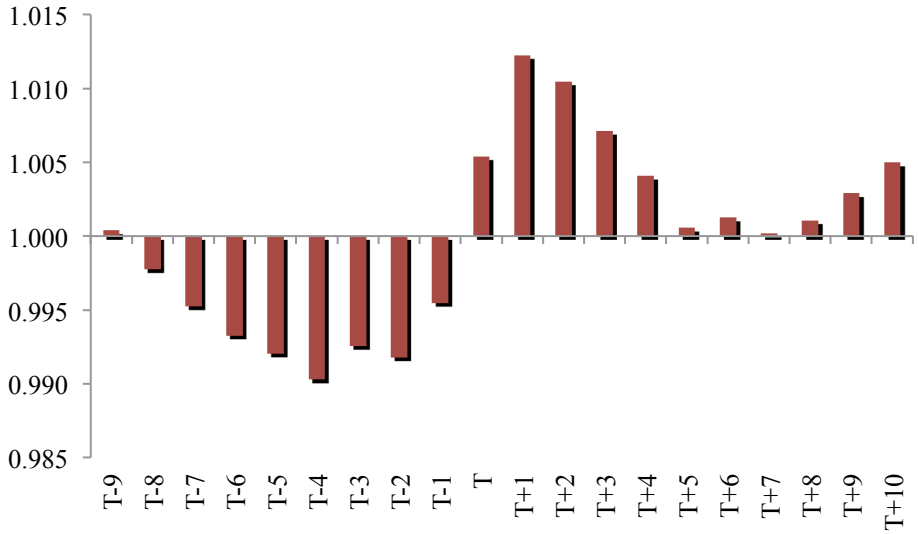


Figure 3B

Federal Funds rate around the turn of the month

This figure shows the level of effective Federal Funds rate excess of its monthly average around the turn of the month. Day *T* denotes the last trading day of the month and *T-1* the trading day preceding that, and so on. The data is from Federal Reserve. The sample period is from January 1980 to December 2013.

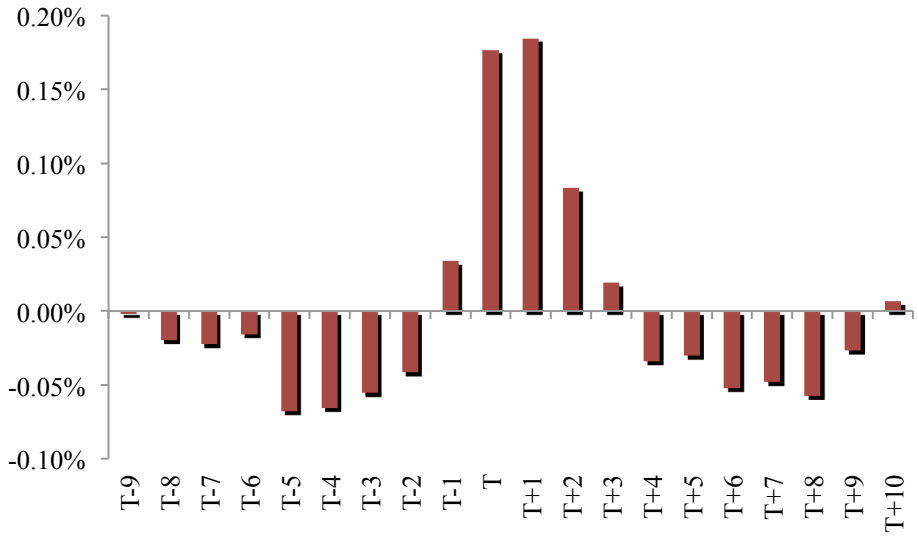


Figure 3C

Libor rate around the turn of the month

This figure shows the level of Libor rate (USD overnight) excess of its monthly average around the turn of the month. Day *T* denotes the last trading day of the month, *T-1* the trading day preceding that, and so on. The data is from Federal Reserve. The sample period is from January 2001 to December 2013.

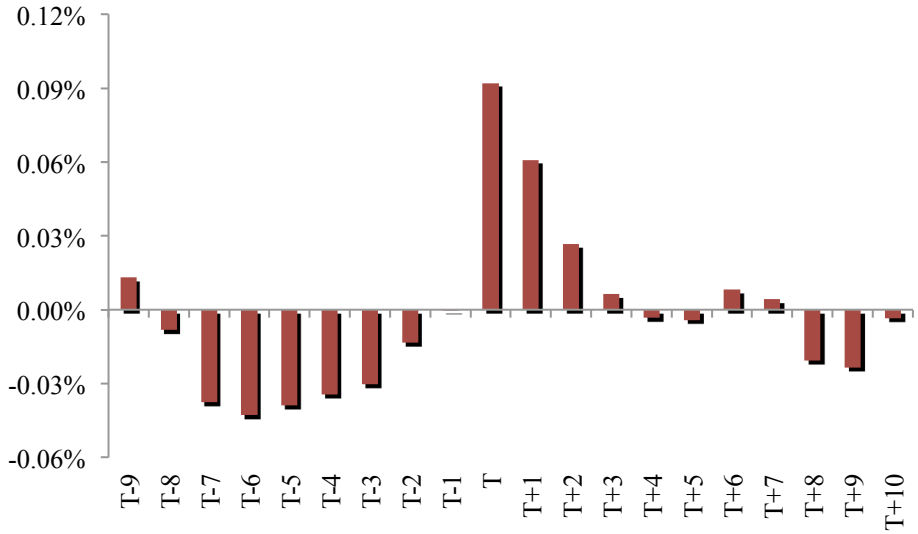


Figure 4

Average 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 *T* denotes the last trading day of the month, *T-1* the trading day preceding that, and so on. The sample period is from July 1995 (the time when the 3-day settlement convention was adopted in the US) to December 2013.

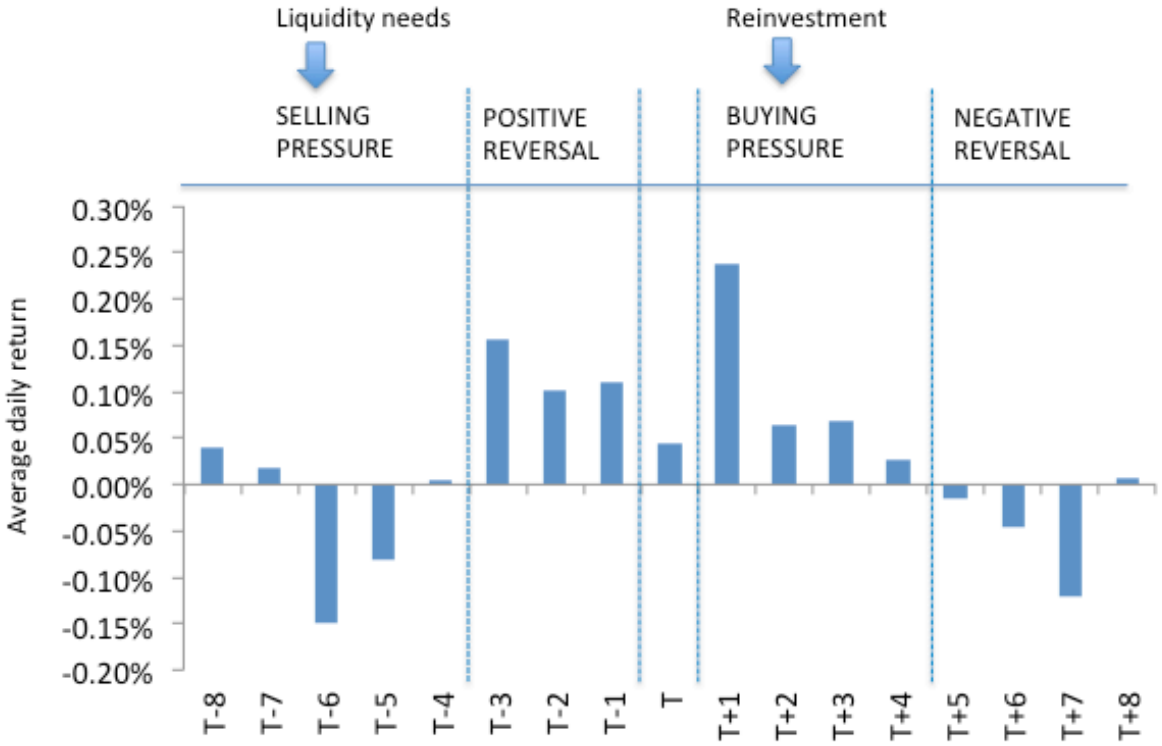


Figure 5

Return reversals around different days of the month – a placebo test

This figure shows the correlation of past 5-day returns and 3-day future varies on the different days of the month. Observation *T-3* shows the correlation of *T-8 – T-4* and *T-3 – T-1* returns. Day *T* denotes the last trading day of the month, *T-1* the trading day preceding that, and so on. Market returns are based on CRSP value weighted stock index. Dashed lines present 5% confidence intervals. The sample period is from July 1995 to December 2013.

