

Dash for Cash: Monthly Market Impact of Institutional Liquidity Needs

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Abstract. We present broad-based evidence that the monthly payment cycle induces systematic patterns in liquid markets around the globe. First, we document temporary increases in the costs of debt and equity capital that coincide with key dates associated with month-end cash needs. Second, we present direct and indirect evidence on the role of institutions in the genesis of these patterns and derive estimates of the associated costs born by market participants. Finally, we investigate the limits to arbitrage that prevent markets from functioning efficiently. Our results indicate that many investors and their agents, including mutual funds, suffer from liquidity-related trading.

Keywords: asset pricing, limits of arbitrage, mutual funds, short-term reversals, turn of the month effect
JEL classification: G10, G12, G13

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Introduction

The value of non-bank payment transfers in the U.S. exceeds 170 trillion dollars annually, which corresponds to roughly seven times the U.S. stock market capitalization or four times the annual trading volume in the U.S. equity market.¹ Many of the largest transfers are repeated payments such as pensions and dividends, which are heavily clustered around the turn of the month (Figures 1A-B). As these payments require cash, there is a “dash for cash,” a large systemic liquidity demand in the economy at the month end. As one would expect, this excess demand for cash predictably increases short-term borrowing costs, as depicted by elevated Repo, Libor and FED funds rates (Figure 2), but it is also associated with temporary increases in the costs of equity and longer-term debt capital, as reflected by elevated stock and bond yields right before the month end (Figure 3).^{2 3}

INSERT FIGURES 1- 3 HERE

In this paper, we study the causes and implications of these repeated and anticipated price pressures in liquid markets. First, we provide evidence that links them to the monthly payment cycle. Second, we present both direct and indirect evidence on the role of institutions’ month-end liquidity needs in the genesis of these patterns and derive estimates of the associated costs born by market participants. Finally, we investigate the limits to arbitrage that keep markets from functioning efficiently. We focus most of our analysis on equity markets where richer data enables us to crisply link the turn of the month return patterns

¹ This is the value of all transactions with cashless payment instruments issued in the U.S. and account transfers based on 2015 data. Payments initiated by banks are excluded unless they are related to the banks own retail payments. Sources: CPMI - BIS Red Book and the World Bank.

² We exclude 2- and 5-year Treasury notes in Figure 3 as their auctions are arranged commonly near the end of the month.

³ The payment cycle is also reflected by an increase in deposits at the turn of the month. See Figure A1 in the Appendix.

to institutions' demand for month-end liquidity and settlement conventions. For example, utilizing trade-level data, we are able to identify institutions that systematically demand month-end liquidity and directly calculate the costs they incur from liquidity-driven trading.

Linking observed price pressures to the monthly payment cycle. Market-specific settlement conventions provide us with a starting point for understanding the timing of liquidity-motivated trading and any resulting impact on market prices at the turn of the month. In the U.S. equity and corporate bond markets, the prevailing 3-day settlement convention dictates that an institution that needs cash on the morning of the last day of the month (T) must sell securities at least *four* business days before the month end; that is, before the market closes on $T-4$.^{4 5} In the U.S. Treasury market, the shorter 1-day settlement convention permits liquidity-driven selling until the close of $T-2$. These conventions help explain the differences in timing observed in Figure 3's yield patterns: Treasury yields tend to rise and remain elevated until $T-2$ while stock yields peak earlier, around $T-4$. That is, Treasury markets experience negative price pressure closer to the month end thanks to the shorter settlement window. Once the liquidity related selling pressure eases, yields decline on the back of recovering prices. The patterns in corporate bond yields seem to derive characteristics from both stocks and Treasury bonds, despite their 3-day settlement convention. This hybrid behavior may be due to arbitrage activity between corporate bonds and Treasury bonds.⁶

INSERT FIGURE 4

⁴ Throughout this paper, "day" should be interpreted as "business day."

⁵ For instance, pension payments must be in the recipients' accounts in the morning of the last day of the month. To make these payments, pension funds need to sell stocks by the market close on day $T-4$ to receive cash by the market close on day $T-1$. Figure A2 in the Appendix clarifies the timing of payment-related activities around the turn of the month.

⁶ Greenwood, Hanson and Liao (2017) study theoretically how anticipated supply shocks in one market are transmitted to a closely related market through speculative trading.

Figure 4 summarizes our understanding of the timing of events for U.S. stocks and documents the average daily returns for the market around the turn of the month. Note that returns are low in the period labeled “price pressure”, from $T-8$ to $T-4$, and high during the seven days that follow, which include the “positive reversal” period, $T-3$ to $T-1$, the last day of the month T , and the first three days of the month, $T+1$ to $T+3$, which we label “buying pressure” following the logic of Ogden (1990). As the buying pressure fueled by newly cleared money subsides, the cycle is completed by a “negative reversal” from $T+4$ to $T+8$.

A cumulative version of this return chart, displayed in Figure 5, helps illustrate the steady accrual of the turn of the month returns over time and highlights the economic importance of the turn of the month patterns. Consider for example the fact that over the last decade of our sample (2003-2013), the cumulative excess return during the positive reversal periods was 103%, accounting for 73% of the total U.S. equity market’s excess return, while the cumulative excess return during the selling pressure periods was -31%. Importantly, the correlation between $T-3$ to $T-1$ returns (positive reversal) and $T-8$ to $T-4$ returns (selling pressure) was -0.54. Indeed, we show that the large month-end returns can be explained to an important extent by reversals from preceding days’ price pressures. We document similar return patterns and reversals also in bonds and international equities: all 25 equity markets that we survey provide some evidence of return reversals and in 22 of them these reversals are statistically significant.⁷

INSERT FIGURE 5

⁷ McConnell and Xu (2008) also document high returns for the last four days of the month in recent samples of U.S. and international equity market data. More commonly, academic literature has focused on the high returns on the last day of the month and the first 3 days of the month. See e.g. Lakonishok and Smidt (1988), Cadsby and Ratner (1992), and Dzhabarov and Ziemba (2010). Our contribution to this literature is to show large return reversals around $T-4$ and $T+3$.

We verify the causality of the observed link between settlement conventions and month-end reversals utilizing our international sample and a quasi-experimental design around a major settlement rule change in Europe.⁸ This analysis strongly supports our conjecture. We also verify the causality between month-end reversals and payment flows by utilizing predictable variation in the month-end payment volume: when the last business day of the month is also a Friday, the monthly cycle for pensions and the weekly payment cycle for salaries coincide, creating abnormally large payment volumes at the month end. Consistent with our hypothesis, we find that the month-end reversals in equity and bond markets are two to three times larger whenever the last trading day of the month is also a Friday.⁹

Role of institutional liquidity needs in the genesis of month-end price pressures. Having documented the systematic nature of price pressures and subsequent reversals at the turn of the month, we present both direct and indirect evidence that links institutional flows to these patterns. Our direct evidence leverages a dataset that contains trade-level observations for hundreds of 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 U.S. 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 and the clustering of institutional payments on T and $T+1$, we find that institutions on average are net sellers in the

⁸ Table 1 documents the dates during our sample period when the 3-day settlement convention was adopted or daily return data became available in different countries. For example, in the U.S. the settlement period was shortened from 5 days to 3 days in June 1995. See e.g. Thomas Murray Ltd. 2014 report "CMI In Focus: Equities Settlement Cycles."

⁹ According to Bureau of Labor Statistics, 69% of private businesses pay their employees either weekly or bi-weekly (Burgess, 2014). This proportion increases in firm size and out of the largest firms 91% pay their employees either weekly or bi-weekly. These wages and salaries are commonly paid at the end of the workweek making Friday the most common payday (e.g. Farrell and Greig, 2016).

stock market on $T-4$ (guaranteed liquidity for payments due on T), and on $T-3$ (guaranteed liquidity for payments due on $T+1$), and that they are net buyers on the last day of the month and the first couple of days of the month. The highest selling pressure occurs on $T-4$, which coincides with the peak in the stock market dividend yield in Figure 2.

When we divide the institutions into groups based on their past year's trading behavior, we find a subset of institutions that systematically engages in this type of trading behavior year after year (some being sellers on $T-4$, some on $T-3$). 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 from market returns with the evidence from institutional investor 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 at approximately 0.7 billion U.S. dollars per year during our sample period. These costs are eventually borne by the clients of the institutions.

We find additional, albeit indirect, evidence for a link between institutional trading and turn of the month return patterns by studying mutual fund flows, mutual fund holdings, and the cross section of stock returns. We begin by linking mutual fund outflows (another measure of selling pressure) to the intensity of month-end reversals. During the sample period for which we have weekly mutual fund flow data, we can predict more than 40% of the $T-3$ to $T-1$ returns by mutual funds' month-end selling pressure up to $T-4$.

Month-end return reversals can also be linked to mutual fund holdings at the stock level. Our findings indicate that stocks held in greater proportions by mutual funds exhibit more pronounced turn of the month

patterns: more negative returns from $T-8$ to $T-4$ and more positive returns from $T-3$ to $T-1$.¹⁰ In addition, such stocks exhibit greater return reversals around $T-4$. We then calculate a measure of expected flow-related price pressure along the lines of Lou (2012) and find that month-end patterns are more pronounced for stocks that face selling pressure due to mutual fund outflows. We moreover find evidence that the statistical significance of the turn of the month return patterns depends on stock-level liquidity. In particular, month-end reversals are significant only for large and liquid stocks, which is consistent with the idea that the patterns are driven by investors' liquidity needs, and that investors respond to month-end outflows and cash needs conscious of transaction costs.

Consistent with the idea that there are cash transfers in and out of the mutual fund sector around the turn of the month, we also find that the average market beta of the mutual fund industry is significantly lower than average on $T-3$ (evidencing equity sales at $T-4$). Furthermore, we find that mutual funds' average return volatility declines toward the month end although there is no observable coincident decline in market volatility, which supports the idea that mutual funds reduce risk toward the month end by increasing their cash reserves for month-end payments. 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 reversals in the U.S. stock market has varied over time with the proportion of the market held by the mutual fund industry.

To complete our evidence related to mutual funds, we show 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 $T-4$, and *negative* for *all* other funds. We interpret this as supplementary evidence (to that obtained from ANcerno's institutional trading

¹⁰ According to Investment Company Institute, approximately one half of U.S. long-term mutual fund assets excluding money market funds are delegated by pension funds (<http://www.ici.org/research/stats/retirement>).

data) that most institutions suffer significantly from their month-end trading practices. Funds that hold more cash tend to have higher alphas.¹¹

Interestingly, we also find that many of the turn of the month return patterns reflecting price pressures have *strengthened* over time. This result suggests that either the selling and buying pressures around the turn of the month have increased or the markets' ability to digest them has deteriorated. We find evidence that the more prominent role of institutional investors in the marketplace is in part responsible for the strengthening, likely for both of these reasons.¹²

Evidence on limits to arbitrage. To our surprise, we find mixed evidence on the efforts of hedge funds to capitalize on the turn of the month 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. This is especially the case for funds with less frequent redemption cycles. Indeed, our results suggest that during our sample period the aggregate hedge fund industry has not mitigated but rather *contributed* to the turn of the month return patterns on average. One possible explanation is that hedge fund vehicles are often ill-designed to provide month-end liquidity, as their redemption dates commonly fall exactly on the last day of the month. Agency reasons may provide additional deterrents for risk taking near the month end.

However, we do find some evidence for liquidity provision as soon as we condition for hedge funds' funding conditions: hedge funds tend to mitigate month-end return patterns when funding conditions in short-term credit markets are good but amplify them when funding conditions are tight (the latter periods

¹¹ The fact that the price pressure is closely tied to mutual fund holdings and flows suggests that investors commonly use their mutual fund holdings to obtain month-end liquidity. One reason for this could be that the trading costs of a mutual fund are shared with *all* of the investors in the fund. This feature might provide an explanation for why investors do not pay sufficient attention to the execution costs that arise from end of month liquidity related trading.

¹² One additional factor that may have amplified the turn of the month patterns is the gradual adoption of the ACH payment system over a check-based payment system during our sample period. The ACH system may also have increased the clustering of the month-end liquidity related equity sales by institutions.

simply tend to dominate our sample). In line with this finding, our time series evidence indicates that tighter funding conditions are associated with greater return reversals around $T-4$. These results are consistent with the literature on limits to arbitrage and the role of funding constraints in decreasing the ability of hedge funds to supply liquidity in the marketplace (see e.g. Shleifer and Vishny, 1997, Brunnermeier and Pedersen, 2009, Nagel 2012, and Jylhä, Rinne and Suominen, 2014).

Although the hedge fund industry as a whole has not systematically provided month-end liquidity during our sample, some hedge funds have. When we look at each hedge fund category separately, we find that funds in managed futures and global macro categories tend to have significantly higher market betas on $T-3$. This implies that they systematically 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 cash market.¹³

Related Literature. The intuition that asynchronously arriving sellers and buyers to the stock market cause short-term reversals in equity returns is present already in Grossman and Miller (1988). Duffie (2010) and Greenwood, Hanson and Liao (2017) show theoretically that similar return reversals occur even when the supply and demand shocks are anticipated. Despite the well-developed theory, there exists only limited empirical support for the idea that investors' aggregate buying and selling pressures (supply and demand shocks) would lead to short-term return reversals in the aggregate equity market. 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 (associated with buying or selling pressure from some groups of investors in

¹³ Note that investors who expect to receive cash at T can start their equity purchases in the morning of $T-3$.

