Dash for Cash: Monthly Market Impact of Institutional Liquidity Needs

This version: 2 February 2019
First version: 2 October 2014

Erkko Etula
Goldman, Sachs & Co.

Kalle Rinne
Mandatum Life

Matti Suominen
Aalto University School of Business

Lauri Vaittinen
Mandatum Life

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 borne 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

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

We thank Doron Avramov, Utpal Btattacharya, John Campbell, Huaizhi Chen, Robert Dittmar, Bernard Dumas, Darrell Duffie, Thierry Foucault, Robin Greenwood (the editor), Denis Gromb, Bruce Grundy, David Hsieh, Antti Ilmanen, Russell Jame, Matti Keloharju, Dong Lou, Rajnish Mehra, Tyler Muir, Marina Niessner, Christopher Parsons, Lubos Pastor, Andrew Patton, Joshua Pollet, Ioanid Rosu, Nikolai Roussanov, Ravi Sastry, Andrei Simonov, Timo Somervuo, David Sraer, Jeremy Stein, Stijn van Nieuwerburgh, Michael Weber, Hongjun Yan, two anonymous referees, and seminar participants at Aalto University, American Finance Association 2016 Annual Meeting, Auckland University of Technology, BI Norwegian Business School, Chinese University of Hong Kong, Conference on Frontiers of Factor Investing, HEC Paris, Hong Kong University of Science and Technology, INSEAD, the 5th Helsinki Finance Summit, Luxembourg School of Finance, the 8th Paul Woolley Centre Conference at the London School of Economics, Manchester Business School, McGill University, National University of Singapore, Singapore Management University, University of Mannheim, University of Sydney, and the WU Gutmann Center Symposium 2015 in Vienna. Contact information. Erkko Etula: Goldman, Sachs & Co., 200 West Street, New York, NY 10282, Email: erkko.etula@gs.com, Tel: +1-617-319-7229; Kalle Rinne: Mandatum Life, 26-28 rue Edward Steichen, L-2540 Luxembourg. E-mail: kalle.rinne@mandatumlife.lu, Tel: +352-691 828 204; Matti Suominen (contact author): Aalto University School of Business, P.O. Box 21210, FI-00076 Aalto, Finland, E-mail: matti.suominen@aalto.fi, Tel: +358-50-5245678; Lauri Vaittinen: Mandatum Life, Bulevardi 56, 00120 Helsinki, Finland, Tel: +358 10 553 3336, E-mail: lauri.vaittinen@mandatumlife.fi. Part of this paper was written when Kalle Rinne was affiliated with the Luxembourg School of Finance and the Luxembourg Institute of Science and Technology. We are grateful to Markus Hjulgren, Joona Karlsson, Antti Lehtinen, Mikael Paaso, and Mounir Shal for excellent research assistance. Matti Suominen recognizes financial support from the Cooperative Banks' Research Foundation, the Finnish Foundation for Securities Market research, Mandatum Life, and the Yrjö Jahnsson foundation.

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). Since payments require cash, there is a "dash for cash," a large systemic liquidity demand in the economy at the month end.[2] We find that this excess demand for cash predictably increases short-term borrowing costs, as depicted by elevated Repo, Libor and Federal Funds rates (Figure 2), and 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).

[INSERT FIGURES 1- 3 HERE]

In this paper, we study the causes and implications of these anticipated and monthly repeated price pressures that occur 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 institutional liquidity needs in the genesis of these patterns and derive estimates of the associated costs borne 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 enable us to crisply link the turn of the month return patterns 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.

[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] This liquidity demand is reflected, for instance, in a rise in the aggregate amount of checkable deposits and a decline in savings deposits, on average, a few days prior to the month end. Please see the Internet Appendix for these results. More generally, we have placed in the Internet Appendix several results and statistics that complement our analysis.

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 3-day settlement convention that prevails during our sample period 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 ("days" henceforth) before the month end; that is, before the market closes on *T-4*.[3] [4] 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*. In other words, 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 is likely due to arbitrage activity between corporate bonds and Treasury bonds.

[INSERT FIGURE 4]

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 from *T-8* to *T-4* labeled "selling pressure" 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

[3] In the U.S. the settlement period was fixed to 3 days in June 1995. Prior to this a 5-day settlement convention was common, although practices varied across time and exchanges. See e.g., Thomas Murray Ltd. 2014 report "CMI In Focus: Equities Settlement Cycles" and the Financial Industry Regulatory Authority's website. See Table 1 for information on the settlement conventions used outside the U.S.

[4] For instance, pension payments must be in the recipients' accounts on 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 A3 in the Internet Appendix provides further details on the mechanics of making payments around the turn of the month.

buying pressure fueled by newly cleared money subsides, the cycle is completed by a "negative reversal" from *T+4* to *T+8*. Since the return patterns at the beginning of the month are already documented in the literature, we focus on the end of the month with particular emphasis on the positive return reversal that follows the month-end selling pressure, generating a negative correlation between *T-8* to *T-4* and *T-3* to *T-1* returns.

A cumulative version of Figure 4 is displayed in Figure 5, which illustrates the accrual of the turn of the month returns over time and highlights the economic importance of these patterns. Note also that the patterns seem to have become more pronounced over time. 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, in this paper we show that the large month-end returns can be explained to a significant extent by reversals from preceding days' price pressures. We document also similar return patterns and reversals in bonds and in international equities: all 23 equity markets that we survey provide some evidence of return reversals prior to month end and in 20 of them the reversals are statistically significant. [5] [6]

[INSERT FIGURE 5]

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. This analysis strongly supports our conjecture. We also find causality between

[5] Notably, the three countries (Finland, New Zealand and Sweden) where reversals are statistically insignificant are small and feature pension systems that make a significant portion of payments outside the turn of the month period. These cross-country findings lend further support to our argument that the return patterns are related to month-end liquidity-related selling as driven by the monthly payment cycle. Please see the Internet Appendix for further details.