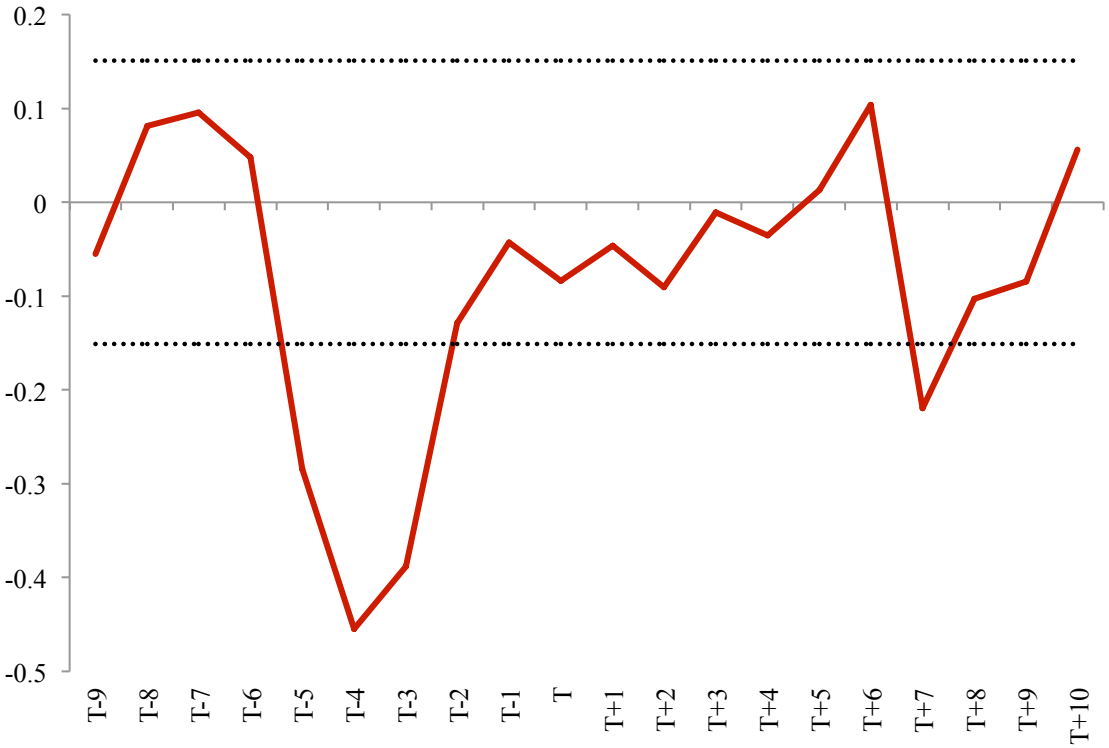


Figure 6

Institutional investors' buy ratios around the turn of the month

This figure shows the buy ratio for a sample of US institutions around the turn of the month in excess of their average buy ratio. Buy ratio is defined as the dollar value of buy transactions divided by the dollar value of both buy and sell transactions during the time period. Day *T* denotes the last trading day of the month and *T-1* the trading day preceding that, and so on. For day *T-3*, the figure also displays the hourly buy ratios; for example, time stamp 10H includes trades from 9.30am until 10.29am, etc. The data is from ANcerno and the sample period is from January 1999 to December 2013. *, ** and *** denote the statistical significance at 10%, 5% and 1% levels, respectively.

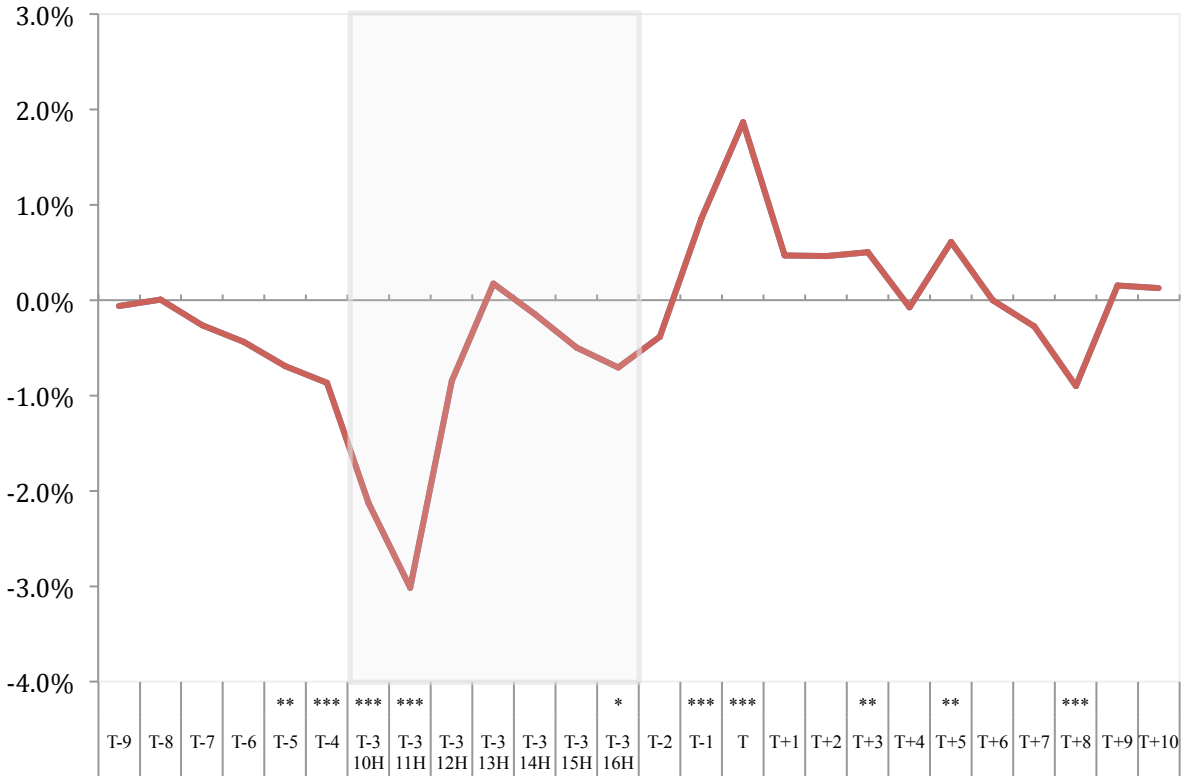


Figure 7

Systematic patterns in institutional trading around the turn of the month

This figure shows for ANcerno institutions, which we classify either as liquidity demanders or other institutions, their signed excess volume (relative to CRSP market volume) around the turn of the month. Signed excess volume for any given time period and institution type equals the sum of the relevant institutions' signed volumes during the relevant time period in excess of their average signed volume during the entire sample. Signed volume for any given institution is the sum of its stock purchases (in dollars) minus its stock sales. An institution is classified as a liquidity demander (other institution) if its previous year's signed volume is negative (positive) on days *T-5* to *T-3*. Day *T* denotes the last trading day of the month and *T-1* the trading day preceding that, and so on. For day *T-3*, the figure also displays the hourly signed volumes in excess of the average signed volumes on other days at the corresponding hours of the day; for example, time stamp 10H includes trades from 9.30am until 10.29am, etc. The data is from ANcerno and the sample period is from January 2000 to December 2010. *, ** and *** denote the statistical significance at 10%, 5% and 1% levels, respectively.

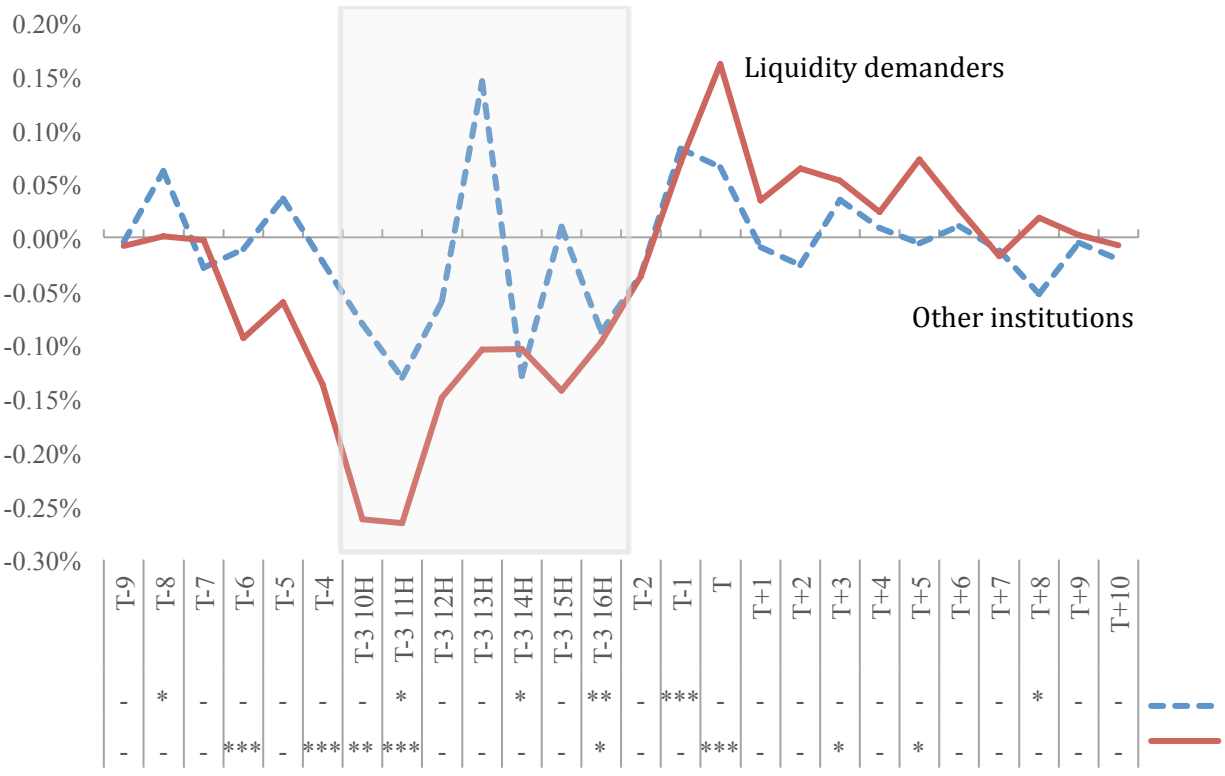


Figure 8

Impact of mutual fund holdings on turn of the month return patterns

This figure shows value- and equal-weighted annualized returns around the turn of the month for deciles of stocks based on mutual funds' total ownership percentages 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 July 1995 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*. Finally, 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.