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, neither of the two papers ties the 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 in the aggregate equity market 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 to arbitrage.¹⁴

Our finding that a systematic pre-scheduled event – the clearing of the monthly payment cycle – can cause significant price pressures in the world's most liquid equity and bond markets is surprising. It parallels the finding of Lou, Yan, and Zhang (2013) that pre-scheduled Treasury auctions also cause price pressure and subsequent return reversals in the maturities that are being auctioned. One reason why the type of price pressure that we document cannot easily be arbitrated away is exactly the fact that it impacts some of the largest and most liquid securities in the world. Furthermore, unlike in Lou, Yan, and Zhang (2013), the risk involved in providing liquidity against month-end flows is not security-specific but largely systematic, so there is no easy way to hedge it. Because of these reasons, it is hard for arbitrageurs to digest the liquidity demand without price impact.

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

¹⁴ Gromb and Vayanos (2012) provide a survey of related literature. 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 suggest 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 $T-4$. Other closely related papers include Mou (2010), which presents evidence of systematic return reversals due to investor rebalancing in commodity markets, and Henderson, Pearson, and Wang (2015), which studies the impact of financial investor flows on commodity futures prices.

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 that 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.

Our results have potentially several important consequences. First, we hope that our results can help institutions alter their month-end liquidity management and payment practices to avoid raising cash when the price of short-term liquidity is high. Second, they provide regulators with additional reasons to adopt shorter settlement windows.¹⁵ Third, central bankers can use them to motivate more aggressive liquidity provision at the month end.¹⁶ Finally, we hope that our findings can help investors avoid falling victim to institutional trading flows. It seems plausible that most market participants, and possibly the entire economy, would benefit from more stable financial asset prices around the turn of the month.

1. Data on returns, mutual funds and hedge funds

The country equity index return data are from Datastream, except for the U.S. 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

¹⁵ Indeed, the U.S. stock and corporate bond markets are transitioning to $T+2$ settlement in September 2017.

¹⁶ There is some evidence that the Fed Funds rate no longer rises around T in the most recent samples.

on price indexes to maximize the country specific sample periods.¹⁷ In case of the U.S., we report both the results for the full sample (since 1980) as well as those after the adoption of the 3-day settlement rule (in June 1995).

Our cross-sectional stock data are from CRSP. Our mutual fund holdings data are from Thomson Reuters Mutual Fund Holdings database. The sample period used is from July 1995 to December 2013 to match the adoption of the 3-day settlement rule in the U.S. 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. Finally, hedge fund betas are estimated using the LIPPER TASS database on individual funds' monthly returns.

Our data on bond yields and returns are obtained from FRED and Datastream. Finally, the Treasury auction dates are downloaded from TreasuryDirect.

2. Return-based evidence on turn of the month price pressures

2.1. Price pressure in the equity market

In this section, we present evidence on returns and return reversals around $T-4$ that are consistent with price pressures due to month-end liquidity related selling. We show also evidence that links the reversals to a) the 3-day settlement window in the equity market and b) to payment volume on day T in the economy.

Let us begin by determining the relevant time periods before and after the event date, $T-4$. A pension fund manager facing cash liabilities at the month end needs to sell his stocks before the close of $T-4$ to

¹⁷ Israeli index returns are entirely based on a price index as this is the only series available in Datastream.

receive cash on time for the month-end payments that must be in recipients' accounts in the morning of day T . Since an important part of the payments are also due on the $T+1$, we should expect the selling pressure to continue until $T-3$. In practice, however, illiquidity and risk considerations are likely to deter even the institutions with $T+1$ 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. Given these considerations, we should expect the institutional selling pressure in the equity market to be at its highest on day $T-4$ and to subside prior to the close of day $T-3$ (Figure A2 in the Appendix illustrates the timing of events and Section 3 provides direct evidence from institutional investor trading data to support these assumptions). For these reasons, and consistent with Figure 4, 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 turn of the month cash liabilities.¹⁸

Following the month-end settlement, part of the cash distributed to salaried employees (those with monthly payment cycle) and pensioners gets reinvested in the stock market via 401k and other retirement plan contributions (often automatic) as well as self-directed investments. This effect has been studied extensively in the existing literature, which reports above-average stock returns from the last business day of the month until the third business day of the month (see e.g., Ogden, 1990, and 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 $T+3$. These key events of our study are illustrated in Figure 4 along with the average daily returns of the CRSP value weighted stock index. Consistent with our hypothesis, average returns are low

¹⁸ The theoretical model in Duffie (2010) explains why an anticipated supply shock at $T-4$ can cause price pressure already several days in advance ($T-8$ to $T-5$). This occurs as the professional intermediaries who are continuously present in the market gradually build up short positions to be able to absorb the supply shock at $T-4$. The model explains also why the price pressure from the supply shock dissipates only gradually over time. Greenwood, Hanson and Liao (2017) predict similar dynamics around anticipated supply shocks.

from $T-8$ to $T-4$ (selling pressure) and high from $T-3$ to $T-1$ (return reversal). As new money arrives in investors' accounts 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 CRSP value weighted return since the 1995 adoption of the 3-day settlement rule is *negative* -17bp for $T-8$ to $T-4$ and *positive* 77bp for $T-3$ to $T+3$. If we look at the abnormal returns (by subtracting from each day's return the sample average daily return) the abnormal $T-8$ to $T-4$ returns are significantly negative at -37bp on an average month. This roughly corresponds with the significantly positive abnormal returns from $T-3$ to $T-1$ of 25bp, and those from $T-3$ to $T+3$ which equal 48 bp.

We can observe similar return patterns not only in the U.S. but also in other developed equity markets. For all of the other 24 equity 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 returns over the selling pressure period and returns over the reversal period: the correlations are negative in all of the 25 markets and statistically significant in 22 of the 25 markets. 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 including the last day of the month (T to $T+3$) and the returns on the subsequent five days ($T+4$ to $T+8$) 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.^{19 20}

[INSERT TABLES 1 AND 2 HERE]

To compare the magnitude of the return reversals around $T-4$ to potential return reversals around other days of the month (a “placebo” test), Figure 6 plots the correlation of past 5-day returns and future 3-day returns for every day of the month in the U.S. stock market.²¹ The results show that the negative correlation is significantly greater in magnitude at $T-5$ and $T-4$ as compared to 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.^{22 23}

[INSERT FIGURE 6 HERE]

¹⁹ 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 Section 4. The unreported results for emerging markets are available from the authors.

²⁰ The return patterns around $T-4$ documented in Tables 1 and 2 for U.S. stocks are robust to excluding from the sample the observations that coincide with year ends and quarter ends (e.g. Sias and Starks, 1997, and Carhart, Kaniel, Musto and Reed, 2002, document large returns near year 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).

²¹ We are grateful to Lubos Pastor for suggesting this test to us.

²² Table A1 in the Appendix demonstrates that similar but less pronounced return patterns to those reported in Table 1 are observable also around the 15th of the month in the U.S. and elsewhere. In unreported tests we find qualitatively similar effects around the 15th of the month also in bond returns.

²³ Similar results confirming the highest reversals around $T-4$ are obtained if we look at correlations of past and future 1-day, 2-day or 3-day returns.

Next, to show that the relation between settlement conventions and reversal patterns is causal, we investigate the impact of a recent concerted settlement change in several countries on the timing of return reversals (quasi-natural experiment). Specifically, on October 6, 2014, a group of European countries (Austria, Belgium, Denmark, Finland, France, Ireland, Italy, Luxemburg, Netherlands, Norway, Portugal, Sweden, Switzerland, and U.K.) changed their stock market settlement rule from three business days to two business days. The goal of the reform was to increase the safety and efficiency of settlements, and to harmonize settlement rules across Europe. As the motivations driving these rule changes are unrelated to the magnitude of the turn-of-the month phenomenon, this reform allows us to execute a quasi-natural experiment using a difference in differences test setup. The control group in this experiment consists of the countries in our international sample that were not affected by this change (Australia, Canada, Japan, New Zealand, Singapore, Spain, and U.S.) and continued to follow a 3-day settlement rule. Following the shortening of the settlement window, we expect a decrease in daily market return autocorrelation on $T-2$ as the return reversal should move closer to the month end. The results, displayed in Table 3 show that the autocorrelation on $T-2$ decreased in a statistically significant way in the countries affected by the change compared to the control group countries. The magnitude of the change (-0.78) is also meaningful from an economic perspective. The results of this experiment provide evidence that market-specific settlement rules, combined with investors' month-end liquidity needs, drive the observed return reversal patterns at the month end.²⁴

²⁴ Difference in differences test setup requires that before the reform the dependent variable has a parallel trend both in the treatment and the control groups. Both visual inspection and formal regression test show that this assumption is satisfied in our test setup.

[INSERT TABLE 3 HERE]

Finally, we can link the return reversal patterns to payment volume, by considering the fact that U.S. corporations commonly pay salaries weekly, typically on Fridays (see e.g. Farrell and Greig, 2016). According to Bureau of Labor Statistics, 69% of private businesses pay their employees either weekly or bi-weekly, and only 31% semi-monthly or monthly (see Burgess, 2014). Given these payment practices, we should expect the month-end return patterns to be more pronounced if the last day of the month T is Friday because then both the monthly payment cycle and the weekly payment cycle coincide, creating larger than usual liquidity needs. This is indeed what we find. Both the month-end returns and the return reversals are considerably higher if the last day of the month, T , is also Friday: the average returns from $T-3$ to $T-1$ are 2.5 times higher and the correlation between $T-8$ to $T-4$ and $T-3$ to $T-1$ returns is negative and 3 times greater. Importantly, however, the month-end average returns are positive and the reversal is statistically significantly negative also if the last day of the month is not Friday.

2.2. Price pressure in the bond market

Analyzing price pressures in the bond market is more complicated due to several reasons, including shorter available sample, changes in the underlying reference security for “constant maturity” bonds, and the fact that Treasury auctions are commonly held near the month end. Moreover, despite the shorter settlement window for Treasury bonds, asset allocation considerations are likely to have institutions conduct their month-end liquidity related Treasury sales close to their equity and corporate bond sales. Consistent with these complications, we observe less crisp patterns in the bond market than in the equity market. Nonetheless, as Figure 3 suggests, the qualitative features of the turn of the month return patterns are broadly

similar also in the aggregate bond market. Due to the shorter one-day settlement period in Treasury bonds, the reversal returns in the aggregate bond market (evaluated using the Barclays aggregate bond index) are highest on $T-1$ after the selling pressure in the Treasury bond market has also come to an end.

In Table A2 of the Appendix we show that the aggregate bond market also experiences significant return reversals between $T-8$ to $T-4$ and $T-3$ to $T-1$. The fact that the return reversals coincide with those in the equity market suggests that selling pressure in the aggregate bond market is affected by settlement conventions in equity and corporate bond markets, in addition to those in the Treasury bond market. Akin to the equity market, the return reversals in the bond market between $T-8$ to $T-4$ and $T-3$ to $T-1$ returns are larger if the last day of the month T is Friday.

3. Direct evidence of price pressure from institutional investors' trades

To directly investigate the selling pressure hypothesis as an explanation for the observed turn of the month return patterns, we turn to ANcerno dataset that contains trade-level observations for hundreds of different institutions including hedge funds, mutual funds, pension funds, and other money managers. Our data cover 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.²⁵

The ANcerno data reveal significant intra-month variation in institutions' buy ratios, defined as the dollar value of buy transactions divided by the dollar value of both buy and sell transactions on a given day. Consistent with our hypothesis, the institutions in the sample seem to submit more sell than buy orders in

²⁵ Unfortunately, Abel Noser Solutions no longer provides 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.

the four trading days leading up to $T-3$, 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 7. As expected, institutional selling pressure is strongest on day $T-4$.²⁶

[INSERT FIGURE 7 HERE]

One may wonder how to square the continuation of institutional selling pressure until $T-3$ with Figure 4's high average returns on the same day. Recall that $T-3$ is the last day that guarantees cash settlement for the first day of the month, which is the second largest payment day for pensions, so we would expect a subset of institutions to remain net sellers that day, particularly in the morning. To investigate this intra-day behavior, we compute *hourly* average excess buy ratios within day $T-3$ and find that excess buy ratios are negative in the first trading hours of the day, but become indistinguishable from zero by the early afternoon.²⁷ In other words, the negative price pressure from institutional investors' liquidity-related selling diminishes rapidly following its peak at $T-4$ prices, contributing to the high $T-3$ market returns observed in the data.

Another contributor to the positive price appreciation on $T-3$ is the increase in the supply of liquidity initiated by investors who *receive* payments on day T and can therefore start purchasing stocks in the morning of day $T-3$ in anticipation of the inflows. Adding to the supply of liquidity, in Section 6 we present

²⁶ To evaluate whether this institutional selling pressure captured in the ANcerno dataset can affect market prices, note that the ANcerno institutions' combined signed trading volume varies between 0.15% to 0.25% of the total CRSP trading volume during the relevant days $T-8$ to $T-3$. Note furthermore that according to Puckett and Yan (2011) the ANcerno institutions represent only about 10% of all the institutional trading 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.

²⁷ See Figure A3 in the Appendix for the analysis.

evidence that certain hedge fund categories (and when funding conditions are good, the hedge fund industry on average) have abnormally high market betas on $T-3$, which suggests that liquidity supplying hedge funds arrive in the market at the end of $T-4$ or in the morning of $T-3$.