[6] 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 (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* and to link them to the monthly payment cycle.

payment flows and month-end reversals by studying predictable variation in month-end payment volume: when the last business day of the month is 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 a Friday.[7]

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 end of the month, we present both direct and indirect evidence that links these patterns to institutional flows. 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 buy and sell stocks. Consistent with our hypothesis and the clustering of institutional payments on *T* and *T+1*, we find that institutions are on average net sellers in the 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 3.[8]

When we divide the institutions into groups based on their past year's trading behavior, we find that a subset of institutions systematically engages in month-end selling year after year – some of them selling regularly up to *T-4*, some of them up to *T-3*. Moreover, we document using regression analysis that greater aggregate institutional net selling on days *T-8* to *T-4* (normalized by stock market

[7] 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).

[8] The direction of the institutional trading changes during the day *T-3*, which helps explain the high returns observed on that day. Figure A5 in the Internet Appendix shows that institutional buy ratios in excess of their hourly sample average are highly negative on the morning of *T-3*, but become indistinguishable from zero by the afternoon.

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 at the end of the month.

Combining this direct evidence on institutional investors' month-end trading patterns with the associated patterns in market returns leads us to conclude that institutions may incur significant costs from their liquidity-driven trading. Indeed, we estimate the annual average costs to institutions at approximately 30.6 billion U.S. dollars during our ANcerno sample period (1999-2013). Moreover, our evidence suggests that this suboptimal behavior can be attributed to agency problems that stem from reputational risks. The associated costs are eventually borne by the clients of the institutions.[9]

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 industry outflows (another measure of market wide selling pressure) to the intensity of month-end reversals. During the sample period for which we have weekly mutual fund flow data, we find that flow-related mutual fund selling pressure helps predict more than 40% of the time-series variation in *T-3* to *T-1* market returns. 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*.

[9] Conditional on the observed return patterns at the month end, it would be optimal for return-maximizing fund managers (agents) to conduct their liquidity-motivated selling as early as *T-9*. However, if their principals punish them for potentially missed market returns or for higher tracking error, it may be optimal for managers to keep their equity exposure until the last possible selling day (*T-4*). We study such agency-related explanations in the Internet Appendix. First, we examine an idea that agents might be less willing to sell at *T-9* (optimal from an expected return standpoint) due to reputational concerns whenever the *T-8* to *T-4* returns in the recent past were positive (such that those who followed the optimal practice and sold at *T-9* underperformed those that delayed their selling until *T-4*). Consistent with this, we find the month-end return patterns to be significantly more pronounced if recent *T-8* to *T-4* returns were positive. In addition, the ANcerno data provides direct evidence that in this case institutions' month-end selling occurs closer to *T-4*. The second reason why institutions might be unwilling to sell at *T-9* is the risk of increased tracking error to the market, which increases in volatile markets. Consistent with this idea, we find that volatility significantly amplifies the month-end return patterns and delays institutions' selling closer to *T-4*, which is the last day that guarantees liquidity on *T* (see Tables A3-A5 in the Internet Appendix).

[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).

We then calculate a stock specific 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 notion that the patterns are driven by investors' liquidity needs, and that investors respond to month-end outflows and cash needs conscious of transaction costs. In our international sample, we show that month-end market 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.[11]

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 larger for the decile of funds whose past returns revert the least around *T-4* compared to the decile of funds experiencing the most negative return reversals around *T-4*. We interpret this as supplementary evidence (to that obtained from ANcerno's institutional trading data) that most institutions suffer significantly from their month-end trading practices.

Evidence on limits to arbitrage. We find mixed evidence on the efforts of hedge funds to capitalize on the turn of the month return patterns. Akin to 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.[12] By implication, our results suggest that the aggregate hedge fund industry has not mitigated but rather *contributed to* the turn of the month return patterns on average during our sample period. One possible explanation is that hedge fund vehicles are often ill-designed to provide month-end liquidity, as their redemption dates

[11] The fact that the price pressure is closely tied to mutual fund holdings and flows suggests that investors commonly use mutual fund vehicles as parking spots for 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 socialization of transaction costs might provide an explanation for why investors do not pay sufficient attention to the costs that arise from month-end liquidity related trading.

[12] This is especially the case for funds with less frequent redemption cycles.

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 of hedge funds' liquidity provision as soon as we condition for market-wide funding conditions or when we divide the aggregate hedge fund industry into sub-strategies. The literature on limits to arbitrage suggests that funding constraints may decrease 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). Consistent with this literature, our time series evidence indicates that tighter funding conditions for hedge funds are associated with greater return reversals around *T-4*. Also, we would expect hedge funds that trade daily settled instruments (e.g., futures) to be in a better position to provide month-end liquidity. Indeed, we find that funds in managed futures and global macro categories tend to have significantly higher market betas on *T-3*, implying that they capitalize on high month-end returns by systematically increasing equity exposure either at the end of day *T-4* or on the morning of *T-3*.[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 (2018) show theoretically that similar return reversals occur even when the supply and demand shocks are anticipated. Despite this 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 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 tie the return reversals to the turn of the

[13] Note that the end of day *T-4* is the best time to invest in order to capitalize on abnormally large month-end returns in light of historical returns.

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] [15]

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 arbitraged 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. For 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 to the seminal paper of Ariel (1987). Most of these studies focus on the four-day period from the last to the third trading day of the month where abnormally high returns are documented. We believe our study is the first to investigate market behavior around the last day of the month that guarantees cash settlement before the month end. We are also the first to link the turn of the month return patterns to institutional investors' buy-sell ratios, mutual fund holdings, mutual 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

[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 are not necessarily associated with high volume around *T-4*.