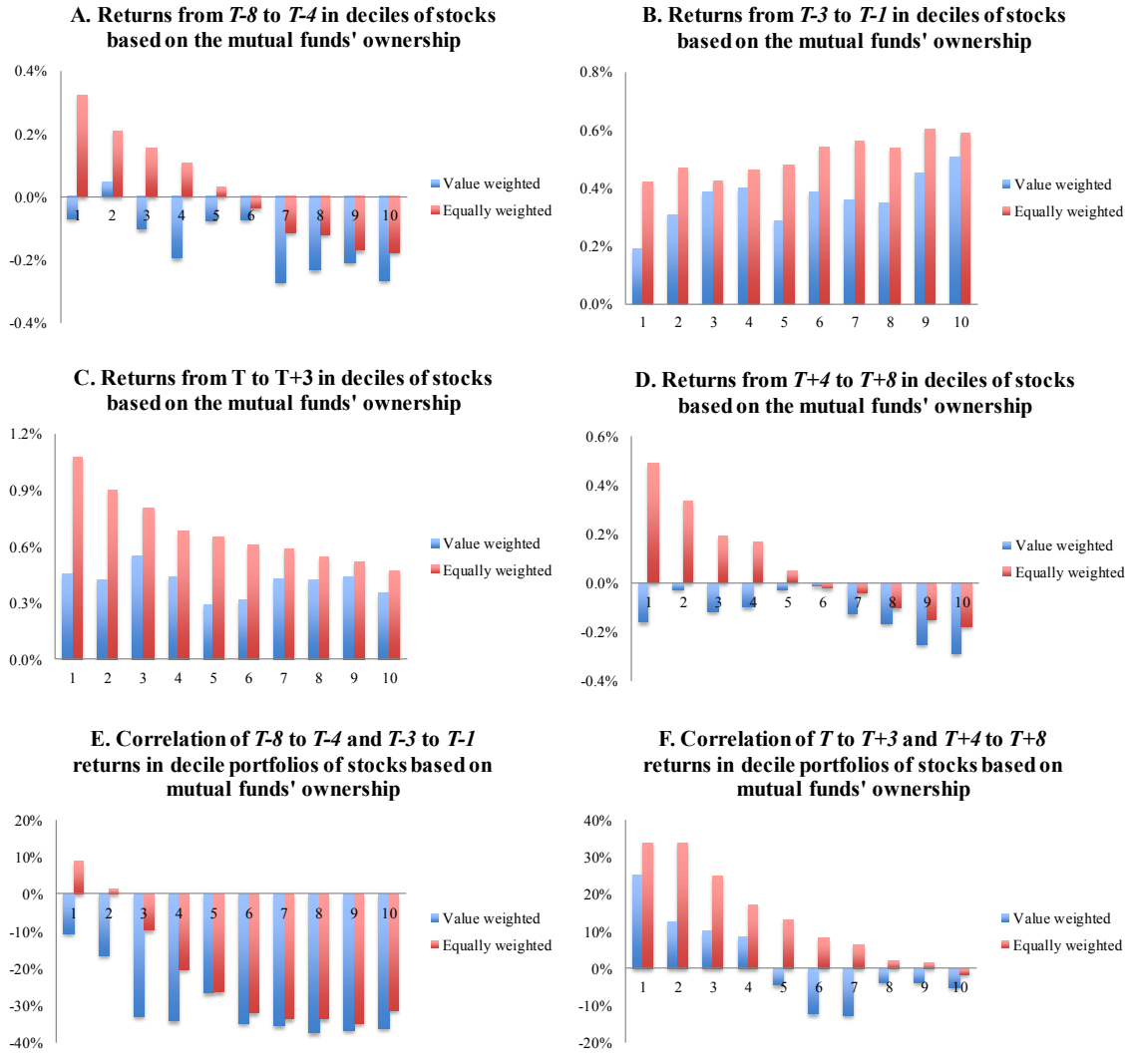
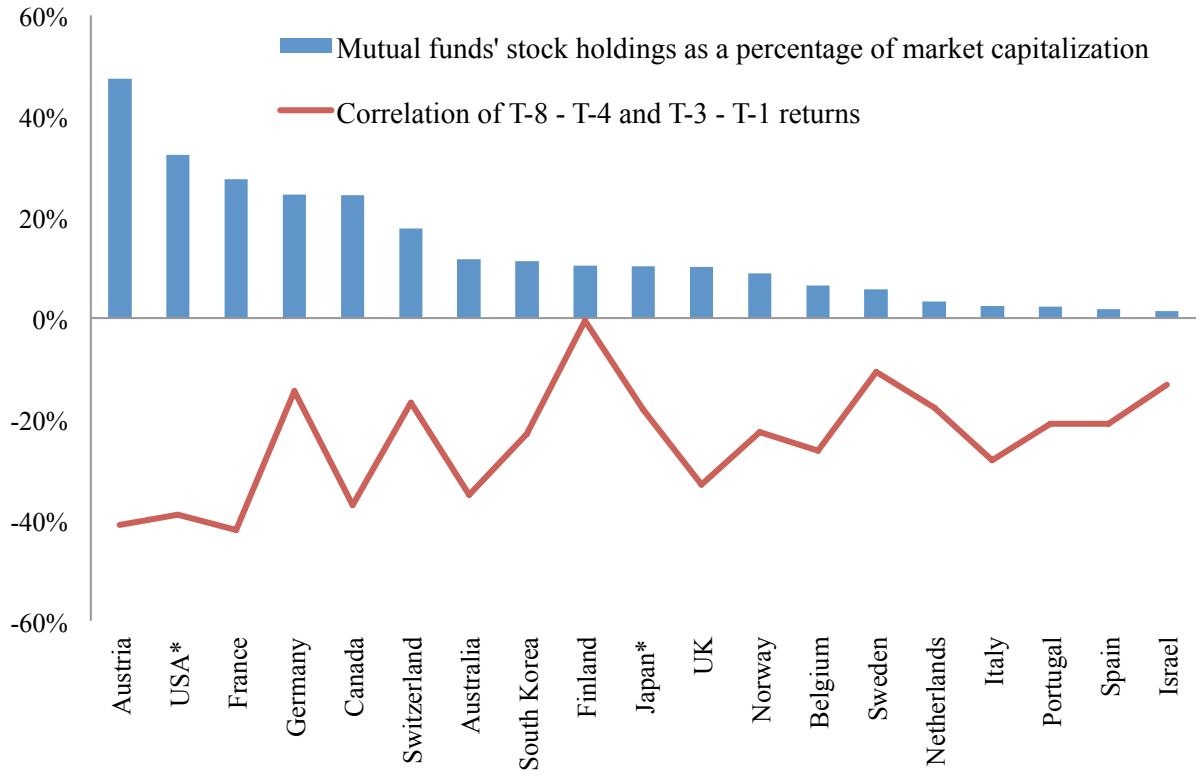


Figure 9

Mutual funds ownership and the correlation of *T-8* to *T-4* and *T-3* to *T-1* returns across countries

This figure shows 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 in the corresponding stock index, reprinted from Table 2. Here *T* refers to the last trading day of the month. 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 database. Total market capitalizations are from World Bank. For some countries, only total stock holdings (i.e. holdings including both domestic and foreign stock holdings) by mutual funds are available. Out of these countries, we have included USA and Japan (denoted with star in the figure) 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 stocks issued by both residents and non-residents

Figure 10

Mutual fund return volatility within the month

This figure shows the mutual funds' average cross-sectional return volatility during each trading day of the month (*T+1* being the first trading day of the month), normalized by the funds' average daily return volatility. Daily returns of active domestic equity mutual funds are from the CRSP Mutual Fund database. The sample period is from September 1998 until December 2013.