We next investigate if there is a subset of ANcerno institutions that consistently demand liquidity when institutional selling pressure is abnormally large (based on Figure 7, days $T-5$ to $T-3$ meet this requirement). To see this, 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 8 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 $T-3$, $T-4$, and before.²⁸

[INSERT FIGURE 8 HERE]

As a robustness check, we split the liquidity demanding institutions in Figure 8 into two groups based on a trading pattern predicted by their payment date (recall from Figure 1A that pension payments clustered at T and $T+1$). The first group includes institutions with negative signed trading volume from $T-5$ to $T-4$ and non-negative signed trading volume on $T-3$ over the previous year – that is, institutions that we conjecture to have payments at T . The second group includes institutions whose signed trading volume is negative from $T-5$ to $T-3$ in the previous year – these we conjecture to be institutions with payments at $T+1$. Interestingly, the selling patterns are highly persistent. The first group has highly significant selling pressure

²⁸ Results are qualitatively similar if we classify liquidity demanders as net sellers during the window $T-8$ to $T-3$ as opposed to using the $T-5$ to $T-3$ window. These unreported results are available from the authors.

on $T-4$, but their signed trading volume on $T-3$ is close to zero. Second group on the other hand has significant selling pressure on $T-4$ but also in the morning of $T-3$. These results lend further support to our hypothesis that the liquidity demanding institutions' month-end selling is linked to their turn of the month payment needs.

ANcerno's trade-level data also allow 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 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 our sample period 1999-2010, the institutions in ANcerno alone would have lost almost 0.8 billion U.S. 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 dollars during our sample period, or approximately 0.7 billion dollars per year.²⁹

To investigate whether institutional liquidity demands can explain the observed month-end return patterns in a regression setting, we use the ANcerno database to examine the market impact of the selling pressure. 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 $T-4$, predict higher stock market returns on days $T-3$ to $T-1$.³⁰ 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 0.32 to 0.67 percentage points

²⁹ 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.

³⁰ We normalize cumulative net selling by the U.S. stock market capitalization.

depending on the regression specification. This finding provides additional direct support to our hypothesis that institutional trading is responsible for the observed predictable variation in stock returns near the turn of the month.³¹

[INSERT TABLE 4 HERE]

Finally, we utilize one more piece of information in the Ancerno dataset to examine our price pressure hypothesis around the turn of the month. If the institutions that we identified as liquidity demanders are indeed “marginal investors” that move markets, their orders ought to be filled at prices that are inferior to broader market pricing on a given day. Consistent with this idea, we find that the sales by liquidity demanders during the selling pressure period $T-8$ to $T-4$ occur at prices that are well below the volume weighted average price from order placement to completion (contrary to the sales by other institutions during this period of time). Similarly, during the buying pressure period, T to $T+3$, these liquidity demanders’ purchases occur at prices that are above the volume weighted average price.

[INSERT TABLE 5 HERE]

In the next section, we present further evidence on the role of institutions in the creation of the turn of the month return patterns by linking stock returns to mutual fund holdings in the cross section of stocks. We also investigate which types of stocks exhibit the strongest turn of the month reversals.

³¹ To avoid the use of overlapping data, we have left out net selling on $T-3$ from these regressions.

4. Cross-sectional evidence on turn of the month price pressures

4.1. Return reversals in 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 6, 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 $T-8$ to $T-4$ returns for each stock. 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 6 HERE]

For completeness, we also conduct an analogous exercise for the period $T+4$ to $T+8$, where we expect reversal from the buying pressure at the beginning of the month. The results, displayed in Panel B of Table 6, 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 or buying pressure periods.

4.2. Mutual fund ownership, flows and turn of the month reversals

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 1A), we do observe the holdings of their agents, mutual funds, which provide an easy and efficient implementation vehicle for pension funds' diversified equity investments. For this reason, we suspect that the turn of the month effects are more pronounced in the stocks that are commonly held by mutual funds.³²

To investigate the link between mutual fund ownership and month-end return patterns, we sort stocks in each month by mutual funds' collective ownership percentage in the previous month and form decile portfolios. We then compute value- and equal-weighted average returns of these portfolios. The results are displayed in Figure 9. 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

³² Another reason why mutual fund holdings might affect end of month patterns is that many mutual funds' own dividend distributions also occur at the end of the month.

$T-8$ 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 9 HERE]

In addition, the correlation between T to $T+3$ and $T+4$ to $T+8$ value-weighted 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.

We next examine the impact of mutual fund flows on return reversals. More precisely, we calculate stock specific measures of expected buy and sell pressures due to flows based on the methodology of Lou (2010). First, each month we assume that the previous month's flows predict flows to all funds, and that those funds buy and sell securities in the same proportion that they own the stocks according to their latest holding data. We then aggregate the flow-induced buying and selling pressures across funds and normalize our flow pressure measures by the respective stocks' market capitalizations. Consistent with our price pressure hypothesis, we find that returns during the selling pressure period $T-8$ to $T-4$ are more than three times as negative for the three lowest flow pressure deciles of stocks (highest selling pressure stocks) compared to the three highest flow pressure deciles of stocks. Similarly the correlation between $T-8$ to $T-4$ and $T-3$ to $T-1$ returns is nearly 50% more negative for those stocks. This evidence supports our selling pressure hypothesis for the observed month-end return patterns.

We also investigate the strength of the return reversals across countries. Figure 10 displays the correlations of $T-8$ to $T-4$ and $T-3$ to $T-1$ returns for different equity indices across countries against the percentage of market capitalization that is held by mutual funds within each country. It appears that the return reversals around $T-4$ 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 return reversals around $T-4$ is statistically significant at the 1% level (results are available upon request). The correlations presented in Figure 10 are negative for all country indexes.³³

[INSERT FIGURE 10 HERE]

4.3. 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]

³³ Note that the correlation is least negative in Finland. Interestingly, Finnish pension payments are not clustered at the month end. Until 2013, a significant part of pension payments was made in alphabetical order to pensioners throughout the month.

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 liquid stocks and large cap stocks. The differences in correlations between extreme size and liquidity deciles are significant at 1% significance level. The return reversals of illiquid and small cap stocks are statistically insignificant.^{34 35}

5. Other evidence on mutual funds and turn of the month price pressures

5.1. Strength of return reversals over time

First, we use regression analysis to study if there is a time-series relationship between the return reversals around $T-4$ and the size of the U.S. mutual fund industry. Our results, presented in Table 7, 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: 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) controlling for a linear time trend.

[INSERT TABLE 7 HERE]

³⁴ 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 this intuition, we find that return reversals around $T-4$ are most pronounced for the most volatile, yet liquid stocks as shown in Figure A4 in the Appendix.

³⁵ We find analogous results in the bond market where the return reversals are more pronounced for bonds of shorter maturities that typically command higher liquidity (see Table A2 in the Appendix).

To complement our direct evidence on the impact of institutional trading on month-end return reversals, we also investigate the impact of mutual fund outflows on stock index returns. Specifically, we regress U.S. 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 total stock market capitalization) or $T-3$ depending on the regression. The results displayed in Table 8 provide evidence that mutual fund flows significantly impact equity 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, with R^2 up to 44%.

[INSERT TABLE 8 HERE]

In Table A2, we show that also in the bond market the past mutual fund industry outflows significantly explain the month-end $T-3$ to $T-1$ returns for 52-week Treasury bonds, consistent with the price pressure hypothesis. Also here the explanatory powers are considerable, up to 42%.

5.2. Evidence from mutual fund betas and risk around the turn of the month

Our evidence on mutual funds' betas and risk presented in Table 9 and Figure 12 support the idea that mutual funds increase their cash holdings prior to the month-end. In Table 9, 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 $T-4$ to meet its month-end cash demands. The finding in Figure 12 that mutual funds' volatility decreases as the month goes by can also be linked to the average fund's tendency to accumulate cash to meet its payments near the month.

[INSERT TABLE 9 AND FIGURE 12 HERE]

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

In this section, we present evidence that links the performance of equity mutual funds to their exposures to month-end return reversals. Our aim is to investigate whether funds that regularly sell equities prior to the month end (perhaps due to client-driven outflows and/or poor month end liquidity management practices) suffer in terms of performance. Hence, the spirit of this investigation is similar to the study of the costs of month-end liquidity demands presented in Section 3.

We sort domestic equity funds by the trailing two-year correlation of their $T-8$ to $T-4$ and $T-3$ to $T-1$ returns. We find that the funds in the highest correlation decile have significantly higher alphas than those in the lowest correlation decile (see Figure 13 and Table 10). That is, funds that are less sensitive to month-end return reversals – due to better month-end liquidity management practices, fewer institutional clients, or other reasons – seem to perform better than others. Concretely, exposure to the market's return reversals *predicts* mutual fund performance.

[INSERT FIGURE 13 AND TABLE 10 HERE]

In Table 11, 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.^{36 37}

[INSERT TABLE 11 HERE]

³⁶ 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) are downloaded from <http://www.petajisto.net>). Motivated by Frazzini, Friedman and Pomorski (2015), we also find 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.

³⁷ 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.

6. Limits to Arbitrage

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. One would expect that speculators like hedge funds step in to trade on the significant systematic price distortions documented in Section 2. Our evidence is mixed. First, in Table 12, we show that the average market beta of hedge funds near the month end behaves similarly to the average beta of mutual funds and is smallest at $T-3$. This finding suggests that hedge funds on average do not provide liquidity to mutual funds that sell near the month end at $T-4$, as one might have expected.

One reason for the inability of hedge funds to systematically provide liquidity at $T-4$ may be related to the fact that their own redemption and reporting dates are also commonly set at month ends. As a result, hedge funds are also facing liquidity needs that are concentrated near the month end, which may reduce their risk bearing capacity. Indeed, in unreported tests we find some support for this reasoning: the time-variation in betas near the month end seems to be more pronounced for those funds with less frequent redemption cycles (and presumably larger in- and outflows at times of subscription and redemption).³⁸ Therefore, it appears that the cash cycle and concerns related to fund flows affect the ability of hedge funds to take risk near the month end – much akin to the reduced risk taking by mutual funds. In other words, arbitrage vehicles with month-end redemption cycles are ill-designed to provide liquidity at the month end.

³⁸ The methodology to identify daily betas from hedge funds' monthly returns is similar to that in Jylhä, Rinne and Suominen (2014).

This result is consistent with Patton and Ramadorai (2013) who find that hedge fund risk exposures are high at the beginning of the month and low at the end of the month.³⁹

[INSERT TABLE 12 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 14, which shows that trading volume is substantially lower than average during the last few trading days of the month. This finding is also consistent with Brunnermeier and Pedersen (2009), which predicts lower market liquidity at times of lower funding liquidity (e.g., near the month end).

[INSERT FIGURE 14 HERE]

While the average hedge fund 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 12). This suggests that at least some hedge funds do provide liquidity at $T-4$, counterbalancing the selling pressure from other institutions. The evidence regarding liquidity supply is especially strong for Managed Futures funds whose betas increase significantly on $T-3$. This behavior is likely to be related to the low margin requirements (and $T+1$ settlement) of the futures and

³⁹ Patton and Ramadorai study day-of-the-month effects in hedge fund risk exposures by including a flexible parametric function in their regression specification.

options contracts traded by these funds, which allow their managers to hold significant cash reserves at all times.

Although the hedge fund sector on average does not appear to provide liquidity at the month end, it is possible that there are some time periods when it does. In fact, there seems to be significant time variation in hedge funds' liquidity provision practices. Specifically, we find that hedge funds on average supply liquidity at month ends when their funding liquidity, as measured by the TED spread, is good (below median) but significantly demand liquidity when the TED spread is high (above median). This is reflected in their abnormally high (low) market beta at $T-3$ during periods of 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 $T-3$ (where our evidence suggests the demand for end of month liquidity is still high). Only at times of poor funding liquidity does the hedge fund sector also become a demander 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. We next investigate if these are also the time periods that month-end returns (reflecting the costs of immediacy to those selling at $T-4$) are the highest.

6.2. Funding constraints and turn of the month returns

Consistent with our finding that the ability of hedge funds 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 15 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 13 also 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. These findings lend support to the idea that funding constraints of institutional investors are an important contributor to return reversals around $T-4$.⁴⁰

[INSERT FIGURE 15 AND TABLE 13 HERE]

Thus far we have shown that month-end reversals are largest when there are large outflows from the mutual fund industry and the funding conditions of hedge funds are tight. A perfect storm for mutual fund outflows and tightening of funding conditions occurred in October 2008, following the bankruptcy of Lehman Brothers. The entire mutual fund sector experienced vast unexpected outflows and institutions had to resort to equity markets to an unusual extent for month-end liquidity due to frozen short-term credit markets. The TED spread rose to record levels, reflecting extraordinary funding constraints for the hedge funds. If our reasoning is correct, this environment should be associated with extremely poor returns during the selling pressure period $T-8$ to $T-4$ and extremely high returns during the following three days. In line with this expectation, following the Lehman crisis the $T-8$ to $T-4$ returns *over the following six months* were exceptionally poor (with cumulative returns approaching -40%) while the end of month rebound from the selling pressure was exceptionally high (cumulative returns approaching +30%). Figure A5 in the Appendix demonstrates the large price pressures following the Lehman bankruptcy.

⁴⁰ 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 directly investigate this channel, we also considered interacting the TED spread with our measure of aggregate hedge fund AUM (scaled by the U.S. stock market capitalization) to obtain a measure of hedge funds' cost of leverage. 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. As the difference is minor we do not separately report these results.

7. Conclusion

In this paper, we study the asset price implications of the monthly payment cycle. We show that the associated excess demand for cash at the month end predictably increases short-term borrowing costs. It is also associated with temporary decreases in equity and bond prices as institutions sell assets to raise cash. These repeated price pressures in equity and bond markets are significant from both statistical and economic perspectives.

To the best of our knowledge, we are the first to document a strong return reversal in equity and bond markets following the last day of the month that guarantees cash for month-end payments. This return reversal exists in the time series of U.S. stock and bond index returns, in the cross-section of U.S. stock returns, and in the time series of most developed stock market index returns. We link the reversal to the month-end cash cycle by demonstrating that the reversals are greater on those month ends where the monthly and weekly payment cycles coincide. We furthermore verify that settlement practices *cause* the month-end reversals via a difference in differences test made possible by a concerted change in several countries' settlement practices in our international sample.