[15] 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 investors' flows on commodity futures prices.

when the price of short-term liquidity is high. Second, they provide regulators with additional reasons to adopt shorter settlement windows.[16] Third, central bankers can use them to motivate more aggressive liquidity provision at the month end.[17] 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

We source our data on country equity index returns from Datastream, except for the U.S. value-weighted index, which is obtained from CRSP. Our international sample consists of the benchmark indices of countries defined by FTSE, MSCI and S&P as developed countries. We focus on data since 1980 and select time periods where the settlement rule in the respective stock exchanges has been 3-day or shorter. Country-specific sample periods are documented in Table 1. Most of the international index returns include dividends, but in some cases we have used price indices to complete the data.[18] In the case of the U.S., we report the results both since 1980 as well as 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 U.S. adoption of the 3-day settlement rule. Mutual fund performance is estimated using 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. Hedge fund betas are estimated using the LIPPER TASS database on individual funds' monthly returns. Fama and French factors are from Ken French's website. Our data on bond yields and returns are obtained from FRED and Datastream. Finally, the Treasury auction dates are downloaded from TreasuryDirect.

[16] Indeed, the U.S. stock and corporate bond markets transitioned to 2-day settlement in September 2017.
[17] There is some evidence that the Federal Funds rate no longer rises around T in the most recent samples.
[18] Israeli index returns are entirely based on a price index as this is the only series available in Datastream.

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 also show evidence that links the reversals to (i) the 3-day settlement window in the equity market and (ii) 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 receive cash on time for payments that must be in recipients' accounts on the morning of day *T*. Since an important part of the payments are also due on the *T+1*, we should expect selling pressure to continue until *T-3*. In practice, however, liquidity 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 A3 in the Internet 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 primary period over which we expect negative price pressure in the stock market due to sales by institutions facing turn of the month cash liabilities.[19]

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

[19] In our sample of institutional trading, described in Section 3, we document that institutions are on average net sellers from *T-8* onwards with the net selling being statistically significant on *T-5*, *T-4* and the morning of *T-3*. Duffie (2010) and Greenwood, Hanson and Liao (2018) examine theoretically the effects of anticipated supply shocks. In their models, speculators and market makers build up short positions prior to anticipated supply shocks in order to be able to absorb the shocks when they occur. Such short selling can explain the low returns in *T-8* to *T-6*, before the end of month liquidity related selling is at its largest.

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 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 holding period return since the 1995 adoption of the 3-day settlement rule is *negative* 17 bps for *T-8* to *T-4* and *positive* 77 bps for *T-3* to *T+3*. If we look at the abnormal holding period returns (by subtracting from each day's return the average daily return during our sample period) the abnormal *T-8* to *T-4* returns are significantly negative at -37bps on an average month. Conversely, abnormal returns are significantly positive from *T-3* to *T-1* at 25 bps, and from *T-3* to *T+3* at 48 bps.

We observe similar return patterns not only in the U.S. but also in other developed equity markets. Table 1 shows that in our international sample, consisting of 22 equity markets, 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 positive reversal period: the correlations are negative in all of the 23 markets and statistically significant in 20 of the 23 markets. This evidence implies that below-average returns over the selling pressure periods are associated with above-average subsequent return reversals. These findings are consistent with our argument that the return patterns are caused by end of month liquidity-related selling as driven by the monthly payment cycle. 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 23 markets) or statistically 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.[20] [21]

[INSERT TABLES 1 AND 2 HERE]

Next, to show that the link between settlement conventions and reversal patterns is causal, we investigate the impact of a recent concerted settlement change in several European countries on the timing of return reversals (a quasi-natural experiment). Specifically, on October 6, 2014, a group of European countries (Austria, Belgium, Denmark, Finland, France, Ireland, Italy, 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

[20] 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.

[21] 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 equity 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). The effects of quarter ends on securities prices are examined also in Du, Tepper and Verdelhan (2018) who document failures in the covered interest rate parity around quarter ends in the currency market.

provide evidence that market-specific settlement rules, combined with investors' month-end liquidity needs, drive the observed return reversal patterns at the month end.[22]

[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 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 a 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 a 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 in magnitude compared to months when *T* is some other weekday. 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 a Friday.

2.2 Price pressure in the bond market

Analyzing price pressures in the bond market is more complicated for several reasons, including 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 one-day 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. Indeed, we observe less crisp patterns in the bond market than in the equity market. Nonetheless, as Figure 3

[22] A 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.

suggests, the turn of the month return patterns across different segments of the aggregate bond market are consistent with the monthly payment cycle.

In Table 4, we show that the Treasury 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 here coincide with those in the equity market suggests that selling pressure in the Treasury market is affected by settlement conventions in equity and corporate bond markets, in addition to those in the Treasury bond market themselves. Akin to the equity market, the return reversals in the bond market between *T-8* to *T-4* and *T-3* to *T-1* are larger if the last day of the month *T* is a Friday. Note, however, from Figure 3 Panel C, that the reversal in yields in the bond market seems to be highest on *T-1* after the selling pressure in the Treasury bond market has come to an end.

[INSERT TABLE 4 HERE]

3. Direct evidence of price pressures 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 the 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.[23]

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 sell more than buy in the four trading days leading up to *T-3* consistent with the negative average returns on days *T-6*, *T-5* and *T-*

[23] 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.

4. In addition, institutions execute more buys than sells in the days *T-1* to *T+3*. On several days, such as *T-5* to *T-3*, *T-1* to *T*, and *T+3*, the buy ratios differ statistically significantly from the unconditional mean. These daily average *excess* buy ratios are displayed in Figure 6. As expected, institutional selling pressure is strongest on day *T-4*. [24]

[INSERT FIGURE 6 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. Given this, we do expect some institutions to remain net sellers that day, particularly in the morning. To investigate institutions' intra-day trading behavior on *T-3*, we compute *hourly* average excess buy ratios within that day 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.[25] 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 potential 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 on *T-3* in anticipation of the inflows. Adding to the supply of liquidity, in Section 6 we present evidence that certain hedge fund strategies (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*.

[24] 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% and 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.

[25] See Figure A5 in the Internet Appendix for the analysis. In addition, unreported test shows using hourly returns of the S&P 500 index that there is a significant intraday return reversal within the day *T-3*: the correlation between morning and afternoon returns is -0.23 and the estimate is significantly different from zero at 5% level. Here we used 11am as the cutoff between morning and afternoon to match the selling pattern in the ANcerno data shown in Figure A5.