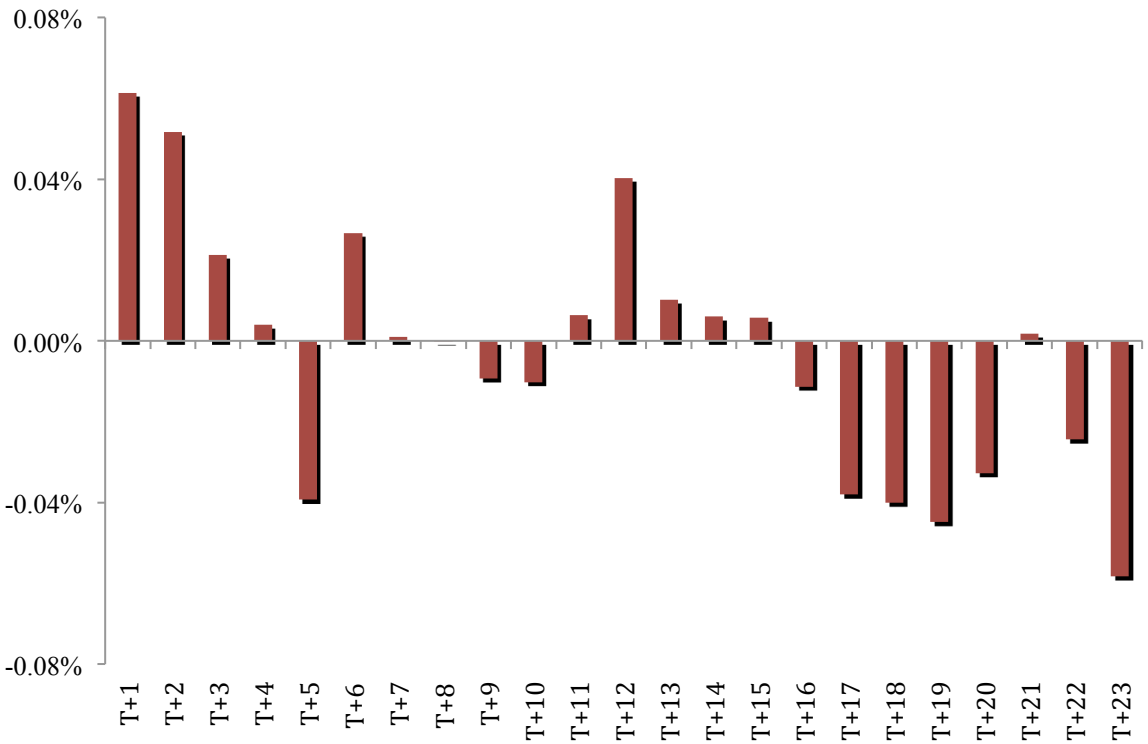
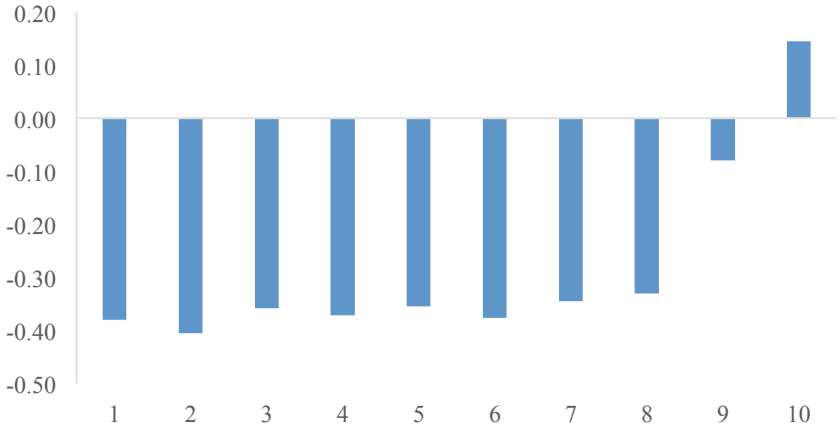


Figure 11

Stock-level liquidity, size and turn of the month patterns

A. This figure shows the impact of stock-level liquidity on the correlation of *T-8* to *T-4* and *T-3* to *T-1* returns. Our sample, covering data from July 1995 to December 2013, includes all stocks in CRSP listed in the NYSE and the Amex. Amihud (2002) *ILLIQ* measure is calculated as a rolling one year average until the 10th trading day of the corresponding month. For stocks sorted into deciles based on their Amihud measure (10th being the most illiquid), the figure shows the correlations between stocks' *T-8* to *T-4* and *T-3* to *T-1* value-weighted returns. *T* refers to the last trading day of the month.



B. This figure shows the impact of stocks' market capitalization on the correlation of their *T-8* to *T-4* and *T-3* to *T-1* returns. Our sample, from July 1995 to December 2013, includes all stocks from CRSP. For stocks sorted into deciles based on their market capitalization (10th being the largest), figure shows the correlations between stocks' *T-8* to *T-4* and *T-3* to *T-1* value-weighted returns. *T* refers to the last trading day of the month.

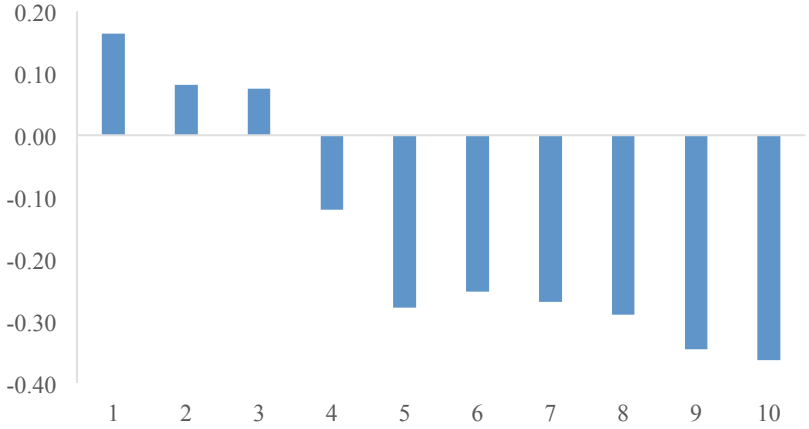


Figure 12

Turnover around the turn of the month

This figure displays the daily stock market turnover around the turn of the month in excess of the average turnover outside the turn of the month. Day *T* denotes the last trading day of the month, *T-1* the trading day preceding that, and so on. The average daily turnover outside the turn of the month refers to the average stock market turnover on days from *T+11* of the ending month to *T-9* of the 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 July 1995 to December 2013.

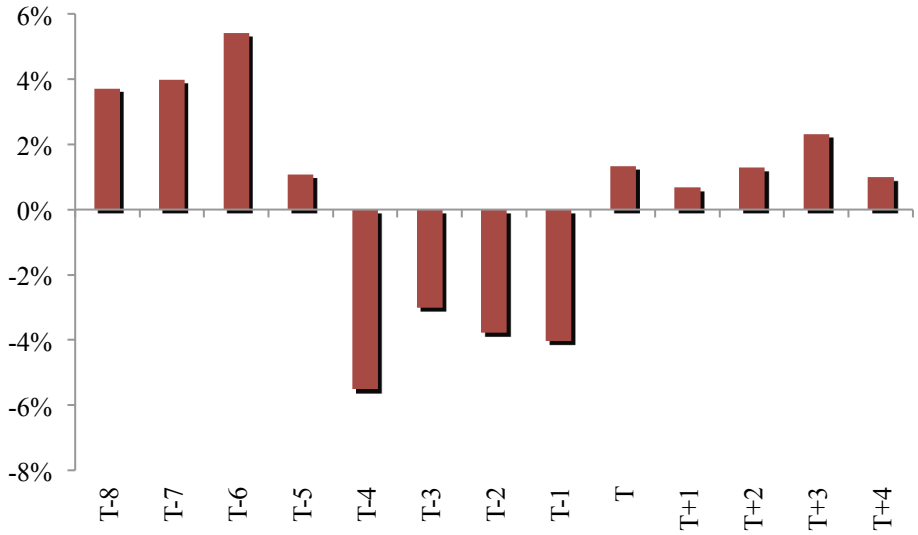


Figure 13

Correlation of *T-8 – T-4* and *T-3 – T-1* returns

This figure shows the scatter plot of *T-8* to *T-4* and *T-3* to *T-1* market returns. Market returns are based on CRSP value weighted stock index. Day *T* denotes the last trading day of the month, *T-1* the trading day preceding that, and so on. Observations in a month when TED spread (the difference between the 3-month Eurodollar and the Treasury rates) exceeds its 97.5th percentile are shown in red. The solid (dashed) line shows the fitted regression line based on full sample (sample excluding observations drawn in red). The sample period is from July 1995 to December 2013.

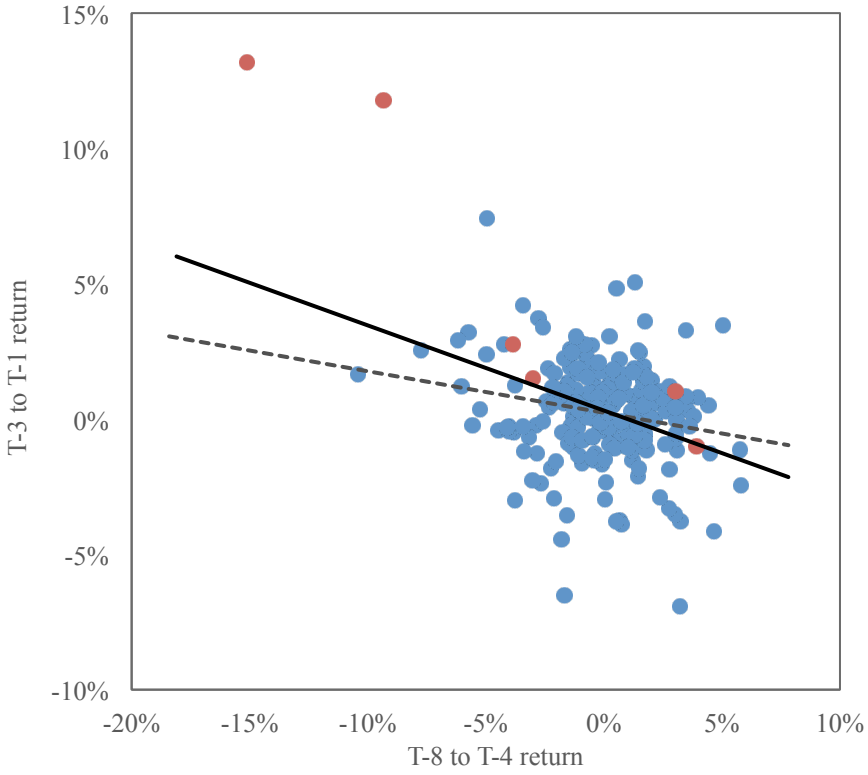


Figure 14

Exposure to month-end return reversals predicts mutual fund performance

This figure shows mutual funds' four factor alphas conditional on fund-specific trailing two-year correlations between the funds' *T-8* to *T-4* and *T-3* to *T-1* returns. Here T refers to the last day of the month. More specifically, funds are divided into deciles every year (at the end of December) based on this correlation. Four factor alphas are calculated using the subsequent year's daily returns controlling for the three factors of Fama and French and Carhart's Momentum factor. Decile 10 contains the funds with the highest correlation in their *T-8* to *T-4* and *T-3* to *T-1* returns. The daily mutual fund returns are from CRSP. The sample period is from January 1999 to December 2013.