To shed further light on the underlying market dynamics, we present extensive evidence that associates the $T-4$ return reversals in equity markets with institutional investors' trading, and with hedge funds' constraints to arbitrage this predictability. Our most direct evidence is based on ANcerno's institutional trade data, which reveal that institutions are on average net sellers up to $T-4$, 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 also present additional, indirect evidence to support the idea that institutions' month-end liquidity needs contribute to return predictability. In particular, we show that the turn of the month return reversals are more pronounced among stocks that are more commonly held by mutual funds, and stocks that are arguably easier to use for cash management, such as large and liquid stocks. We find also that mutual fund flows up to $T-4$ 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 may currently mismanage their turn of the month liquidity related trading.

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Figure 1

Payment dates of pensions and corporate dividends around the turn of the month

Panel A shows the proportion of pension payment dates occurring on specific dates around the turn of the month, based on data from the 20 largest U.S. public pension plans in 2012. Panel B shows the proportion of annual dividend payments (in dollars) by CRSP companies occurring on specific dates around the turn of the month. Day T denotes the last trading day of the month, $T-1$ the trading day before that, and so on. The pension payment date data are from Pension & Investment 300 Analysis by Tower Watson and from individual pension funds' websites. The dividend data are from CRSP. The sample period in Panel A is January 1980 to December 2013.

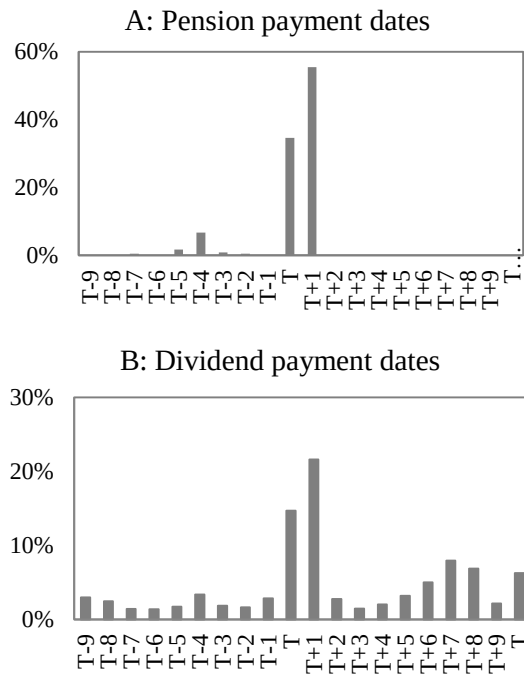


Figure 2

Repo rate, Libor rate, and Federal Funds rate around the turn of the month

This figure shows the differences between the repo, Libor, and effective Federal Funds rates and their monthly averages for the last and the first ten trading days of the month. Here day T denotes the last trading day of the month, $T-1$ the trading day before that, and so on. The repo rate data are from November 1995 to December 2013, the Libor rate data from January 2001 to December 2013, and the Federal Funds rate data from January 1980 to December 2013. Sources: FRED database (Libor rate and Federal Funds rate) and Datastream (Repo rate).

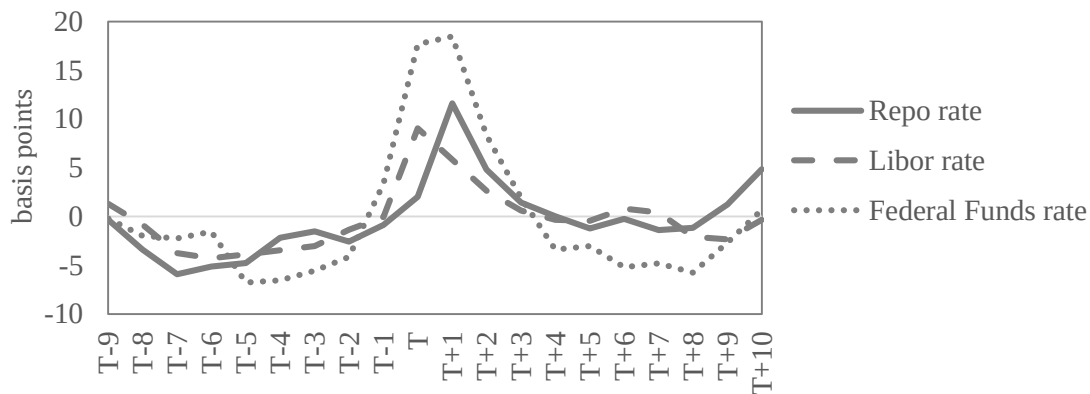
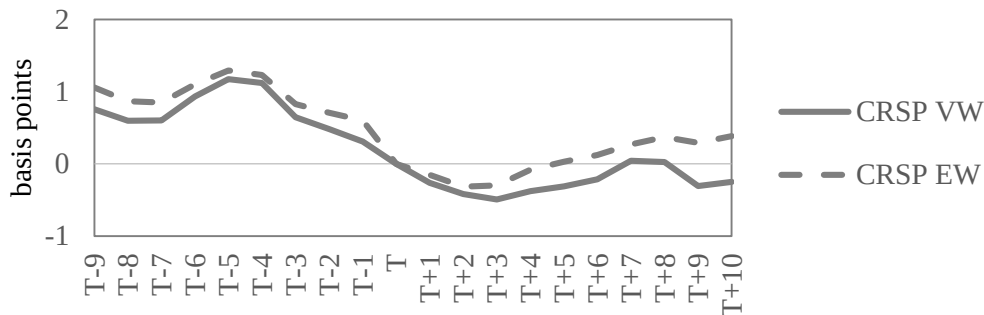


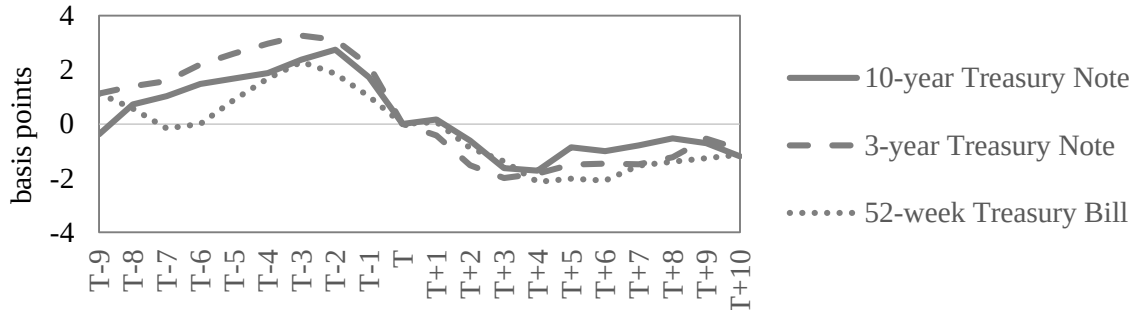
Figure 3
Bond and dividend yields around the turn of the month

Panel A shows the difference between the dividend yield of CRSP value-weighted and equal-weighted indexes and its value on the last trading day of the month. Panel B shows the same for the yields of the 52-week Treasury bill, 3-year Treasury note, and 10-year Treasury note, and Panel C for the yields of the Barclays Aggregate, Barclays U.S. Corporate (IG), and J.P. Morgan U.S. Government Bond indices. In Panel B we exclude all ten day periods around Treasury auctions. Here day T denotes the last trading day of the month, $T-1$ the trading day before that, and so on. The sample period is July 1995 (start of the 3-day settlement period in U.S. equity and corporate bond markets) to December 2013. Sources: CRSP, Datastream and FRED.

A: Dividend yields of CRSP indices



B: Yields of constant maturity Treasury bonds



C: Yields of aggregate bond indices

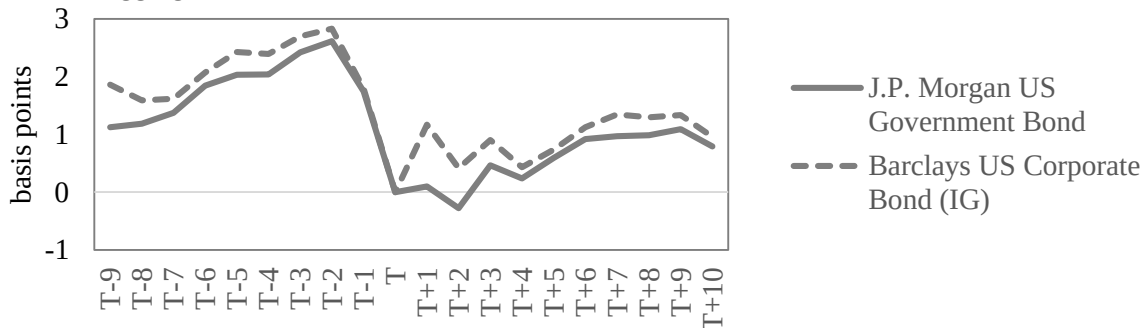


Figure 4

Average daily returns around the turn of the month

This figure shows the average daily returns of the CRSP value-weighted index around the turn of the month. Day T denotes the last trading day of the month, $T-1$ the trading day before that, and so on. The sample period is July 1995 (start of the 3-day settlement period in U.S. equity and corporate bond markets) to December 2013.

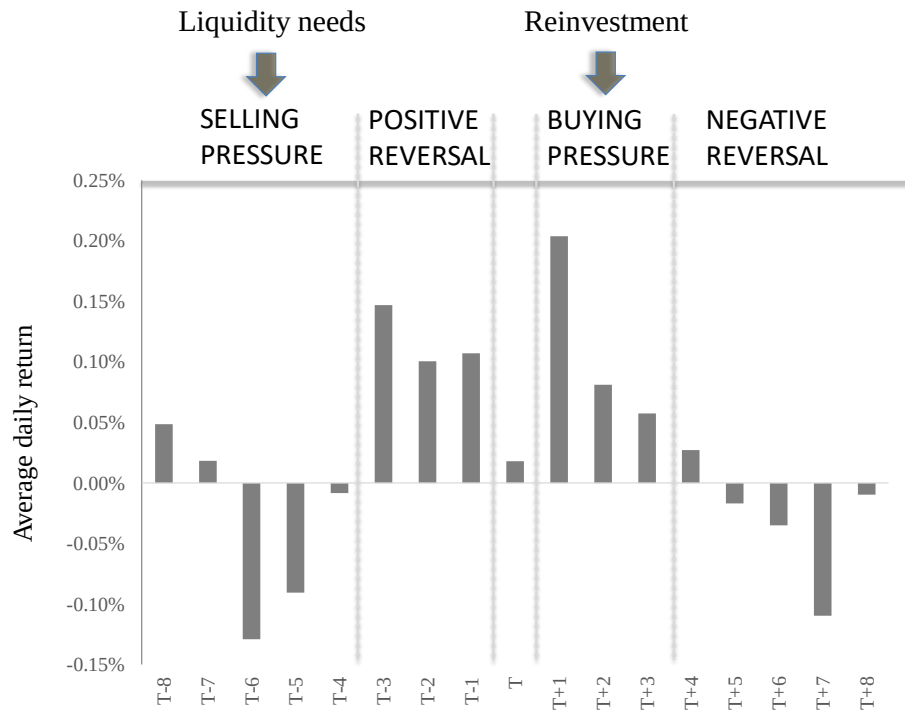


Figure 5

Cumulative stock returns around the turn of the month

This figure shows the cumulative returns in excess of the risk free rate from investing in the CRSP value-weighted index only on days $T-3$ to $T+3$ around the turn of the month, where T refers to the last trading day of the month, $T+3$ to the third trading day of the next month, and so on. It also shows the excess returns from investing in the same index only on days $T-8$ to $T-4$, and only on days outside $T-8$ to $T+3$. The sample period is January 1980 to December 2013. Note the logarithmic scale.

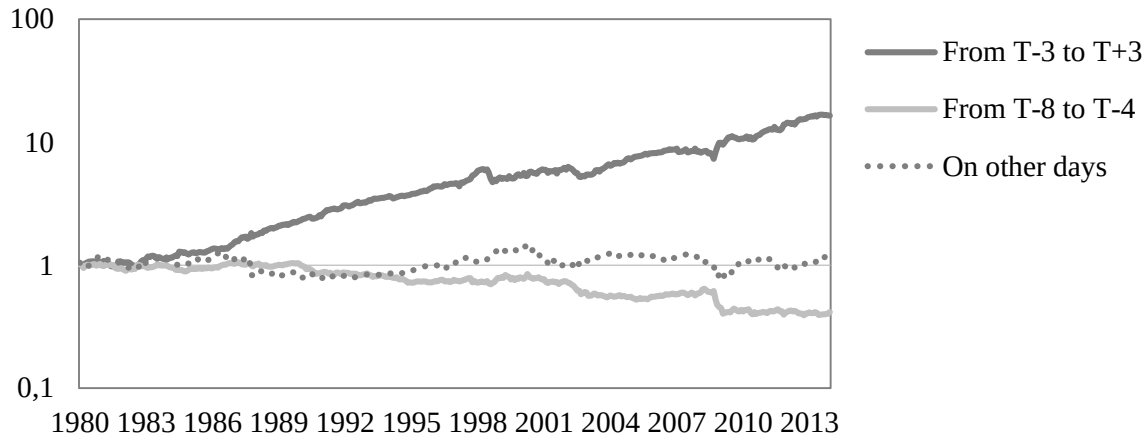


Figure 6

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

This figure shows the correlations between the past five-day returns and the future three-day returns of the CRSP value-weighted index on different days of the month. For example, the observation at $T-4$ represents the correlation between $T-8$ to $T-4$ and $T-3$ to $T-1$ returns. Day T denotes the last trading day of the month, $T-1$ the trading day before that, and so on. Dashed lines denote the critical values for non-zero correlation at the 5% significance level. The sample period is July 1995 to December 2013.