We next investigate whether there is a subset of ANcerno institutions that consistently demand liquidity on the days preceding the month end when the aggregate institutional selling on average is abnormally large. Based on Figure 6, days *T-5* to *T-3* meet this requirement. 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.[26] Figure 7 shows the sum of signed volumes for liquidity demanders and other institutions, normalized by the CRSP market trading volume for the relevant days. It appears that some of the institutions systematically demand liquidity in the stock market at *T-3, T-4,* and before. [27]

[INSERT FIGURE 7 HERE]

As a robustness check, we split the liquidity demanding institutions in Figure 7 into two groups based on a trading pattern predicted by their payment date (recall from Figure 1A that pension payments are 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-4* and also negative on *T-3* in the previous year – these we conjecture to be institutions with payments at *T+1*.[28] Interestingly, the selling patterns are highly persistent. The first group has highly significant negative trading volume on *T-4*, but their signed trading volume on *T-3* is close to zero. The second group, on the other hand has significant negative trading volume on *T-4* but also in the morning of *T-3*. These results lend further support to our hypothesis that

[26] Focusing on institutions' net sales during *T-5* to *T-3* allows a clean identification of the liquidity demanding institutions. Results are qualitatively similar however 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.

[27] Consistent with institutions spreading their selling activity, we find that liquidity demanders who sell at *T-4* during a given month, also sell statistically significantly at *T-6, T-5* and *T-3* in the same month.

[28] This definition guarantees that we do not have any overlap between the groups of institutions and allows us to study these two separate groups' trading behavior on *T-3*.

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 the price impact of their month-end liquidity related 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 compare a scenario where the institutions execute at the closing prices of *T-9* all of the trades that they in reality execute between *T-8* and *T-3*. This calculation suggests that over our sample period 1999-2013, the institutions in the ANcerno database sacrificed 45.9 billion U.S. dollars due to price impact of their month-end liquidity related trades. This amount corresponds to 26 bps of the ANcerno institutions' total trading volume during our sample period. Assuming as in Puckett and Yan (2011) that the institutions in the ANcerno's database represent 10% of all institutional trading volume, the total trading cost of month-end liquidity related trading to institutions could be tenfold: 459 billion dollars during our sample period, or approximately 30.6 billion dollars per annum.[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 5 show that the net selling of the ANcerno institutions during *T-8* to *T-4*, and particularly during *T-5* to *T-4*, predict higher stock market returns from *T-3* to *T-1*. The economic magnitude of this institutional selling pressure is meaningful: a one standard deviation increase in net selling is predicted to increase *T-3* to *T-1* market returns by 0.32 to 0.67 percentage points, 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.[30]

[INSERT TABLE 5 HERE]

[29] Note 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] To avoid the use of overlapping data, we have left out net selling on *T-3* from these regressions.

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, Table A2 of the Internet Appendix shows 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.

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.

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

4.1 Return reversals in the cross section of stock returns

We begin our cross-sectional investigation with a straightforward extension of our aggregate stock market study. 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 the 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 this is the case, 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.[31]

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.[32] We then compute value- and equal-weighted average returns of these portfolios. The results are displayed in Figure 8. Consistent with our hypothesis, the stocks that are held to a greater

[31] 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.

[32] Stocks without any mutual fund ownership are included in decile 1. Mutual fund ownership of stocks varies considerably. Ranking all CRSP stocks based on their mutual fund ownership during our sample period (July 1995 to December 2013) gives a 10th percentile of 0.3% and 90th percentile of 47.7%. So, the interdecile range is as much as 47.3%.

extent by mutual funds in a given month tend to experience monotonically lower returns over the selling pressure period, from *T-8* to *T-4*. These same stocks also experience greater returns over the subsequent three days from *T-3* to *T-1*, and again monotonically lower average returns from *T+4* to *T+8*. Finally, the correlation between *T-8* to *T-4* and *T-3* to *T-1* returns is more negative and statistically highly significant for the stocks that are more commonly held by mutual funds.[33] [34]

[INSERT FIGURE 8 HERE]

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 (2012). 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 9 displays the correlations of *T-8* to *T-4* and *T-3* to *T-1* returns for different equity indices in our international sample 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

[33] Figure A6 in the Internet Appendix shows that these patterns are even stronger if we use only institutional fund ownership percentages to form the decile portfolios. Institutional funds are defined as mutual funds with at least one share class marked as institutional.

[34] Taken together, our evidence suggests that mutual funds (as agents) 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 be linked to the *strengthening* of the turn of the month return patterns over time – a result that we document in Section 5.

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 9 are negative for all country indices.[35]

[INSERT FIGURE 9 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. In other words, 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 10.

[INSERT FIGURE 10 HERE]

Consistent with the notion that institutional investors 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.[36] [37] ANcerno data also confirm that institutional investors are mainly selling liquid stocks between *T-8* and *T-4* (see Figure A8 in the Internet Appendix).

[35] 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. See the Internet Appendix for further details.

[36] Furthermore, if the patterns we observe are due, in part, 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 A7 in the Internet Appendix.

[37] 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 4).

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

5.1 Strength of return reversals over time

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]

5.2 Mutual fund flow and market returns

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 current month's mutual fund industry outflow up to those dates, controlling for past market returns. Mutual fund industry outflow is defined as the negative of the net flow to all mutual funds (equity, hybrid and bond funds) from the first Wednesday of the month until the last Wednesday before *T-8* or *T-3*, when the net flow is negative, and zero otherwise (normalized by total stock market capitalization).[38] 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 outflow (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'

[38] We use the aggregate flows to examine reversals in stock returns (and bond yields in the Internet Appendix) as they reflect, better than the flows within any single asset class, the investors' aggregate liquidity needs at month-end, which we expect to influence expected returns across all asset classes in equilibrium. The flows within one individual asset class are influenced by existing price pressures in all the different markets as investors' selection of which long-term assets to liquidate at month-end is endogenous to existing market conditions.

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 A9, we also show that in the bond market the past mutual fund industry outflow significantly explains the *T-3* to *T-1* yield change for Treasury bonds, consistent with the price pressure hypothesis. Also here, the explanatory powers are considerable, up to 50% (40% when ignoring the effect of the dummy variables).