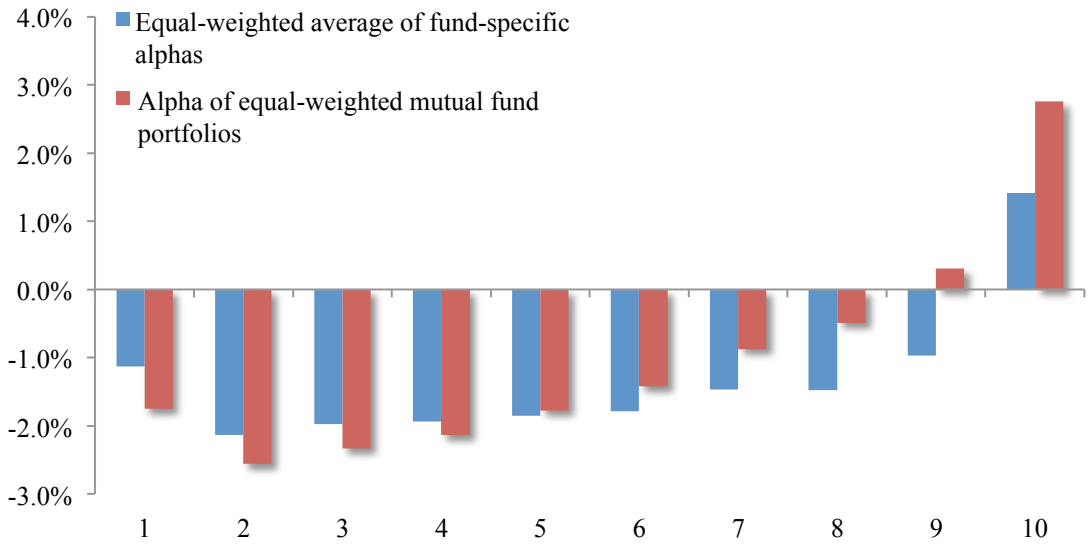


Table 1

Stock market returns near the turn of the month around the world

This table presents average daily stock market returns near the turn of the month in the United States as well as in several other industrialized countries. *T* refers to the last trading day of the month. Our sample starts in January 1980 or later as the relevant data becomes available, and settlement rule is T+3 or shorter. For the US we show also the full sample results. The sample runs until the end of 2013 (to be precise, until the 8th trading day of 2014). All figures that are statistically significant at 5% level are displayed in bold.

Country	Settlement period	Sample starts	From *T-3* to *T-1*	On *T*	From *T+1* to *T+3*	From *T-8* to *T-4*	From *T+4* to *T+8*	Average daily return
United States (S&P 500)	T+3	Jul-95	**0.11%**	-0.04%	**0.13%**	-0.04%	-0.03%	**0.04%**
United States (CRSP VW)	T+3	Jul-95	**0.12%**	0.04%	**0.12%**	-0.03%	-0.03%	**0.04%**
United States (S&P 500)	T+5/T+3	Jan-80	**0.11%**	0.08%	**0.13%**	-0.01%	-0.01%	**0.05%**
United States (CRSP VW)	T+5/T+3	Jan-80	**0.11%**	**0.14%**	**0.13%**	-0.02%	-0.01%	**0.05%**
Other industrialized countries								
Australia (S&P/ASX200)	T+3	Feb-99	**0.14%**	0.10%	0.09%	-0.02%	-0.02%	**0.04%**
Austria (ATX)	T+3	Feb-98	**0.18%**	0.17%	**0.19%**	0.00%	-0.07%	0.04%
Belgium (BEL20)	T+3	Jan-90	0.06%	**0.20%**	**0.15%**	-0.05%	-0.03%	**0.03%**
Canada (S&P/TSX C)	T+3	Jul-95	0.06%	**0.21%**	0.09%	0.00%	-0.03%	**0.04%**
Denmark (OMXC20)	T+3	Dec-89	0.07%	**0.14%**	**0.18%**	-0.06%	0.00%	**0.04%**
Finland (OMXH25)	T+3	Jan-91	0.12%	**0.33%**	**0.16%**	-0.02%	-0.02%	**0.06%**
France (CAC40)	T+3	Oct-00	**0.18%**	0.15%	0.07%	-0.07%	-0.11%	0.01%
Ireland (ISEQ OVER)	T+3	Mar-01	0.02%	**0.35%**	**0.17%**	-0.05%	-0.05%	0.01%
Italy (FTSE MIB)	T+3	Jan-98	**0.12%**	0.09%	0.08%	-0.06%	-0.07%	0.02%
Japan (NIKKEI225)	T+3	Jan-80	**0.11%**	0.11%	0.07%	0.01%	-0.06%	0.02%
Luxembourg (LUXX)	T+3	Jan-99	0.10%	**0.21%**	0.09%	-0.04%	0.00%	0.03%
Netherlands (AEX)	T+3	Jan-83	**0.07%**	**0.15%**	**0.18%**	0.00%	-0.02%	**0.05%**
New Zealand (NZX50)	T+3	Jan-01	**0.12%**	**0.25%**	**0.07%**	0.00%	-0.04%	**0.03%**
Norway (OBX)	T+3	Jan-87	0.07%	**0.26%**	**0.17%**	-0.02%	-0.02%	**0.05%**
Portugal (PSI-20)	T+3	Dec-98	0.05%	**0.14%**	**0.12%**	-0.08%	-0.01%	0.00%
Singapore (STI)	T+3	Sep-99	0.10%	**0.17%**	**0.15%**	-0.02%	0.01%	0.03%
Spain (IBEX35)	T+3	Mar-97	0.11%	0.10%	**0.18%**	-0.06%	-0.07%	0.04%
Sweden (OMXS30)	T+3	Jan-86	**0.12%**	**0.16%**	**0.20%**	-0.03%	0.00%	**0.06%**
Switzerland (SMI)	T+3	Jul-88	**0.09%**	0.11%	**0.15%**	-0.04%	-0.01%	**0.04%**
UK (FTSE100)	T+3	Aug-96	**0.11%**	0.04%	**0.16%**	-0.04%	-0.03%	**0.03%**
Countries with settlement period less than T+3								
Germany (DAX)	T+2	Jan-80	0.06%	**0.16%**	**0.21%**	-0.03%	-0.04%	**0.05%**
Hong Kong (HSI)	T+1/T+2	Jan-80	0.08%	**0.26%**	**0.15%**	-0.01%	0.03%	**0.07%**
Israel (TA-25)	T+1	Jan-92	0.08%	0.17%	**0.17%**	0.00%	0.04%	**0.06%**
South Korea (KOSPI)	T+2	Jan-80	0.01%	**0.34%**	**0.16%**	0.00%	0.03%	**0.05%**
Average of all indexes excluding US			0.09%	0.18%	0.14%	-0.03%	-0.02%	0.04%

Table 2

Return correlations near the turn of the month around the world

This table presents correlations of returns between *T-8* to *T-4* and *T-3* to *T-1*, and correlations of returns between *T* to *T+3* and *T+4* to *T+8*. *T* refers to the last trading day of the month. Our sample starts in January 1980 or later as the relevant data becomes available, and settlement rule is *T+3* or shorter. For the US we show also the full sample results. The sample runs until the end of 2013 (to be precise, until the 8th trading day of 2014). All figures that are statistically significant at 5% level are displayed in bold.

Country	Settlement period	Sample starts	Correlation of *T-8 to T-4* and *T-3 to T-1* returns	Correlation of *T to T+3* and *T+4 to T+8* returns	Daily return auto-correlation	Weekly return auto-correlation
United States (S&P 500)	T+3	Jul-95	**-0.38**	-0.11	**-0.07**	**-0.08**
United States (CRSP VW)	T+3	Jul-95	**-0.39**	-0.06	**-0.04**	-0.06
United States (S&P 500)	T+5/T+3	Jan-80	**-0.30**	-0.09	**-0.03**	**-0.05**
United States (CRSP VW)	T+5/T+3	Jan-80	**-0.32**	-0.03	0.01	-0.02
Other industrialized countries						
Australia (S&P/ASX200)	T+3	Feb-99	**-0.35**	**-0.16**	**-0.04**	-0.06
Austria (ATX)	T+3	Feb-98	**-0.41**	-0.09	**0.06**	-0.01
Belgium (BEL20)	T+3	Jan-90	**-0.26**	**-0.23**	**0.07**	-0.03
Canada (S&P/TSX C)	T+3	Jul-95	**-0.37**	0.03	0.00	**-0.09**
Denmark (OMXC20)	T+3	Dec-89	**-0.38**	-0.02	**0.06**	-0.05
Finland (OMXH25)	T+3	Jan-91	-0.01	**-0.19**	**0.04**	0.02
France (CAC40)	T+3	Oct-00	**-0.42**	**-0.18**	**-0.04**	**-0.09**
Ireland (ISEQ OVER)	T+3	Mar-01	**-0.26**	**-0.32**	**0.05**	-0.05
Italy (FTSE MIB)	T+3	Jan-98	**-0.28**	-0.04	0.00	-0.01
Japan (NIKKEI225)	T+3	Jan-80	**-0.18**	0.00	-0.02	-0.02
Luxembourg (LUXX)	T+3	Jan-99	**-0.23**	-0.14	**0.07**	0.07
Netherlands (AEX)	T+3	Jan-83	**-0.18**	**-0.21**	0.00	0.03
New Zealand (NZX50)	T+3	Jan-01	-0.03	0.05	**0.05**	0.04
Norway (OBX)	T+3	Jan-87	**-0.23**	-0.10	**0.03**	0.02
Portugal (PSI-20)	T+3	Dec-98	**-0.21**	**-0.16**	**0.08**	0.01
Singapore (STI)	T+3	Sep-99	**-0.35**	-0.06	0.03	0.03
Spain (IBEX35)	T+3	Mar-97	**-0.21**	**-0.15**	0.02	-0.06
Sweden (OMXS30)	T+3	Jan-86	-0.11	**-0.11**	**0.04**	-0.02
Switzerland (SMI)	T+3	Jul-88	**-0.17**	**-0.24**	**0.03**	**-0.07**
UK (FTSE100)	T+3	Aug-96	**-0.33**	**-0.24**	-0.03	**-0.08**
Countries with settlement period less than T+3						
Germany (DAX)	T+2	Jan-80	**-0.15**	**-0.15**	0.00	-0.02
Hong Kong (HSI)	T+1/T+2	Jan-80	**-0.19**	-0.04	**0.03**	**0.08**
Israel (TA-25)	T+1	Jan-92	**-0.13**	-0.08	0.02	**-0.07**
South Korea (KOSPI)	T+2	Jan-80	**-0.23**	-0.07	**0.06**	**-0.07**
Average of all indexes excluding US			**-0.24**	-0.12	0.03	-0.02