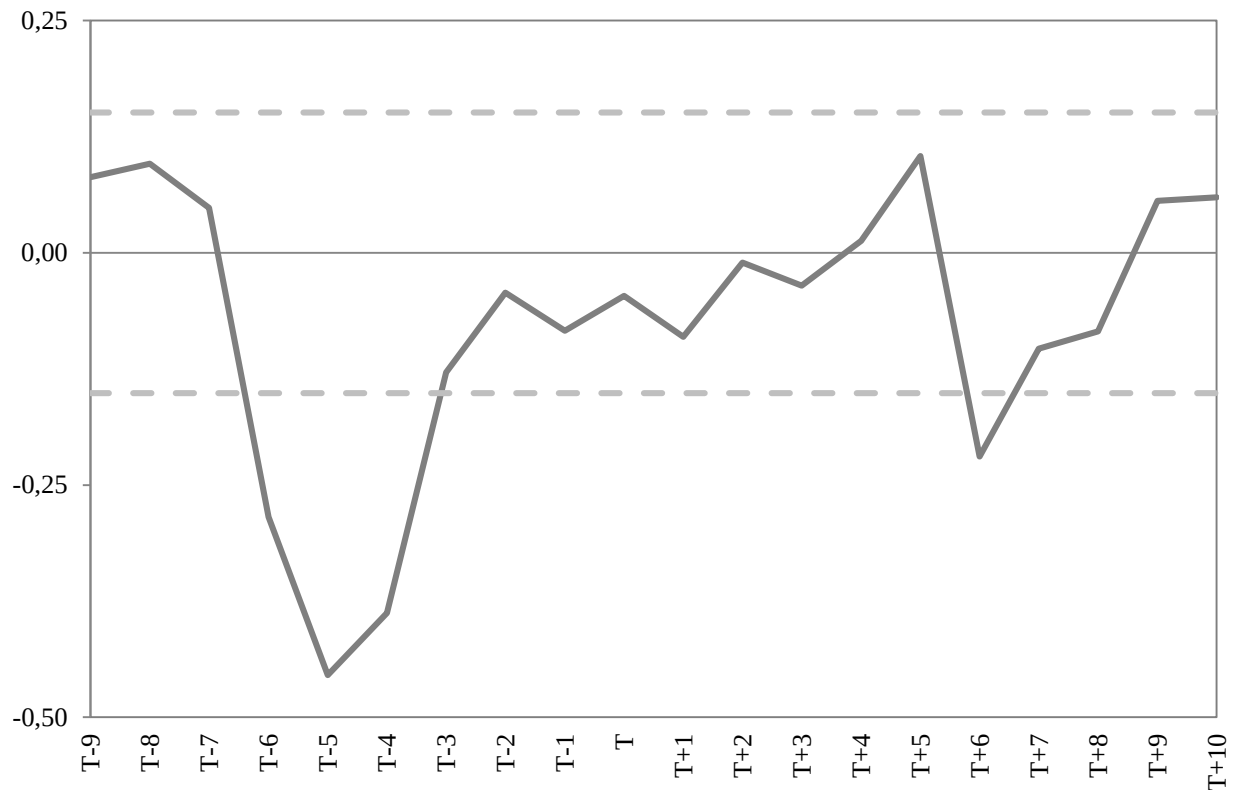


Figure 7

Institutional investors' buy ratios around the turn of the month

This figure shows the aggregate buy ratio of a sample of institutional investors around the turn of the month, in excess of the average daily aggregate buy ratio. The buy ratio is defined as the dollar value of buy transactions divided by the dollar value of both buy and sell transactions during a given day. Day T denotes the last trading day of the month, $T-1$ the trading day before that, and so on. The data are from ANcerno and the sample period is January 1999 to December 2013. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

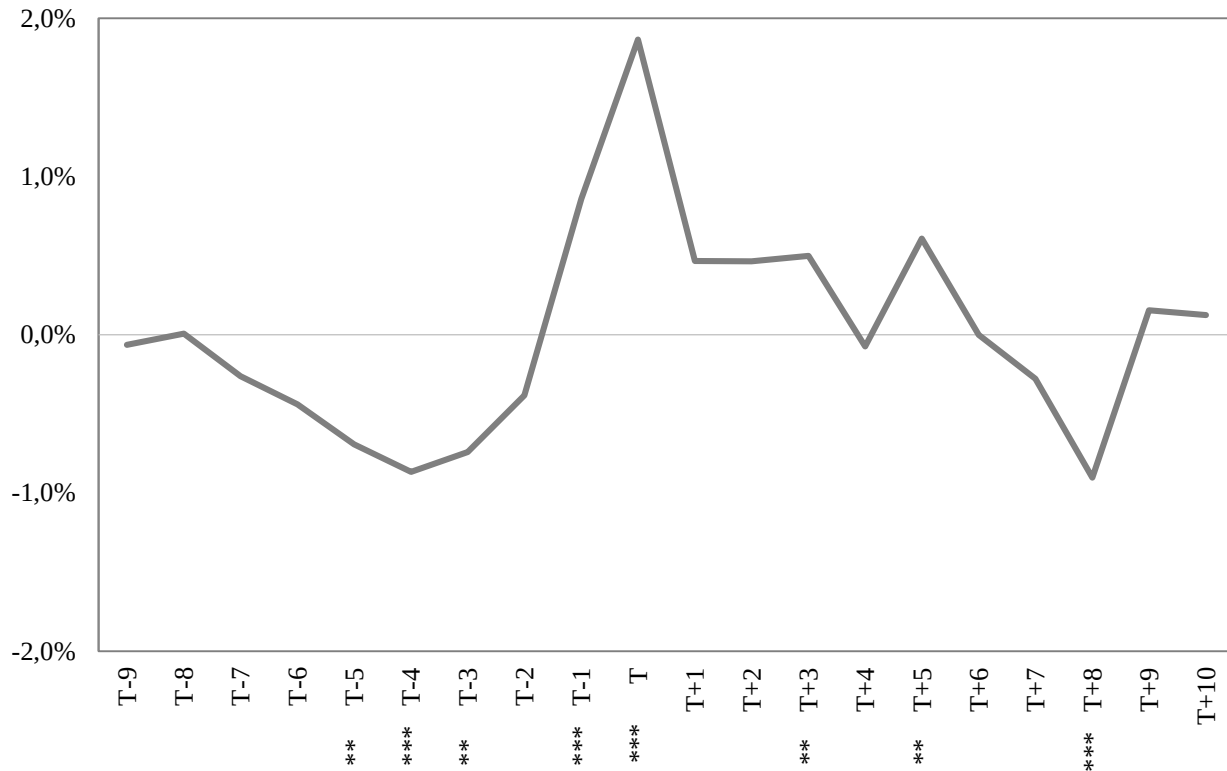


Figure 8

Systematic patterns in institutional trading around the turn of the month

This figure shows for ANcerno institutions, which we classify as either liquidity demanders (solid line) or other institutions (dotted line), their signed excess volume (relative to CRSP market volume) around the turn of the month. The signed excess volume for a given day and institution type equals the sum of the institutions' signed volumes during the day in excess of their average daily signed volume during the entire sample. The signed volume for a given institution in a given period is the sum of its stock purchases (in dollars) minus its stock sales in that period. An institution is classified as a liquidity demander (other institution) if its signed volume during the previous year is negative (positive) on days $T-5$ to $T-3$. Day T denotes the last trading day of the month, $T-1$ the trading day before that, and so on. The data are from ANcerno and the sample period is January 2000 to December 2010. *, **, and *** denote the statistical significance of liquidity demanders' signed excess volumes at the 10%, 5%, and 1% levels, respectively.

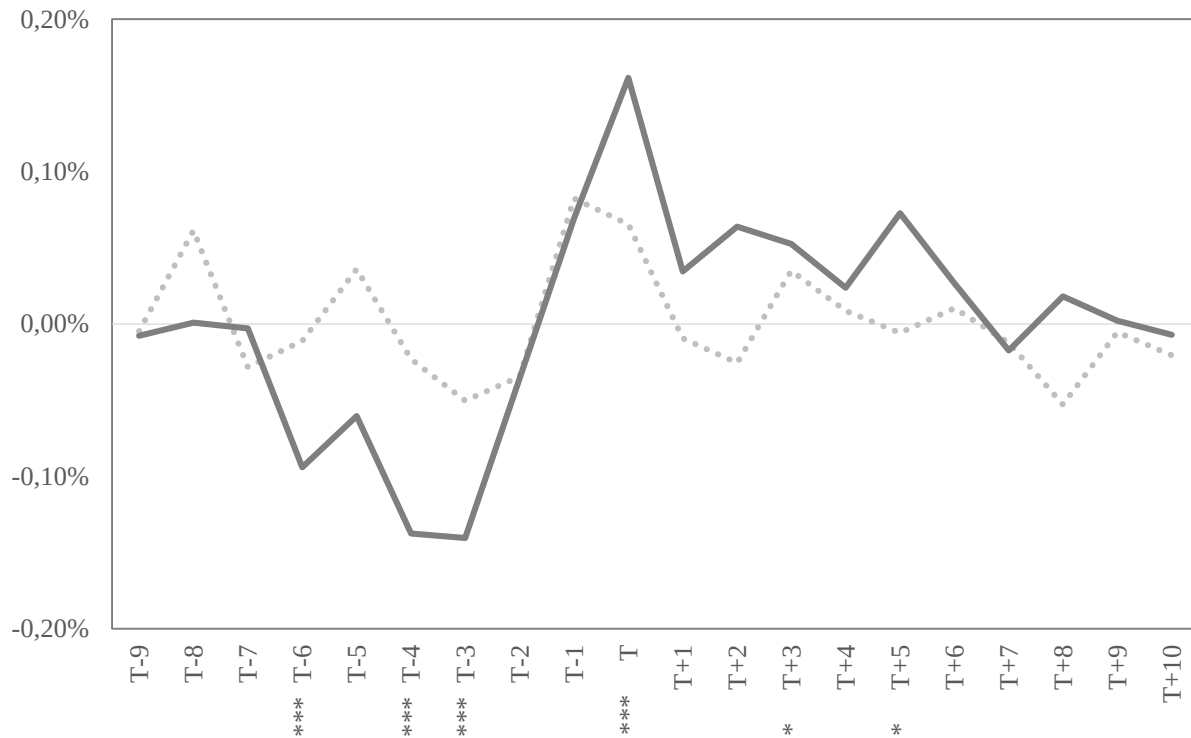


Figure 9

The impact of mutual fund holdings on turn of the month return patterns

This figure shows value- (light grey) and equal-weighted (dark grey) average returns and selected correlations of returns around the turn of the month for deciles of stocks sorted 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 the Thomson Reuters Mutual Fund Holdings database. The sample period is July 1995 to December 2013. Panel A documents the returns from $T-8$ to $T-4$, 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 correlations between $T-8$ to $T-4$ and $T-3$ to $T-1$ returns, and Panel F the correlations between T to $T+3$ and $T+4$ to $T+8$ returns in different mutual fund ownership deciles. 10 = highest ownership decile.

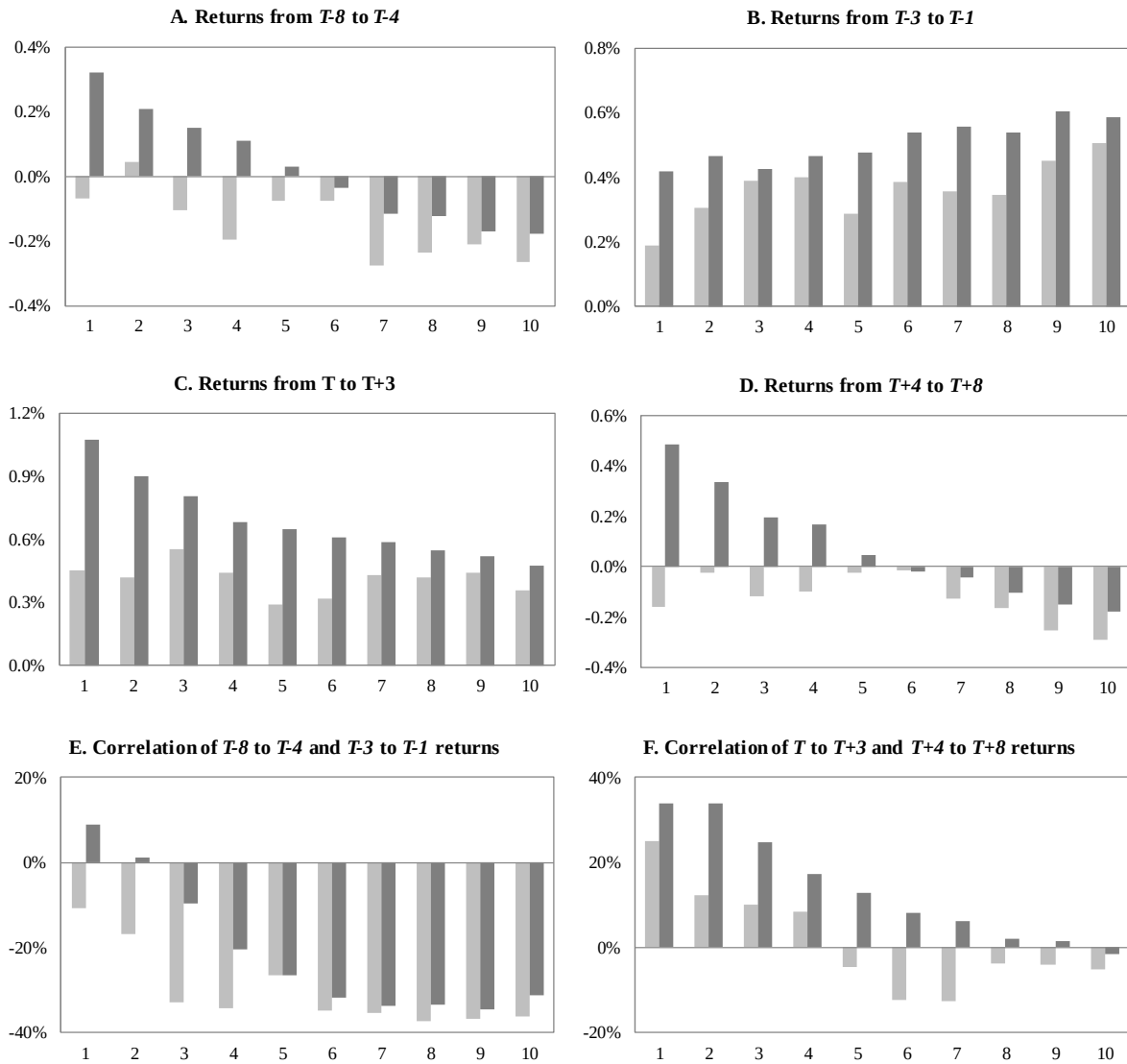


Figure 10

Mutual fund ownership and correlation between $T-8$ 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 and the correlations between $T-8$ to $T-4$ and $T-3$ to $T-1$ stock market returns for different countries. Here T refers to the last trading day of the month. The stock holdings percentage is an average of the 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. The total market capitalizations are from the 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 include the U.S. and Japan (denoted with stars 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 reported domestic stock holdings exceed the total market capitalization of the Luxembourg stock exchange.