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

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 equity 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 cost of institutions' month-end liquidity demand presented in Section 3.

Every month, 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 Table 9). In other words, 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 TABLE 9 HERE]

In Table 10, 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, implying 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 on other days. In other words, their outperformance cannot be fully attributed to their returns at the turn of the month but they exhibit greater skill also during the rest of the month. Nonetheless, their rate of outperformance is clearly higher during the last eight trading days of the month.[39]

[INSERT TABLE 10 HERE]

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, seeking 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 11, we show that the average market beta of hedge funds near the month end behaves similarly to the average beta of mutual funds (see Table 11 below and Table A8 in the Internet Appendix) and is smallest at *T-3*. This finding implies that hedge funds on average do not provide liquidity at *T-4* to mutual funds that sell near the month end, contrary to what one might have expected.

One reason for the lack of appetite from 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

[39] We also study other fund characteristics often associated with performance (see e.g., Cremers and Petajisto, 2009) and find that the funds in our highest correlation decile are smallest by AUM, have the highest turnover and expense ratios, and the highest measured active shares (active share measures are described in Petajisto (2013) and downloaded from http://www.petajisto.net). Motivated by Frazzini, Friedman and Pomorski (2016), we also find that the funds' exposure to month-end reversals is linked to their benchmark type: 12% of small cap funds benchmarked to Russell 2000 are in the highest correlation decile while around 5% of large cap funds benchmarked to Russell 1000 or its value and growth variants are in this decile.

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, 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 (results available from authors). Therefore, it appears that the cash cycle affects the ability of hedge funds to take risk near the month end. In other words, arbitrage vehicles with month-end redemption cycles are ill-designed to provide liquidity at the month end. 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. [40] [41]

[INSERT TABLE 11 HERE]

While on average the hedge fund industry 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 (betas) to the market on day *T-3* (see Table 11). This implies that at least some hedge funds do provide liquidity at *T-4*, counterbalancing the selling pressure from other institutions.[42]

There is furthermore significant time variation in the average hedge fund's propensity to demand or supply liquidity around *T-4*. Specifically, we find that hedge funds on average supply liquidity at month ends (i.e., have a significant positive beta on *T-3*) 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). Interestingly, in times of high funding liquidity, hedge funds seem to increase

[40] Patton and Ramadorai (2013) study day-of-the-month effects in hedge fund risk exposures by including a flexible parametric function in their regression specification.

[41] Our methodology to identify daily excess betas around the turn of the month from hedge funds' monthly returns follows the approach in Jylhä, Rinne and Suominen (2014): we regress hedge funds' monthly returns on the daily returns on the S&P 500 index, for the days *T-5* to *T+5*, and the return on the S&P500 index outside the turn of the month period. The funds' average excess beta on any given day around the turn of the month is the difference between the daily beta and the rest of the month beta.

[42] The evidence regarding liquidity supply is especially strong for Managed Futures funds. This behavior is likely to be related to the low margin requirements (and T+1 settlement) of the futures and options contracts traded by these funds, which enable their managers to hold significant cash reserves at all times.

their stock market betas exactly at *T-3*, implying 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 indicates that the demand for month-end liquidity is still high). Only at times of poor funding liquidity does the hedge fund industry also become a demander of liquidity.

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 11 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 the TED spread exceeds its 97.5th percentile. To complement this analysis, we show in the Internet Appendix that the interaction of the TED spread with *T-8* to *T-4* returns is 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*. Note however, that the return reversals are statistically significant also if we exclude the extreme TED spread observations from our sample.[43]

[INSERT FIGURE 11 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

[43] Similarly, the return patterns around *T-4* documented in Tables 1 and 2 are robust to excluding from the sample the observations that coincide with NBER recessions and just the recent financial crisis (the high TED spread period). See Table A7 in the Internet Appendix.

constraints for 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 -35%) while the end of month rebound from the selling pressure was exceptionally high (cumulative returns approaching +30%). Figure A10 in the Internet Appendix demonstrates the large price pressures following the Lehman bankruptcy.

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 and is 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 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. We also link the reversal to the month-end cash cycle by demonstrating that the reversals are greater at those month ends where the monthly payment cycle coincides with the weekly payment cycle of salaries.

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' limits to arbitrage. 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 are likely to 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 amplify 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 also find that mutual fund flows up to *T-4* significantly affect the size of the return reversals. At an aggregate level, we show that the return reversals near the turn of the month appear to have 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 skills to manage liquidity or other abilities) 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.

References

Amihud, Y. (2002). Illiquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets* 5:31-56.

Ariel, R. (1987). A monthly effect in stock returns. *Journal of Financial Economics* 18:161-74.

Ben-Rephael, A., S. Kandel, and A. Wohl. (2011). The price pressure of aggregate mutual fund flows. *Journal of Financial and Quantitative Analysis* 46:585-603.

Brunnermeier, M., and L. Pedersen. (2009). Market liquidity and funding liquidity. *Review of Financial Studies* 22:2201-38.

Burgess, M. (2014). How frequently do private businesses pay workers? *Beyond the Numbers: Pay & Benefits* 3:1-8.

Cadsby, C., and R. Mitchell. (1992). Turn-of-month and pre-holiday effects on stock returns: Some international evidence. *Journal of Banking & Finance* 16:497-509.

Campbell, J., S. Grossman, and J. Wang. (1993). Trading volume and serial correlation in stock returns. *Quarterly Journal of Economics* 108:905-39.

Carhart, M. (1997). On persistence in mutual fund performance. *Journal of Finance* 52:57-82.

Carhart, M., R. Kaniel, D. Musto, and A. Reed. (2002). Leaning for the tape: Evidence of gaming behavior in equity mutual funds. *Journal of Finance* 57:661-93.

Cremers, M., and A. Petajisto. (2009). How active is your fund manager? A new measure that predicts performance. *Review of Financial Studies* 22:3329-65.

Du, W., A. Tepper, and A. Verdelhan. (2018). Deviations from covered interest rate parity. *Journal of Finance* 73:915-57.