Table 3

Difference in differences test around the change in the settlement period

This table shows the results from a difference in differences setup testing whether the change in the settlement period affects market index return autocorrelations at *T-2* (i.e., correlation of *T-2* and *T-3* returns). In October 6, 2014 most of the European countries changed their settlement rule from T+3 to T+2. Our treatment group is formed from our international sample countries affected by this change (AUT, BEL, CHE, DNK, FIN, FRA, GBR, IRL, ITA, LUX, NLD, NOR, PRT, and SWE). Our control group consists of all countries in our international sample following T+3 settlement period at the end of September 2013 and not affected by this change (AUS, CAN, ESP, JPN, NZL, SGP, and USA). In the first regression, autocorrelation is regressed on treatment group dummy, after change dummy and their interaction, and in the second specification autocorrelation is regressed on after change dummy, treatment dummy (Treatment group dummy * after change dummy), and country fixed effects. *T* refers to the last trading date of the month. Autocorrelations are calculated using one year of data before and after October 2014. T-statistics based on White heteroskedasticity robust standard errors are shown below the coefficients. All figures that are statistically significant at 5% level are displayed in bold.

	Autocorrelation at *T-2*	
Treatment group * After change	**-0.776**	**-0.776**
	(-3.70)	(-3.24)
Treatment group	0.194	
	(1.46)	
After Change	0.336	0.336
	(1.81)	(1.51)
Intercept	**-0.313**	
	(-2.85)	
Country fixed effects	No	Yes
N	42	42
R^2	0.395	0.789

Table 4

Impact of institutional trading on turn of the month returns

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* index returns, and on the institutional investors' selling pressure. Here *T* refers to the last trading day of the month. Institutional investors' selling pressure is defined to be the difference between the value of their stock sales and purchases from *T-8* to *T-4* or alternatively from *T-5* to *T-4* (normalized by the US total stock market capitalization at the beginning of the selling pressure period) when the sales exceed the purchases, and to be zero otherwise. Our institutional investors' trade data is from ANcerno and the sample period is from January 1999 to December 2013. The index returns are those of the CRSP value-weighted index. T-statistics based on Newey-West (1987) standard errors are shown below the coefficients. All figures that are statistically significant at 5% level are displayed in bold.

y = returns *T-3 to T-1*					
Market return *T-8 to T-4*	**-0.352**			**-0.344**	**-0.344**
	(-2.51)			(-2.71)	(-2.71)
Institutional investors' selling pressure (*T-8 to T-4*)		35.27		**40.37**	
		(1.50)		(2.14)	
Institutional investors' selling pressure (*T-5 to T-4*)			**117.25**		**111.09**
			(2.53)		(3.49)
Intercept	**0.003**	0.002	0.000	0.001	-0.001
	(2.39)	(0.98)	(-0.09)	(0.32)	(-0.52)
R^2	0.184	0.020	0.084	0.209	0.259

Table 5

Cross-sectional return reversals around the turn of the month

Panel A shows evidence of cross-sectional return reversals around the turn of the month by displaying the returns from *T–3* to *T–1* and from *T* to *T+3* for deciles of stocks based on their *T-8* to *T-4* returns. Here *T* refers to the last trading day of the month. In Panel B, the table shows returns from *T+4* to *T+8* for deciles of stocks based on 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 NYSE 10th market capitalization percentile on the 10th trading day of the corresponding month. The sample period is from July 1995 to December 2013. The last column shows the difference in returns between the two extreme deciles. T-statistics are provided in the parenthesis. All figures that are statistically significant at 5% level are displayed in bold.

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

	1	2	3	4	5	6	7	8	9	10	1-10
Return	**0.98%**	**0.72%**	**0.60%**	**0.58%**	**0.53%**	**0.48%**	**0.46%**	**0.44%**	**0.41%**	0.26%	**0.72%**
T-3 to *T-1*	(3.76)	(3.50)	(3.31)	(3.49)	(3.45)	(3.23)	(3.12)	(2.98)	(2.67)	(1.44)	(4.19)
Return	**0.65%**	**0.52%**	**0.52%**	**0.46%**	**0.39%**	**0.42%**	**0.43%**	**0.36%**	**0.41%**	0.31%	0.34%
T to *T+3*	(2.16)	(2.29)	(2.70)	(2.65)	(2.34)	(2.53)	(2.57)	(2.09)	(2.11)	(1.28)	(1.78)

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

	1	2	3	4	5	6	7	8	9	10	1-10
Return	0.13%	-0.10%	-0.12%	-0.15%	-0.10%	-0.15%	-0.14%	-0.16%	-0.19%	-0.33%	**0.46%**
T+4 to *T+8*	(0.43)	(-0.41)	(-0.57)	(-0.73)	(-0.55)	(-0.83)	(-0.73)	(-0.83)	(-0.92)	(-1.29)	(2.66)

Table 6

Impact of mutual fund AUM on month-end return reversals

This table shows the results from a regression of US equity market index returns from *T-3* to *T-1* on *T-8* to *T-4* index returns, and on mutual fund industry AUM, and its interaction with *T-8* to *T-4* index returns. *T* refers to the last trading day of the month. Mutual fund industry AUM is the sum of all domestic equity mutual funds' assets under management based on the CRSP mutual fund database, normalized by the US total stock market capitalization. The index returns are those for the CRSP value-weighted index. T-statistics based on Newey-West standard errors are shown below the coefficients. All figures that are statistically significant at 5% level are displayed in bold.

y = returns *T-3 - T-1*			
Market return *T-8 - T-4*	**-0.315**	0.627	0.627
	(-2.58)	(1.52)	(1.53)
Mutual fund industry AUM		0.043	0.048
		(1.51)	(0.32)
Interaction of mutual fund industry AUM and market return *T-8 - T-4*		-4.450	**-4.446**
		(-1.96)	(-1.98)
Linear trend			-0.000
			(-0.03)
Intercept	**0.003**	-0.006	-0.006
	(2.55)	(-0.98)	(-0.31)
R^2	0.150	0.200	0.200
Sample	7/1995-12/2013	7/1995-12/2013	7/1995-12/2013

Table 7

Impact of mutual fund outflows on turn of the month returns

This table shows the results from a regression in which the US equity market index returns from *T-8* to *T-4* (Panel A) or *T-3* to *T-1* (Panel B) are regressed on the past market index returns, and on the mutual fund aggregate outflow. Here *T* refers to the last trading day of the month. Mutual funds' aggregate outflow (normalized by the US total stock market capitalization) is defined to be the negative of the net flow to all mutual funds from the first Wednesday of the month until the last Wednesday before *T-8* (Panel A) or until the last Wednesday before *T-3* (Panel B) when the net flow is negative, and zero otherwise. Our weekly mutual funds' flow data is from Investment Company Institute and the sample period is from January 2007 to December 2013. The index returns are those of the CRSP value-weighted index. T-statistics based on Newey-West (1987) standard errors are shown below the coefficients. All figures that are statistically significant at 5% level are displayed in bold.

A. Impact of outflows on *T-8* to *T-4* returns

y = returns *T-8* to *T-4*		
Mutual funds' aggregate outflow	**-190.00**	**-176.34**
	(-2.87)	(-2.55)
Past 20 day returns		0.052
		(0.53)
Intercept	0.001	0.000
	(0.28)	(0.10)
R^2	0.189	0.193

B. Impact of outflows on *T-3* to *T-1* returns

y = returns *T-3* to *T-1*		
Mutual funds' aggregate outflow	**212.51**	**136.43**
	(4.30)	(2.63)
T-8 to *T-4* return		**-0.345**
		(-3.00)
Intercept	0.002	0.002
	(0.81)	(1.09)
R^2	0.296	0.437

Table 8

Mutual fund excess market betas around the turn of the month

This table shows mutual funds' average market betas on various days around the turn of the month in excess of their market betas on all other days. *T* refers to the last trading day of the month. The average market betas are obtained from fund specific regressions where mutual funds' daily returns excess of risk-free rate are regressed on daily S&P 500 index returns (excess of risk-free rate), dummies for days corresponding to their location relative to the turn of the month, and their interactions. Daily returns of active domestic equity mutual funds are from the CRSP Mutual Fund database. The sample period is from September 1998 to December 2013. All figures that are statistically significant at 5% level are displayed in bold.