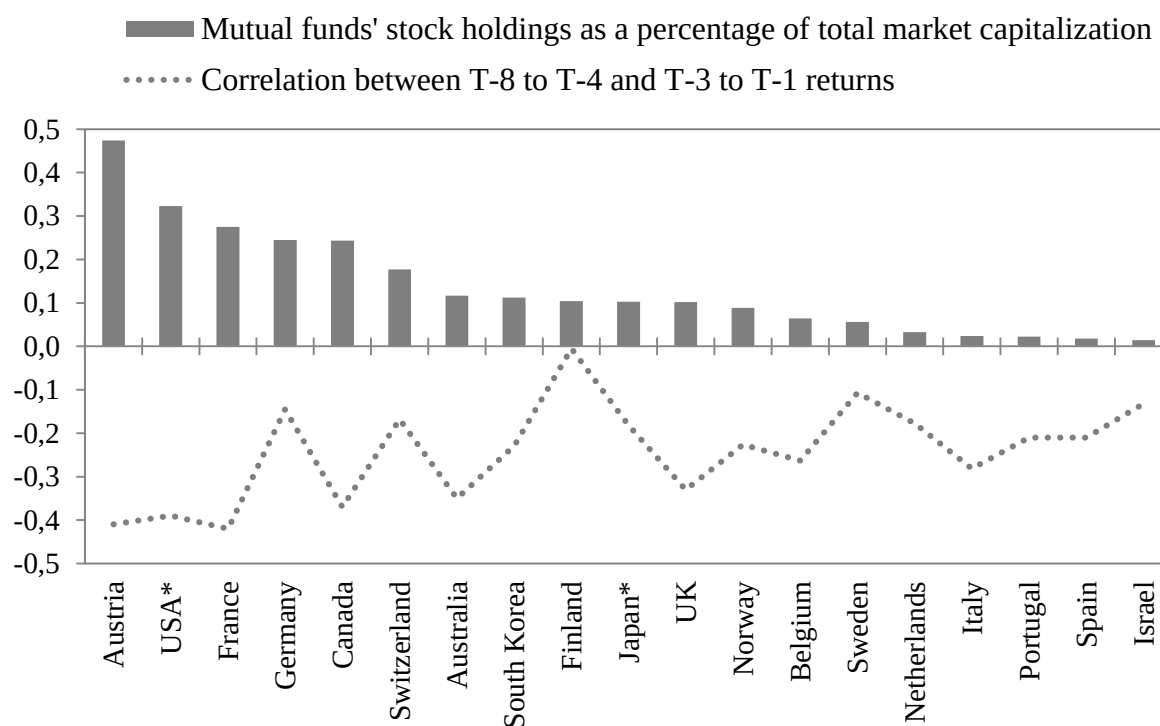


Figure 11

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

Panel A shows the correlations between $T-8$ to $T-4$ and $T-3$ to $T-1$ returns for stocks sorted into deciles based on their Amihud *ILLIQ* measure (10th being the most illiquid). Panel B shows the same correlations for stocks sorted into deciles based on their market capitalization (10th being the largest). Our sample, covering data from July 1995 to December 2013, includes all stocks in CRSP listed in the NYSE and the Amex (panel A), or all stocks from CRSP (panel B). The Amihud (2002) *ILLIQ* measure is calculated as a rolling one year average until the 10th trading day of the corresponding month. T refers to the last trading day of the month.

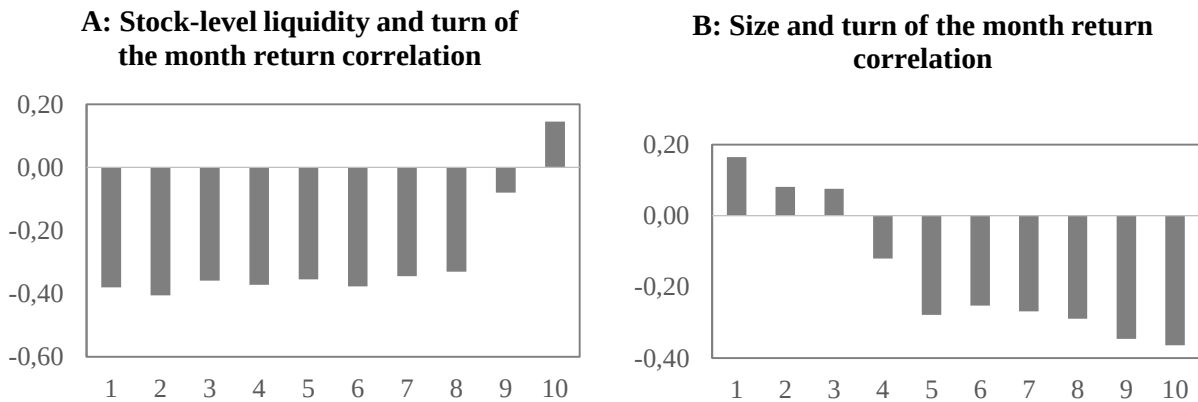


Figure 12

Mutual fund return volatility within a month

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

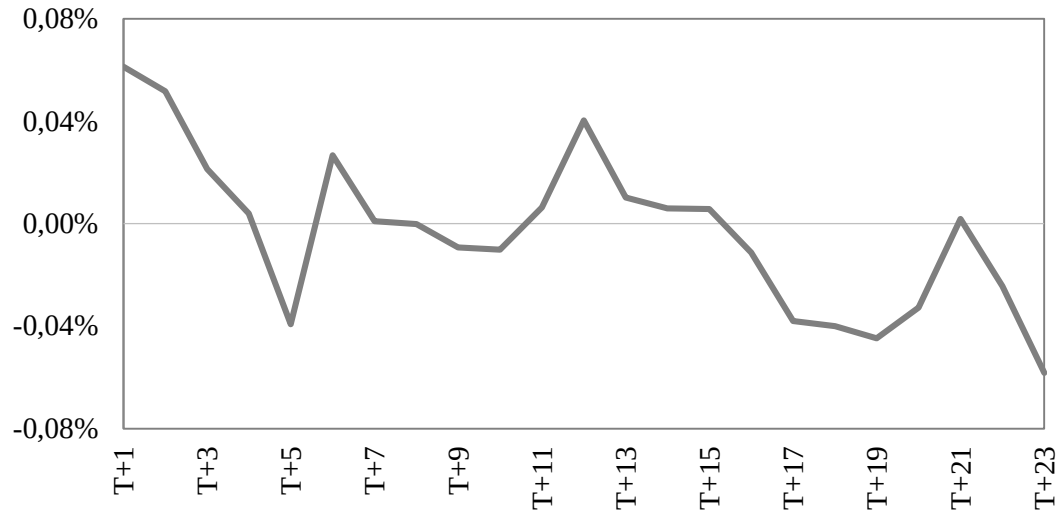


Figure 13

Exposure to month-end return reversals predicts mutual fund performance

This figure shows mutual funds' four factor alphas conditioned 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 of equally-weighted mutual fund portfolios, controlling for the three Fama and French factors and the Carhart momentum factor. Decile 10 contains the funds with the highest correlations between 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 January 1999 to December 2013.

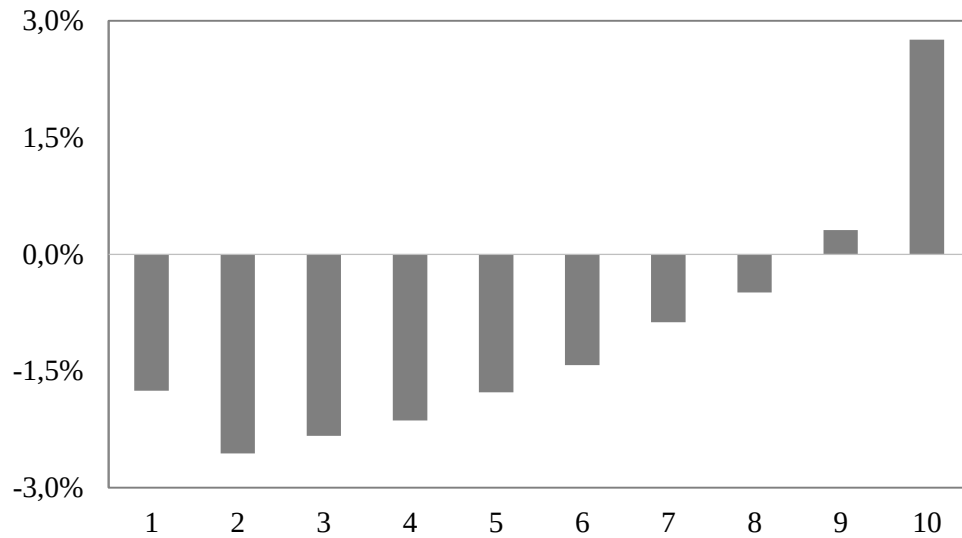


Figure 14
Turnover around the turn of the month

This figure displays the average of 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 before that, and so on. Let TP denote the last trading day of the previous month. The average daily turnover outside the turn of the month refers to the average stock market turnover on days $TP+11$ to $T-9$, and $T+5$ to $T+10$. Turnover is estimated as the CRSP total trading volume (in dollars) divided by the CRSP total market capitalization of the previous day. The sample period is July 1995 to December 2013.

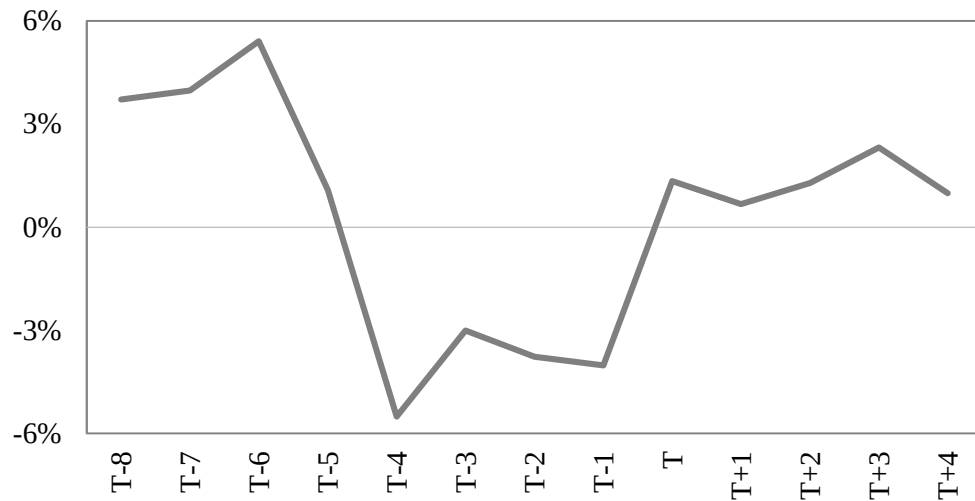


Figure 15

Correlation between $T-8$ to $T-4$ and $T-3$ to $T-1$ returns

This figure shows the scatter plot of $T-8$ to $T-4$ and $T-3$ to $T-1$ CRSP value-weighted index returns. Day T denotes the last trading day of the month, $T-1$ the trading day before that, and so on. Observations from months where the TED spread (the difference between the three-month Eurodollar and Treasury rates) exceeds its 97.5th percentile are shown in black. The solid (dashed) line shows the fitted regression line based on the full sample (sample excluding observations drawn in black). The slope of $T-8$ to $T-4$ returns is statistically significant at the 1% level in both regressions. The sample period is July 1995 to December 2013.