Duffie, D. (2010). Presidential address: Asset price dynamics with slow-moving capital. *Journal of Finance* 65:1237-67.

Dzhabarov, C., and W. Ziemba. (2010). Do seasonal anomalies still work? *Journal of Portfolio Management* 36:93-104.

Fama, E., and K. French. (1992). The cross-section of expected stock returns. *Journal of Finance* 47:427-65.

Farrell, D. and F. Greig. (2016). Paychecks, Paydays, and the Online Platform Economy. JPMorgan Chase & Co. Institute Publication.

Frazzini, A., J. Friedman, and L. Pomorski. (2016). Deactivating Active Share. *Financial Analyst Journal* 72:14-21.

Greenwood, R., S. Hanson, and G. Liao. (2017). Asset price dynamics in partially segmented markets. *Review of Financial Studies* 31:3307-43.

Gromb, D., and D. Vayanos. (2012). Limits of arbitrage: the state of the theory. *Annual Review of Financial Economics* 2:251-75.

Grossman, S., and M. Miller. (1988). Liquidity and market structure. *Journal of Finance* 43:617-33.

Henderson, B., N. Pearson, and L. Wang. (2015). New evidence on the financialization of commodity markets. *Review of Financial Studies* 28:1285-311.

Jylhä P., K. Rinne, and M. Suominen. (2014). Do hedge funds demand or supply liquidity? *Review of Finance* 18:1259–98.

Lakonishok, J., and S. Smidt. (1988). Are seasonal anomalies real? A ninety-year perspective. *Review of Financial Studies* 1:403-25.

Lou, D. (2012). A flow-based explanation for return predictability. *Review of Financial Studies* 25:3457-89.

Lou, D., H. Yan, and J. Zhang. (2013). Anticipated and repeated shocks in liquid markets. *Review of Financial Studies* 26:1891-912.

Lucca, D., and E. Moench. (2015). The Pre-FOMC announcement drift. *Journal of Finance* 70: 329-71.

McConnell, J., and W. Xu. (2008). Equity returns at the turn of the month. *Financial Analysts Journal* 64:49-64.

Mou, Y. (2011). Limits to arbitrage and commodity index investment: front-running the Goldman Roll. Working Paper, Columbia University.

Nagel, S. (2012). Evaporating liquidity. *Review of Financial Studies* 25:2005-39.

Newey, W., and K. West. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica* 55:703-8.

Ogden, J. (1990). Turn-of-month evaluations of liquid profits and stock returns: a common explanation for the monthly and January Effects. *Journal of Finance* 45:1259-72.

Patton, A., and T. Ramadorai. (2013). On the high-frequency dynamics of hedge fund risk exposures. *Journal of Finance* 68:597-635.

Petajisto, A. (2013). Active share and mutual fund performance. *Financial Analysts Journal* 69:73-93.

Puckett, A., and X. Yan. (2011). The interim trading skills of institutional investors. *Journal of Finance* 66:601-33.

Savor, P., and M. Wilson. (2013). How much do investors care about macroeconomic risk? Evidence from scheduled economic announcements. *Journal of Financial and Quantitative Analysis* 48:343-75.

Shleifer, A., and R. Vishny. (1997). Limits of Arbitrage. *Journal of Finance* 52:35-55.

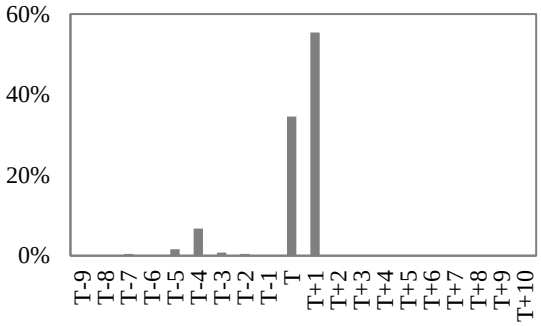
Sias, R., and L. Starks. (1997). Institutions and individuals at the turn-of-the-year. *Journal of Finance* 52:1543-62.

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 days 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 days 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 B is from July 1995 (start of the 3-day settlement period in U.S. equity and corporate bond markets) to December 2013.

A: Pension payment dates



B: Dividend payment dates

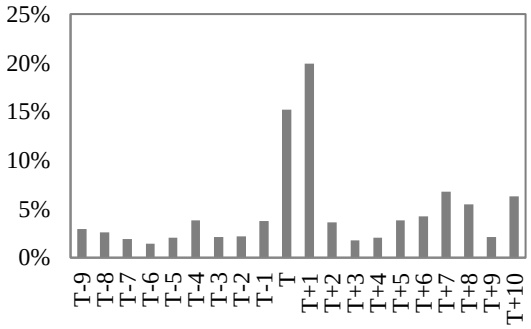


Figure 2
Repo, Libor, and Federal Funds rates around the turn of the month

This figure shows the differences between the Repo (overnight general collateral), Libor (overnight), 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. 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 July 1995 (start of the 3-day settlement period in U.S. equity and corporate bond markets) to December 2013. Sources: FRED (Libor rate and Federal Funds rate) and Datastream (Repo rate).