		Coefficient	t-stat
Interactions of time period dummies and daily S&P500 returns	T-5	**-0.024**	(-15.67)
	T-4	**-0.017**	(-10.16)
	T-3	**-0.053**	(-31.50)
	T-2	**0.016**	(10.62)
	T-1	**-0.021**	(-16.40)
	T	**-0.075**	(-43.62)
	T+1	**0.012**	(10.03)
	T+2	**0.052**	(22.61)
	T+3	**0.033**	(17.64)
	T+4	-0.001	(-0.74)
	T+5	**-0.012**	(-8.10)
Daily S&P500 return		**0.978**	(220.10)
Intercept		**0.000**	(-8.74)
Time period dummies		**Yes**	
Number of funds		3619	

Table 9

Hedge fund excess market betas and redemption frequencies

This table shows the hedge funds' average excess market betas around the turn of the month and the hedge funds' average excess market betas depending on the hedge funds' redemption frequency (we have excluded all categories with less than 200 observations). *T* refers to the last trading day of the month. Hedge funds' market betas are 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 outside the turn of the month period. Excess market betas are calculated as a difference of the fund's estimated beta for any given day and its beta for the outside the turn of the month period. 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 are statistically significant at 5% level are displayed in bold.

	All funds	Monthly	Quarterly	Semi-Annually	Annually
T-5	**-0.110**	**-0.123**	**-0.110**	-0.039	**-0.103**
	(-15.43)	(-11.60)	(-9.32)	(-0.99)	(-4.04)
T-4	**-0.089**	**-0.081**	**-0.118**	-0.092	**-0.113**
	(-12.04)	(-7.54)	(-10.43)	(-1.78)	(-3.65)
T-3	**-0.017**	0.012	**-0.058**	**-0.121**	**-0.112**
	(-2.54)	(1.22)	(-5.61)	(-2.87)	(-3.40)
T-2	**-0.088**	**-0.097**	**-0.083**	-0.057	-0.010
	(-13.26)	(-9.96)	(-8.27)	(-1.23)	(-0.39)
T-1	**-0.061**	**-0.041**	**-0.065**	**-0.097**	**-0.132**
	(-10.46)	(-5.05)	(-7.28)	(-2.37)	(-5.28)
T	**-0.176**	**-0.173**	**-0.176**	**-0.121**	**-0.093**
	(-21.86)	(-14.81)	(-12.98)	(-2.54)	(-2.98)
T+1	**0.142**	**0.134**	**0.171**	**0.112**	**0.163**
	(21.64)	(14.56)	(16.35)	(2.85)	(7.11)
T+2	**0.250**	**0.227**	**0.260**	**0.355**	**0.348**
	(32.86)	(20.42)	(22.47)	(6.58)	(10.32)
T+3	**0.164**	**0.141**	**0.188**	**0.241**	**0.238**
	(24.01)	(13.78)	(17.81)	(5.26)	(7.74)
T+4	**0.106**	**0.079**	**0.145**	**0.125**	**0.121**
	(16.04)	(8.73)	(12.65)	(2.96)	(3.36)
T+5	0.038	0.017	**0.071**	**0.091**	**0.146**
	(4.89)	(1.54)	(5.85)	(2.10)	(3.55)
N	7,810	3,817	2,714	208	322

Table 10

Hedge funds' liquidity provision around the turn of the month

This table shows the hedge funds' average excess market betas around the turn of the month in select hedge fund style categories and during low (below sample median) and high TED spread. *T* refers to the last trading day of the month. Hedge funds' average excess market betas are based on fund-specific regressions in which hedge fund's (monthly) return is regressed on the daily S&P 500 returns around the turn of the month and the return on the S&P500 index outside the turn of the month period. Excess market betas for any given fund are calculated as the difference of its estimated beta for any given day and its beta outside the turn of the month period. 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 are statistically significant at 5% level are displayed in bold.

	Global Macro	Managed Futures	Other styles	During low TED spread	During high TED spread
T-5	-0.024	**0.147**	**-0.134**	**-0.047**	**-0.082**
	(-0.62)	(3.85)	(-18.66)	(-4.31)	(-9.35)
T-4	-0.077	**0.102**	**-0.104**	**-0.191**	**-0.112**
	(-1.63)	(2.35)	(-14.40)	(-14.59)	(-12.13)
T-3	**0.106**	**0.424**	**-0.057**	**0.063**	**-0.048**
	(2.36)	(9.95)	(-8.94)	(4.73)	(-5.38)
T-2	-0.062	-0.052	**-0.092**	-0.013	**-0.139**
	(-1.88)	(-1.49)	(-13.56)	(-1.24)	(-14.78)
T-1	**0.091**	-0.065	**-0.068**	**-0.067**	**-0.053**
	(2.35)	(-1.77)	(-12.01)	(-6.63)	(-8.33)
T	**-0.143**	**-0.092**	**-0.185**	**0.059**	**-0.245**
	(-3.03)	(-2.14)	(-22.61)	(4.44)	(-24.98)
T+1	0.052	**0.191**	**0.142**	**0.079**	**0.252**
	(1.39)	(4.74)	(22.06)	(6.54)	(30.87)
T+2	0.066	**0.213**	**0.261**	**0.159**	**0.375**
	(1.42)	(5.44)	(33.99)	(15.05)	(37.25)
T+3	**0.100**	**0.089**	**0.173**	-0.010	**0.232**
	(2.21)	(2.14)	(25.98)	(-1.08)	(24.04)
T+4	0.044	-0.053	**0.121**	0.116	**0.066**
	(1.09)	(-1.40)	(18.54)	(12.28)	(7.86)
T+5	-0.025	-0.046	**0.047**	0.148	**0.033**
	(-0.67)	(-0.93)	(6.19)	(12.02)	(3.92)
N	314	538	6,958	3,892	5,217

Table 11

Funding conditions and 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 cost of leverage, and its interaction with the *T-8* to *T-4* returns. *T* refers to the last trading day of the month. In the first column cost of leverage is measured with the TED spread (the difference between the 3-month Eurodollar and the Treasury rates). In the second column we modify the cost of leverage measure by multiplying the TED spread by the hedge fund industry's assets under management and call this *Hedge Funds' Cost of Leverage*. Hedge funds' assets under management is the sum of all hedge funds' assets under management based on HFR and TASS databases (calculated as in Jylhä and Suominen, 2011) divided by US stock market capitalization. The market index returns are those of the CRSP value-weighted index. T-statistics based on Newey-West standard errors are shown below the coefficients. All figures that are statistically significant at 5% level are displayed in bold.

y = Return *T-3 - T-1*		
Return *T-8 - T-4*	-0.089	-0.096
	(-1.44)	(-1.62)
TED spread	0.004	
	(1.43)	
Interaction of TED spread and the *T-8 - T-4* return	**-0.142**	
	(-5.39)	
Hedge funds' Cost of Leverage		0.031
		(0.99)
Interaction of hedge funds' Cost of Leverage and the *T-8 - T-4* return		**-1.453**
		(-5.40)
Intercept	0.001	0.002
	(0.44)	(1.13)
R^2	0.299	0.310
Sample	7/1995-12/2013	7/1995-12/2013

Table 12

Mutual fund alphas and exposures to month-end return reversals

This table shows active equity mutual funds' annualized alphas conditional on fund-specific trailing two-year correlations between the funds' *T-8* to *T-4* and *T-3* to *T-1* returns. More specifically, funds are divided into deciles every year (at the end of December) based on this correlation. Alphas are calculated using the subsequent year's daily returns controlling for the three factors of Fama and French and Carhart's Momentum factor. Panel A shows equally-weighted average of fund specific alphas and risk exposures and Panel B alphas and risk exposures based on equally-weighted mutual fund portfolio returns. Decile 10 contains the funds with the highest correlation in their *T-8* to *T-4* and *T-3* to *T-1* returns. The daily returns of active domestic equity mutual funds are from CRSP. The sample period is from January 1999 to December 2013.

A: Equal-weighted average of fund specific alphas and risk exposures

	Mutual fund deciles based on correlation of funds' T-8 - T-4 and T-3 - T-1 returns										
	1	2	3	4	5	6	7	8	9	10	10-1
Alpha	-1.13%	-2.13%	-1.98%	-1.94%	-1.85%	-1.78%	-1.47%	-1.47%	-0.97%	1.42%	2.55%
	(-6.12)	(-15.87)	(-14.73)	(-15.22)	(-14.00)	(-13.19)	(-10.69)	(-9.77)	(-5.66)	(4.85)	
R_M	0.94	0.98	0.99	0.99	0.99	0.99	0.98	0.99	0.97	0.88	-0.06
	(211.41)	(318.93)	(297.23)	(278.21)	(262.35)	(293.78)	(271.14)	(282.58)	(236.31)	(127.33)	
SMB	0.14	0.13	0.16	0.18	0.20	0.21	0.26	0.26	0.29	0.29	0.15
	(21.30)	(20.10)	(23.91)	(26.24)	(28.31)	(29.53)	(34.82)	(34.83)	(37.41)	(36.63)	
HML	0.03	0.01	0.00	-0.01	0.00	0.00	0.02	0.02	0.01	0.03	0.00
	(3.93)	(1.51)	(-0.72)	(-2.27)	(-0.33)	(0.50)	(2.61)	(2.46)	(0.78)	(3.48)	
MOM	0.01	0.00	0.01	0.02	0.03	0.04	0.03	0.03	0.05	0.06	0.05
	(1.83)	(1.21)	(1.37)	(5.86)	(6.89)	(11.35)	(8.39)	(8.22)	(10.84)	(8.70)	