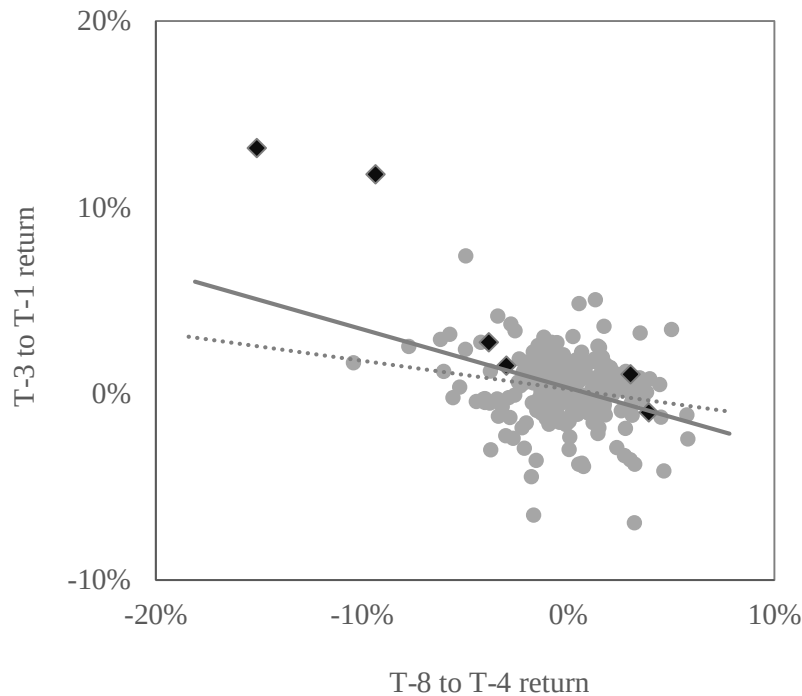


Table 1
Stock market returns near the turn of the month around the world

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 become available, and settlement rule is $T+3$ or shorter. For the U.S. 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	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%
U.K. (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 U.S.			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 become available, and settlement rule is $T+3$ or shorter. For the U.S. 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	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
U.K. (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 U.S.			-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 test whether a change in the settlement period affects market index return autocorrelations at $T-2$ (i.e., correlation of $T-3$ and $T-2$ market returns). In October 6, 2014 most of the European countries changed their settlement period from 3 to 2 days. 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 the 3-day 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 at $T-2$ 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**The impact of institutional trading on the turn of the month returns**

This table shows the results from a regression in which the 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 during days $T-8$ to $T-4$, or, alternatively, during days $T-5$ to $T-4$, when their sales exceed purchases, and to be zero otherwise. The figures are normalized by the U.S. total stock market capitalization at the beginning of the selling pressure period. Our institutional investors' trade data are 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.

$y = \text{returns } T-3 \text{ to } T-1$					
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 (1.50)		40.37 (2.14)	
Institutional investors' selling pressure ($T-5$ to $T-4$)			117.25 (2.53)		111.09 (3.49)
Intercept	0.003	0.002 (0.98)	0.000 (-0.09)	0.001 (0.32)	-0.001 (-0.52)
R^2	0.184	0.020	0.084	0.209	0.259

Table 5
Execution costs around the turn of the month

This table shows for ANcerno institutions, which we classify either as liquidity demanders or other institutions, their average execution costs around the turn of the month conditional on the direction of the trade. In case of purchases the executions cost is measured as the difference between the execution price and the Volume Weighted Average Price from placement to execution in basis points. In case of sales, in turn, it equals the difference between the Volume Weighted Average Price from placement to execution and the execution price. 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. The data are 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.

		From $T-8$ to $T-4$	From $T+1$ to $T+3$		
Selling	Liquidity demanders	1.35	***	-0.31	
		(3.48)		(-0.35)	
	Other institutions	-0.91		-0.98	
		(-1.41)		(-1.49)	
Buying	Liquidity demanders	1.35	***	2.10	***
		(3.28)		(2.97)	
	Other institutions	-1.32	**	-1.90	***
		(-2.38)		(-3.09)	

Table 6

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 stocks in CRSP that have a share price above 5 USD, 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 7

The impact of mutual funds' AUM on month-end return reversals

This table shows the results from a regression of 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 the $T-8$ 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 U.S. total stock market capitalization. The index returns are those for the CRSP value-weighted index. The sample period is from July 1995 to December 2013. 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.

$y = \text{returns } T-3 \text{ to } T-1$			
Market return $T-8$ to $T-4$	-0.315 (-2.58)	0.627 (1.52)	0.627 (1.53)
Mutual fund industry AUM		0.043 (1.51)	0.048 (0.32)
Interaction of mutual fund industry AUM and market return $T-8$ to $T-4$		-4.450 (-1.96)	-4.446 (-1.98)
Linear trend			-0.000 (-0.03)
Intercept	0.003 (2.55)	-0.006 (-0.98)	-0.006 (-0.31)
R^2	0.150	0.200	0.200

Table 8

The impact of mutual fund outflows on the turn of the month returns

This table shows the results from a regression in which the 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 funds' aggregate outflow. Here T refers to the last trading day of the month. Mutual funds' aggregate outflow (normalized by the U.S. 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 are 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

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

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

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

Table 9

Mutual funds' 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
	$T-5$	-0.024	(-15.67)
	$T-4$	-0.017	(-10.16)
	$T-3$	-0.053	(-31.50)
	$T-2$	0.016	(10.62)
Interactions of time period dummies and daily S&P500 returns	$T-1$	-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 10

Mutual fund alphas and exposures to month-end return reversals

This table shows active domestic 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 of equally-weighted mutual fund portfolios, controlling for standard risk factors. 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 are from CRSP. The sample period is from January 1999 to December 2013.

Mutual fund deciles based on correlation of $T-8$ - $T-4$ and $T-3$ - $T-1$ returns											
	1	2	3	4	5	6	7	8	9	10	10-1
CAPM Alpha	-0.94% (-0.74)	-2.39% (-2.55)	-1.91% (-2.41)	-1.46% (-2.02)	-0.82% (-1.20)	-0.15% (-0.21)	0.69% (0.81)	1.45% (1.38)	2.45% (1.95)	4.77% (2.71)	5.77% (2.43)
Market return	1.04 (67.52)	1.04 (114.11)	1.03 (136.27)	1.02 (166.29)	1.01 (168.27)	1.00 (157.30)	0.98 (147.36)	0.97 (109.35)	0.95 (96.90)	0.83 (64.31)	-0.20 (-9.68)
FF3 Alpha	-2.15% (-1.72)	-2.86% (-3.36)	-2.52% (-3.68)	-2.22% (-3.78)	-1.79% (-3.64)	-1.30% (-2.45)	-0.69% (-1.22)	-0.17% (-0.22)	0.78% (0.78)	3.38% (2.15)	5.65% (2.41)
Market return	1.02 (73.09)	1.03 (117.18)	1.02 (178.86)	1.01 (242.91)	1.00 (327.88)	0.98 (266.54)	0.97 (202.92)	0.95 (138.08)	0.93 (102.53)	0.82 (58.83)	-0.20 (-9.12)
SMB	0.19 (6.50)	0.15 (9.75)	0.17 (15.41)	0.19 (21.87)	0.21 (31.64)	0.22 (35.96)	0.26 (29.51)	0.27 (20.75)	0.29 (16.01)	0.26 (8.63)	0.07 (1.30)
HML	0.11 (3.88)	-0.05 (-1.94)	-0.03 (-2.28)	-0.01 (-0.84)	0.02 (2.49)	0.05 (4.12)	0.06 (4.40)	0.11 (4.90)	0.11 (3.72)	0.05 (1.38)	-0.06 (-0.91)
FF4 Alpha	-1.75% (-1.47)	-2.56% (-3.18)	-2.33% (-3.45)	-2.14% (-3.57)	-1.77% (-3.53)	-1.42% (-2.79)	-0.87% (-1.63)	-0.49% (-0.72)	0.31% (0.36)	2.76% (1.89)	4.59% (2.18)
Market return	0.98 (83.97)	1.01 (148.07)	1.01 (175.00)	1.00 (232.77)	1.00 (309.33)	1.00 (340.57)	0.98 (277.79)	0.99 (215.78)	0.97 (176.20)	0.87 (85.74)	-0.11 (-6.77)
SMB	0.21 (7.32)	0.17 (11.97)	0.18 (17.64)	0.19 (22.05)	0.21 (30.40)	0.22 (33.66)	0.26 (31.53)	0.26 (23.60)	0.27 (18.61)	0.24 (8.75)	0.03 (0.61)
HML	0.09 (4.19)	-0.06 (-3.11)	-0.04 (-3.77)	-0.01 (-1.34)	0.02 (2.51)	0.06 (4.93)	0.07 (6.06)	0.13 (7.19)	0.13 (6.23)	0.08 (3.15)	-0.01 (-0.23)
Momentum	-0.11 (-10.24)	-0.08 (-9.19)	-0.05 (-6.89)	-0.02 (-2.88)	-0.01 (-0.87)	0.03 (4.74)	0.05 (8.18)	0.08 (10.42)	0.12 (14.21)	0.16 (12.08)	0.27 (14.21)

Table 11

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' <i>T-8 - T-4</i> and <i>T-3 - T-1</i> returns											
	1	2	3	4	5	6	7	8	9	10	10-1
Trailing 2-year correlation of <i>T-8 - T-4</i> and <i>T-3 - T-1</i> 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											
<i>T-8</i> through <i>T-4</i>	-3.85%	-4.49%	-4.72%	-4.38%	-4.39%	-4.13%	-3.89%	-3.65%	-3.28%	-1.94%	1.91%
<i>T-3</i> through <i>T-1</i>	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 12

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 selected 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 are 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	During high TED spread	During low TED spread	Global Macro	Managed Futures
$T-5$	-0.110 (-15.43)	-0.082 (-9.35)	-0.047 (-4.31)	-0.024 (-0.62)	0.147 (3.85)
$T-4$	-0.089 (-12.04)	-0.112 (-12.13)	-0.191 (-14.59)	-0.077 (-1.63)	0.102 (2.35)
$T-3$	-0.017 (-2.54)	-0.048 (-5.38)	0.063 (4.73)	0.106 (2.36)	0.424 (9.95)
$T-2$	-0.088 (-13.26)	-0.139 (-14.78)	-0.013 (-1.24)	-0.062 (-1.88)	-0.052 (-1.49)
$T-1$	-0.061 (-10.46)	-0.053 (-8.33)	-0.067 (-6.63)	0.091 (2.35)	-0.065 (-1.77)
T	-0.176 (-21.86)	-0.245 (-24.98)	0.059 (4.44)	-0.143 (-3.03)	-0.092 (-2.14)
$T+1$	0.142 (21.64)	0.252 (30.87)	0.079 (6.54)	0.052 (1.39)	0.191 (4.74)
$T+2$	0.250 (32.86)	0.375 (37.25)	0.159 (15.05)	0.066 (1.42)	0.213 (5.44)
$T+3$	0.164 (24.01)	0.232 (24.04)	-0.010 (-1.08)	0.100 (2.21)	0.089 (2.14)
$T+4$	0.106 (16.04)	0.066 (7.86)	0.116 (12.28)	0.044 (1.09)	-0.053 (-1.40)
$T+5$	0.038 (4.89)	0.033 (3.92)	0.148 (12.02)	-0.025 (-0.67)	-0.046 (-0.93)
N	7,810	5,217	3,892	314	538

Table 13**Funding conditions and the turn of the month returns**

This table shows the results from a regression in which the $T-3$ to $T-1$ market returns are regressed on the $T-8$ to $T-4$ market returns, TED spread, and its interaction with the $T-8$ to $T-4$ returns. T refers to the last trading day of the month. The TED spread is the difference between the 3-month Eurodollar and the Treasury rates. The market index returns are those of the CRSP value-weighted index. Our sample period is from June 1995 to December 2013. 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.

$y = \text{Return } T-3 \text{ to } T-1$	
Return $T-8$ to $T-4$	-0.089 (-1.44)
TED spread	0.004 (1.43)
Interaction of TED spread and the $T-8$ to $T-4$ return	-0.142 (-5.39)
Intercept	0.001 (0.44)
R^2	0.299

Figure A1

Deposits around the turn of the month

This figure shows the deposits in U.S. commercial banks relative to the average deposits in those banks in the two months surrounding the observation date, around the turn of the month. Day T denotes the last trading day of the month, $T-1$ the trading day before that, and so on. The deposit data are from FRED. The sample period is January 1980 to December 2013.

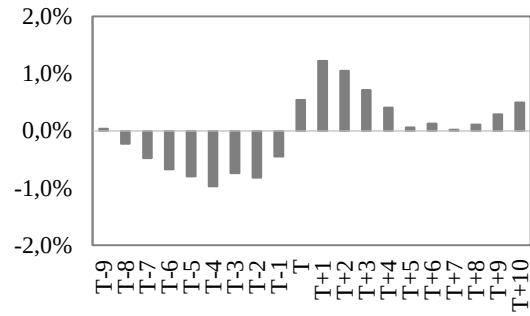


Figure A2

Timing of events around $T-4$ and $T-3$

This figure illustrates the timing of equity sales and purchases that are related to turn of the month payments. It shows the emergence of a liquidity gap in the stock market following the market close on day $T-4$. This occurs due to the fact that payment processing requires that pension funds' end-of-month liquidity related sales must take place at $T-4$ or before, while any purchases by recipients of end-of-month payments can only occur at $T-3$. Due to this liquidity gap, we expect end-of-month liquidity related sales to depress prices most at $T-4$.