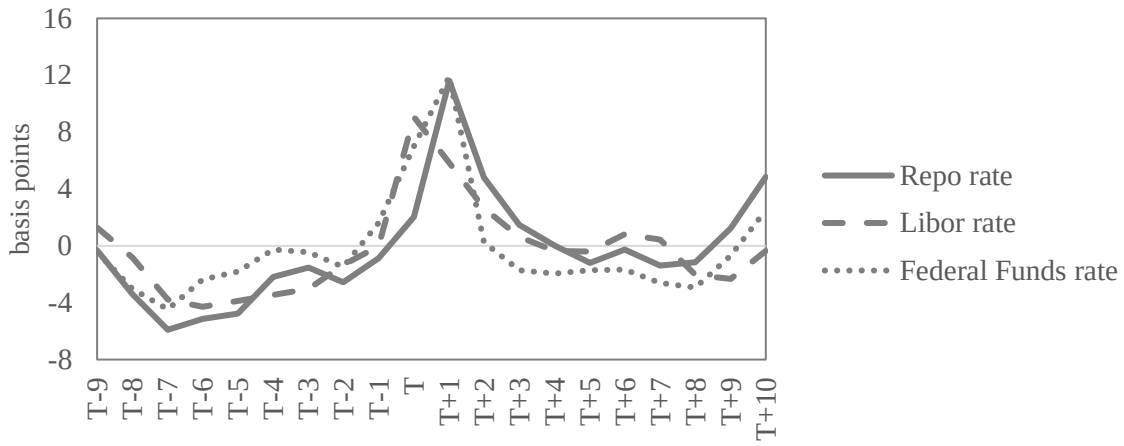
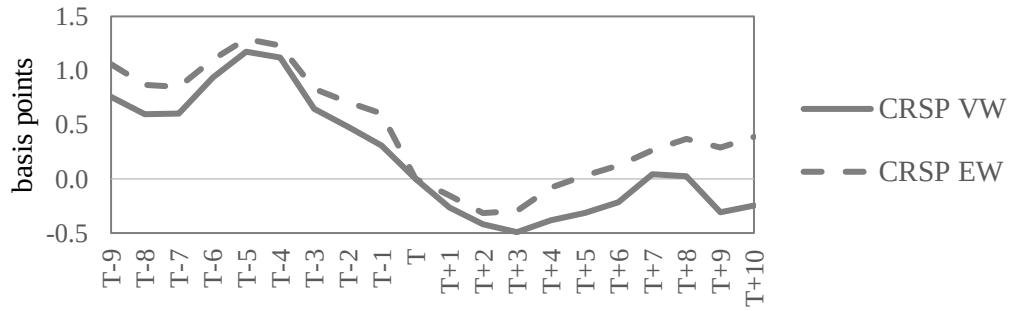


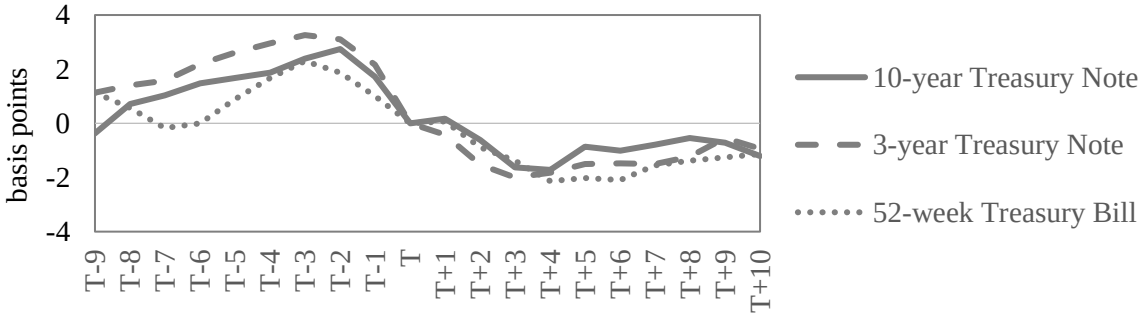
Figure 3
Dividend yields and bond yields around the turn of the month

Panel A shows the dividend yields of CRSP value-weighted and equal-weighted indices in excess of their 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. Due to this restriction, we have excluded 2- and 5-year Treasury notes from our analysis altogether as their auctions are arranged commonly near the end of the month. Day *T* denotes the last trading day of the month. The sample period is from 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

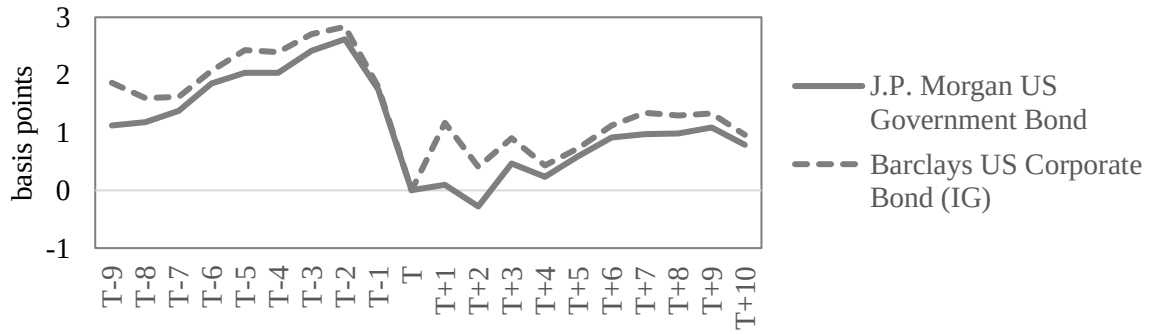


Figure 4
Average daily returns around the turn of the month

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. The sample period is from July 1995 (start of the 3-day settlement period in U.S. equity and corporate bond markets) to December 2013.

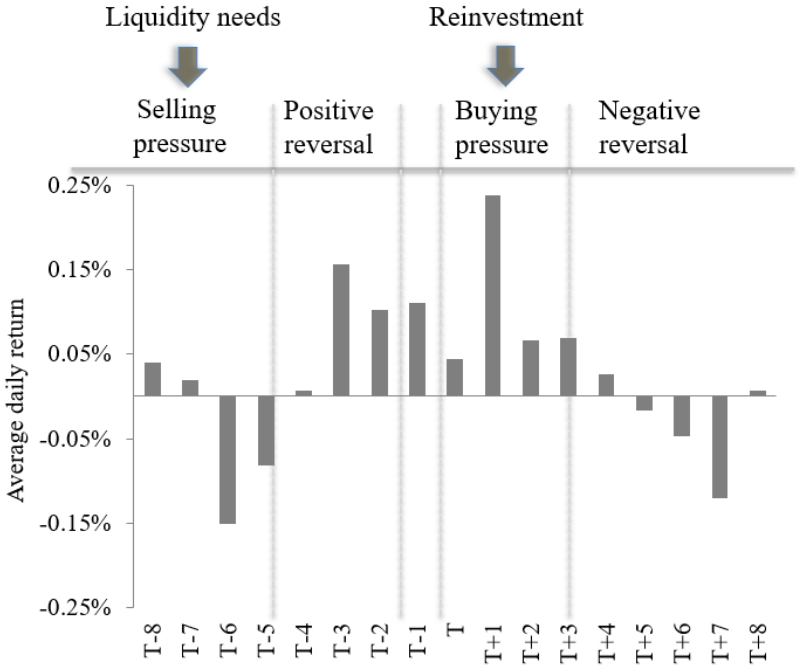


Figure 5
Cumulative stock returns around the turn of the month

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. Day *T* refers to the last trading day of the month. 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 from January 1980 to December 2013. Note the logarithmic scale.