B: Alpha and risk exposures of equal-weighted mutual fund portfolios

	Mutual fund deciles based on correlation of funds' T-8 - T-4 and T-3 - T-1 returns										
	1	2	3	4	5	6	7	8	9	10	10-1
Alpha	-1.75%	-2.56%	-2.33%	-2.14%	-1.77%	-1.42%	-0.87%	-0.49%	0.31%	2.76%	4.51%
	(-1.47)	(-3.18)	(-3.45)	(-3.57)	(-3.53)	(-2.79)	(-1.63)	(-0.72)	(0.36)	(1.89)	
R_M	0.98	1.01	1.01	1.00	1.00	1.00	0.98	0.99	0.97	0.87	-0.11
	(83.97)	(148.07)	(175.00)	(232.77)	(309.33)	(340.57)	(277.79)	(215.78)	(176.20)	(85.74)	
SMB	0.21	0.17	0.18	0.19	0.21	0.22	0.26	0.26	0.27	0.24	0.03
	(7.32)	(11.97)	(17.64)	(22.05)	(30.40)	(33.66)	(31.53)	(23.60)	(18.61)	(8.75)	
HML	0.09	-0.06	-0.04	-0.01	0.02	0.06	0.07	0.13	0.13	0.08	-0.01
	(4.19)	(-3.11)	(-3.77)	(-1.34)	(2.51)	(4.93)	(6.06)	(7.19)	(6.23)	(3.15)	
MOM	-0.11	-0.08	-0.05	-0.02	-0.01	0.03	0.05	0.08	0.12	0.16	0.27
	(-10.24)	(-9.19)	(-6.89)	(-2.88)	(-0.87)	(4.74)	(8.18)	(10.42)	(14.21)	(12.08)	

Table 13

Mutual fund characteristics and exposures to month-end return reversals

This table shows the active equity mutual funds' characteristics conditional on fund-specific trailing two-year correlations between the funds' *T-8* to *T-4* and *T-3* to *T-1* returns. More specifically, funds are divided into deciles every year (at the end of December) based on this correlation. *Annualized mutual fund return in excess of risk-free rate in the year following the ranking year* shows mutual funds' returns during specific days in a calendar month. *Mutual fund portfolio composition during the ranking year* shows the funds' portfolio composition (in %) at the end of ranking year using CRSP data. *Other mutual fund characteristics* shows mutual funds' AUM (in MUSD) at the end of ranking year, funds' active share (using data downloaded from Antti Petajisto's webpage), share of funds' AUM with an institutional fund flag (CRSP), funds' turnover and expense ratio during the ranking year. Decile 10 contains the funds with the highest correlation in their *T-8* to *T-4* and *T-3* to *T-1* returns. The daily returns of active domestic equity mutual funds are from CRSP. The sample period is from January 1999 to December 2013.

	Mutual fund deciles based on correlation of funds' T-8 - T-4 and T-3 - T-1 returns										
	1	2	3	4	5	6	7	8	9	10	10-1
Trailing 2-year correlation of T-8 - T-4 and T-3 - T-1 returns											
Correlation	-0.47	-0.39	-0.35	-0.33	-0.30	-0.28	-0.25	-0.21	-0.16	-0.03	0.44
Annualized mutual fund return in excess of risk-free in the year following the ranking year											
T-8 through T-4	-3.85%	-4.49%	-4.72%	-4.38%	-4.39%	-4.13%	-3.89%	-3.65%	-3.28%	-1.94%	1.91%
T-3 through T-1	5.48%	5.23%	5.54%	5.63%	5.87%	6.12%	6.47%	6.65%	7.01%	6.83%	1.36%
Other days	3.53%	2.90%	2.98%	3.13%	3.26%	3.48%	3.37%	3.79%	3.69%	4.60%	1.06%
Mutual fund portfolio composition during the ranking year											
Cash-%	3.53%	2.92%	3.34%	3.17%	3.28%	3.04%	3.30%	3.55%	4.24%	6.78%	3.25%
Equity-%	92.20%	93.07%	92.40%	92.68%	92.39%	92.90%	92.12%	91.95%	91.27%	87.28%	-4.92%
Bond-%	0.67%	0.65%	0.63%	0.70%	0.58%	0.50%	0.98%	0.60%	0.54%	1.33%	0.66%
Other mutual fund characteristics											
Average AUM	1,493	1,684	1,490	1,340	1,288	1,279	1,121	1,265	1,085	920	-573
Median AUM	239	298	293	263	250	240	241	235	210	168	-71
Active share	79.5%	74.9%	74.1%	73.1%	75.1%	74.9%	79.6%	80.8%	83.5%	88.8%	9.3%
Institutional fund	21.1%	25.3%	26.3%	27.6%	27.1%	28.2%	26.0%	24.7%	22.0%	17.4%	-3.7%
Turnover	114.1%	89.2%	91.2%	88.8%	93.6%	94.3%	90.1%	97.1%	96.7%	137.1%	22.9%
Expense ratio	1.37%	1.26%	1.24%	1.24%	1.25%	1.25%	1.29%	1.30%	1.36%	1.52%	0.15%

Table A1

Return patterns around the 15th (calendar) day of the month

Let *S* refers to the last trading day of the month that equals or precedes the 15th calendar day of the month. This table presents average daily stock market returns around the day *S* in the United States as well as in several other industrialized countries. In addition, the table presents the correlation of the returns from *S-8* to *S-4* and *S-3* to S-*1*; as well as the correlation of the returns from *S* to *S+3* and *S+4* to *S+8*. Our sample starts in January 1980 or later as the relevant data becomes available, and settlement rule is T+3 or shorter. For the US we show also the full sample results. The sample runs until the end of 2013. All figures that are statistically significant at 5% level are displayed in bold.

Country	Sample starts	From *S-3* to *S-1*	On *S*	From *S+1* to *S+3*	From *S-8* to *S-4*	From *S+4* to *S+8*	Correlation of *S-8 - S-4* and *S-3 - S-1* returns	Correlation of *S - S+3* and *S+4 - S+8* returns
United States (S&P 500)	Jul-95	0.07%	-0.04%	0.09%	-0.01%	0.00%	**-0.26**	-0.06
United States (CRSP VW)	Jul-95	0.06%	-0.05%	0.08%	-0.01%	0.01%	**-0.26**	-0.08
United States (S&P 500)	Jan-80	**0.08%**	0.01%	0.05%	0.01%	0.03%	**-0.17**	-0.04
United States (CRSP VW)	Jan-80	**0.07%**	0.00%	0.03%	0.01%	0.03%	**-0.16**	-0.01
Other industrialized countries								
Australia (S&P/ASX200)	Feb-99	-0.02%	0.03%	0.01%	0.02%	0.03%	-0.04	-0.01
Austria (ATX)	Feb-98	-0.03%	-0.14%	0.01%	0.03%	0.04%	**-0.24**	0.04
Belgium (BEL20)	Jan-90	0.02%	0.03%	0.02%	0.02%	-0.03%	-0.11	0.09
Canada (S&P/TSX C)	Jul-95	0.00%	-0.04%	**0.09%**	-0.01%	0.03%	**-0.17**	-0.10
Denmark (OMXC20)	Dec-89	0.04%	0.04%	0.02%	0.03%	-0.03%	-0.10	0.05
Finland (OMXH25)	Jan-91	-0.02%	-0.02%	0.09%	0.07%	0.03%	-0.11	-0.05
France (CAC40)	Oct-00	0.00%	-0.08%	0.03%	-0.06%	-0.04%	**-0.25**	-0.05
Ireland (ISEQ OVER)	Mar-01	-0.07%	-0.10%	0.00%	0.00%	-0.03%	**-0.17**	0.01
Italy (FTSE MIB)	Jan-98	0.04%	-0.10%	0.05%	-0.04%	-0.02%	**-0.28**	0.06
Japan (NIKKEI225)	Jan-80	-0.04%	**0.14%**	-0.02%	0.01%	0.03%	**-0.10**	0.03
Luxembourg (LUXX)	Jan-99	0.00%	-0.08%	-0.02%	-0.01%	0.01%	-0.05	0.04
Netherlands (AEX)	Jan-83	0.01%	0.07%	0.05%	0.05%	0.01%	**-0.17**	0.10
New Zealand (NZX50)	Jan-01	-0.01%	-0.01%	0.02%	0.00%	0.04%	-0.02	0.01
Norway (OBX)	Jan-87	0.03%	0.00%	0.00%	0.02%	0.03%	**-0.12**	-0.04
Portugal (PSI-20)	Dec-98	-0.03%	-0.13%	-0.05%	0.05%	-0.05%	**-0.16**	0.03
Singapore (STI)	Sep-99	-0.01%	-0.07%	-0.09%	0.03%	0.01%	0.05	**0.18**
Spain (IBEX35)	Mar-97	0.01%	-0.13%	0.10%	0.05%	-0.04%	-0.09	-0.04
Sweden (OMXS30)	Jan-86	0.02%	-0.02%	0.04%	0.07%	0.03%	**-0.16**	0.00
Switzerland (SMI)	Jul-88	0.01%	0.03%	0.01%	0.04%	-0.01%	**-0.17**	0.10
UK (FTSE100)	Aug-96	-0.03%	-0.07%	0.05%	0.04%	0.00%	**-0.21**	-0.02
Countries with settlement period less than T+3								
Germany (DAX)	Jan-80	0.01%	0.05%	0.06%	0.05%	-0.02%	**-0.12**	0.04
Hong Kong (HSI)	Jan-80	0.02%	0.15%	0.02%	**0.08%**	0.03%	0.00	0.10
Israel (TA-25)	Jan-92	-0.04%	0.15%	0.05%	**0.09%**	0.02%	-0.02	**-0.15**
South Korea (KOSPI)	Jan-80	0.00%	-0.01%	-0.01%	**0.08%**	-0.03%	**-0.12**	0.03
Average of all indexes excluding US		0.00%	-0.01%	0.02%	0.03%	0.00%	-0.12	0.02