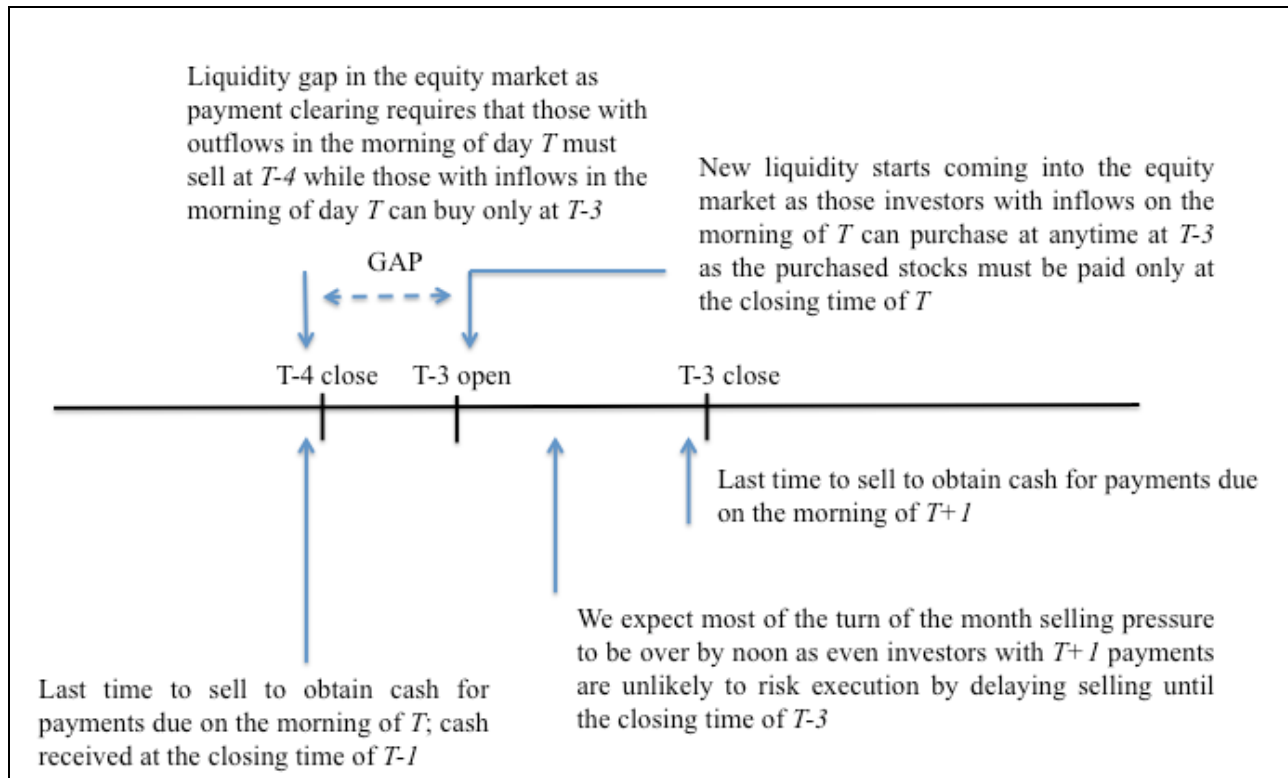


Figure A3

Institutional investors' buy ratios around the turn of the month

This figure shows the buy ratio for a sample of institutional investors 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 are 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.

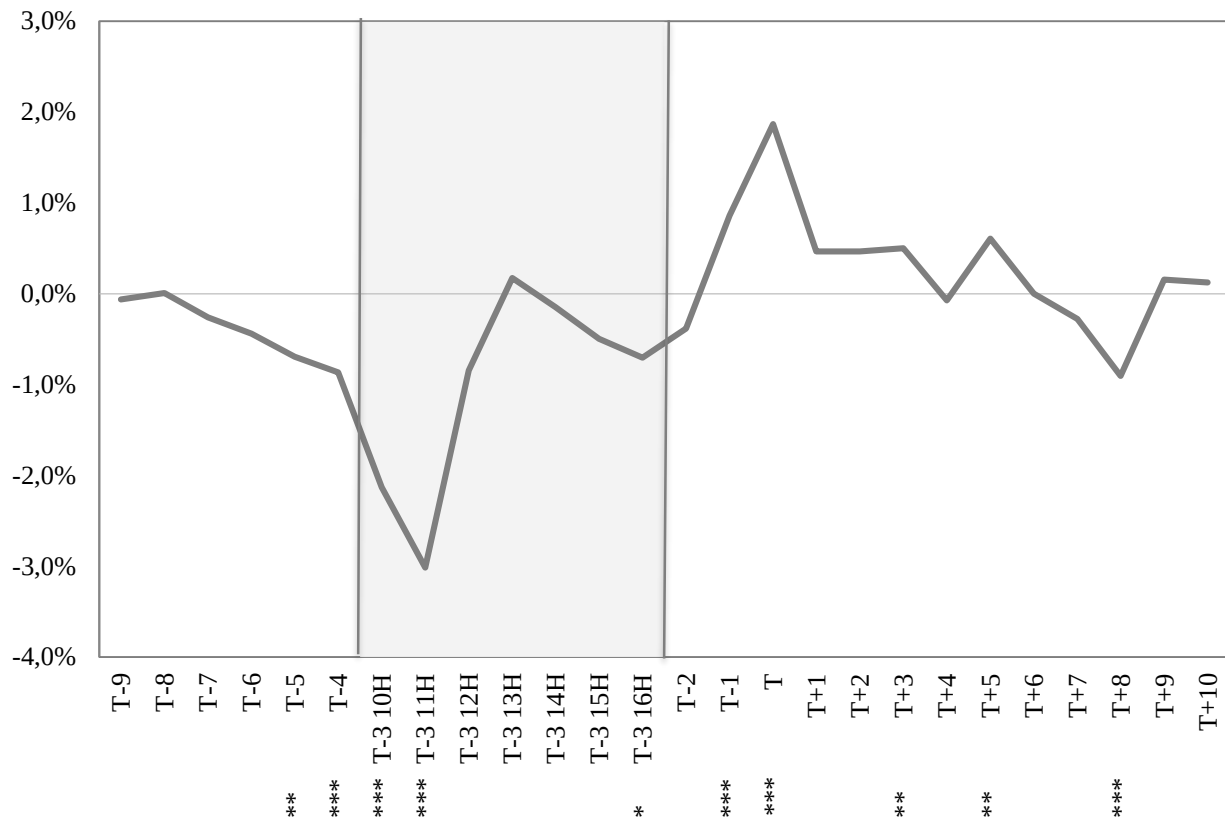


Figure A4

Stock-level volatility and turn of the month return patterns

This figure shows the effect of stocks' past six-month return volatility on the correlation between their $T-8$ to $T-4$ and $T-3$ to $T-1$ returns. Here T refers to the last trading day of the month. To control for the fact that liquidity and volatility are correlated we condition our volatility estimates on liquidity. Our sample, covering data from July 1995 to December 2013, includes all stocks in CRSP listed in NYSE or Amex that have a share price higher than 5 USD on the 10th trading day of the corresponding month, and a market capitalization that exceeds the 10th NYSE market capitalization percentile. The Amihud (2002) *ILLIQ* measure is calculated as a rolling one-year average until the 10th trading day of the corresponding month. Stocks fulfilling the requirements stated above are first divided into Amihud *ILLIQ* quartiles. After this, every Amihud *ILLIQ* quartile is further divided into volatility quartiles. The reported correlations of the $T-8$ to $T-4$ and $T-3$ to $T-1$ returns are based on value-weighted returns of the Amihud-Volatility sorted portfolios.

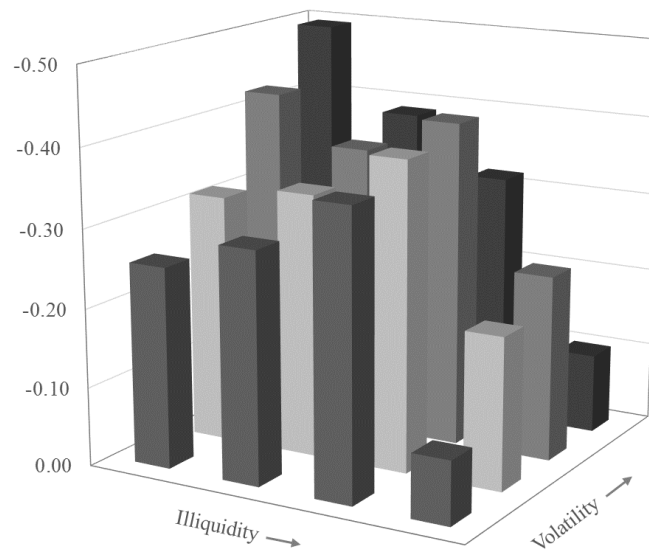


Figure A5

The turn of the month effect around the bankruptcy of Lehman Brothers

This figure shows the cumulative CRSP equity market returns when investing from $T-8$ to $T-4$ or from $T-3$ to $T-1$ (left axis) in the period around the Lehman Brothers bankruptcy on September 15, 2008. In addition, the figure shows the development of the TED spread (the difference between the three-month Eurodollar and Treasury rates) and aggregate mutual fund flows during the same period (right axis). Sources: Mutual fund flows are from ICI, return data from CRSP, and the Ted spread from Datastream.

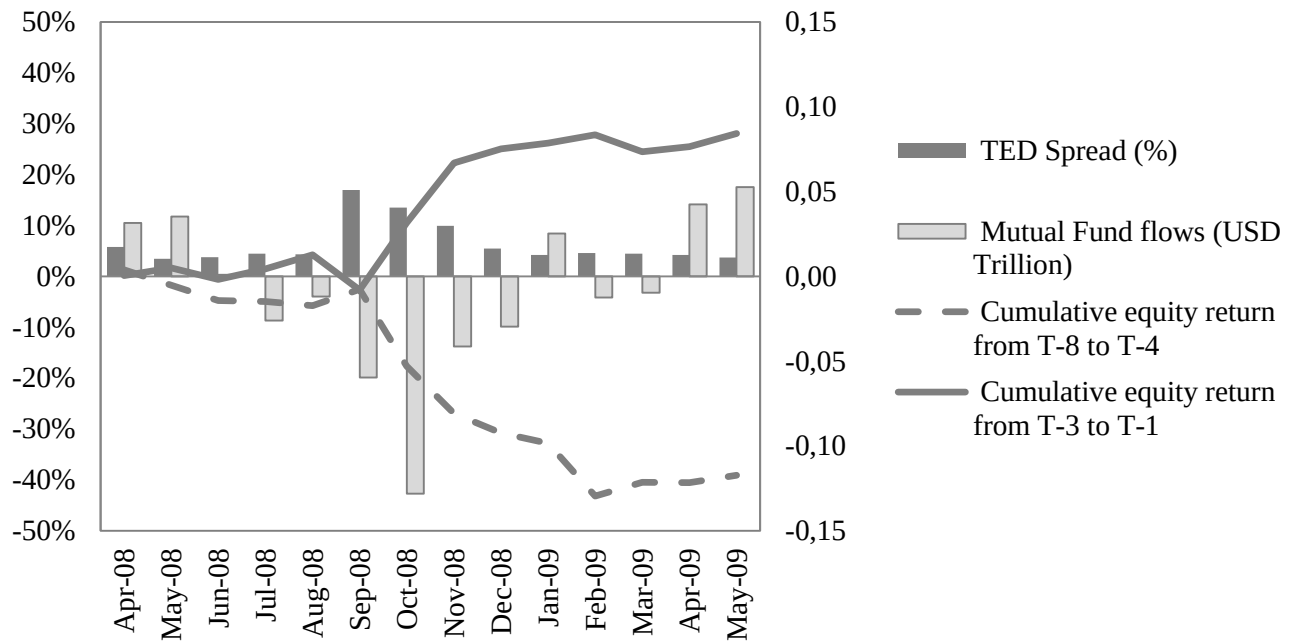


Table A1

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 become available, and settlement rule is three days or shorter. For the U.S. we show also the full sample results. The sample runs until the end of 2013.

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
U.K. (FTSE100)	Aug-96	-0.03%	-0.07%	0.05%	0.04%	0.00%	-0.21	-0.02
Countries with settlement period less than 3 days								
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 U.S.		0.00%	-0.01%	0.02%	0.03%	0.00%	-0.12	0.02

Table A2

**Return correlations before the turn of the month and the impact of mutual fund outflows:
evidence from Treasury yields**

This table shows the results from a regression in which the change in Treasury yields from $T-3$ to $T-1$ are regressed on the change in Treasury yields from $T-8$ to $T-4$, and on the mutual funds' aggregate outflow. Here T refers to the last trading day of the month. Mutual funds' aggregate outflow (normalized by the U.S. 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 $T-3$ when the net flow is negative, and zero otherwise. The Treasury yields are those of 52-week Treasury Bill (Panel A) and 3-year Treasury Note (Panel B). Unreported Treasury auction controls are included in all regressions. The yield data are from Datastream and the weekly mutual funds' flow data are from Investment Company Institute. 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. 52-week Treasury Bill			
y = yield change from $T-3$ to $T-1$			
$T-8$ to $T-4$ yield change	-0.185 (-2.37)	-0.309 (-2.36)	-0.333 (-2.92)
Mutual funds' aggregate outflow			-477.91 (-7.51)
Intercept	-0.008 (-1.14)	-0.017 (-1.64)	-0.012 (-1.21)
Sample period	Jul 1995- Dec 2013	Jan 2007- Dec 2013	Jan 2007- Dec 2013
R^2	0.060	0.229	0.417

B. 3-year Treasury Note			
y = yield change from $T-3$ to $T-1$			
$T-8$ to $T-4$ yield change	-0.182 (-2.60)	-0.309 (-3.25)	-0.313 (-3.25)
Mutual funds' aggregate outflow			-185.53 (-2.14)
Intercept	-0.005 (-0.75)	-0.013 (-1.46)	-0.009 (-0.96)
Sample period	Jul 1995- Dec 2013	Jan 2007- Dec 2013	Jan 2007- Dec 2013
R^2	0.042	0.146	0.161