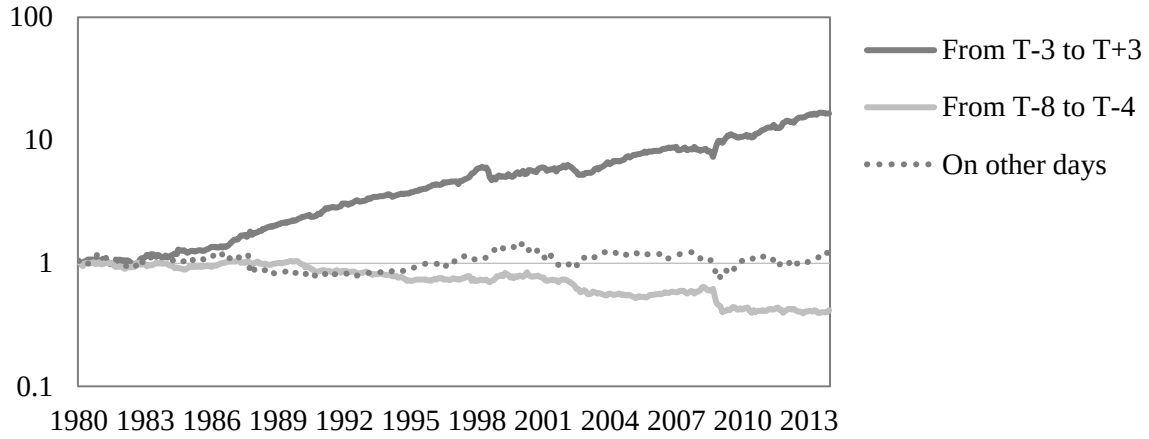


Figure 6
Institutional investors' buy ratios around the turn of the month

This figure shows institutional investors' average daily aggregate buy ratios on specific days around the turn of the month, in excess of their sample average. On any given day, the aggregate buy ratio is defined as the dollar value of institutions' buy transactions divided by the dollar value of their buy and sell transactions. Day *T* denotes the last trading day of the month. The sample includes all institutions in the ANcerno database and the sample period is from January 1999 to December 2013. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

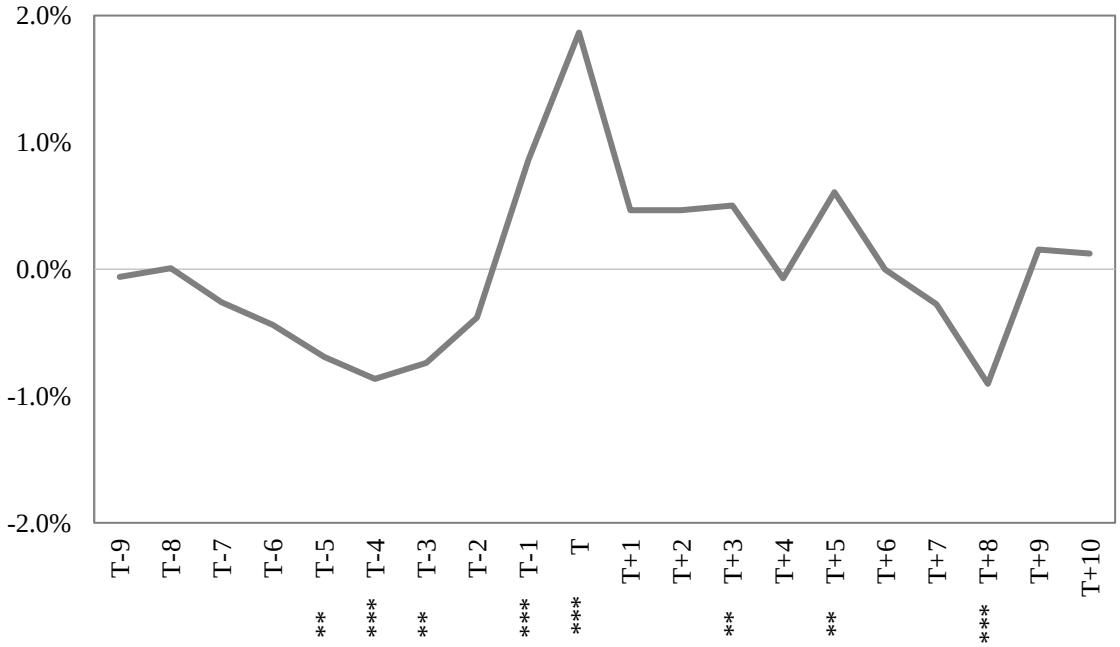


Figure 7
Systematic patterns in institutional trading around the turn of the month

This figure shows for ANcerno institutions, which we classify 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 (relative to the month end) and institution type equals the average of this type of institutions' signed volumes during the relevant days in excess of the same institutions' 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*. This time interval is selected for the identification of liquidity demanders based on Figure 6, where the institutions' month end selling is found to be significant on days *T-5* to *T-3*. Day *T* denotes the last trading day of the month. The data are from ANcerno and the sample period is from January 2000 to December 2010. The sample period ends at 2010, the time when Abel Noser stops providing client codes needed to track institutions. *, **, and *** denote the statistical significance of liquidity demanders' signed excess volumes at the 10%, 5%, and 1% levels, respectively.

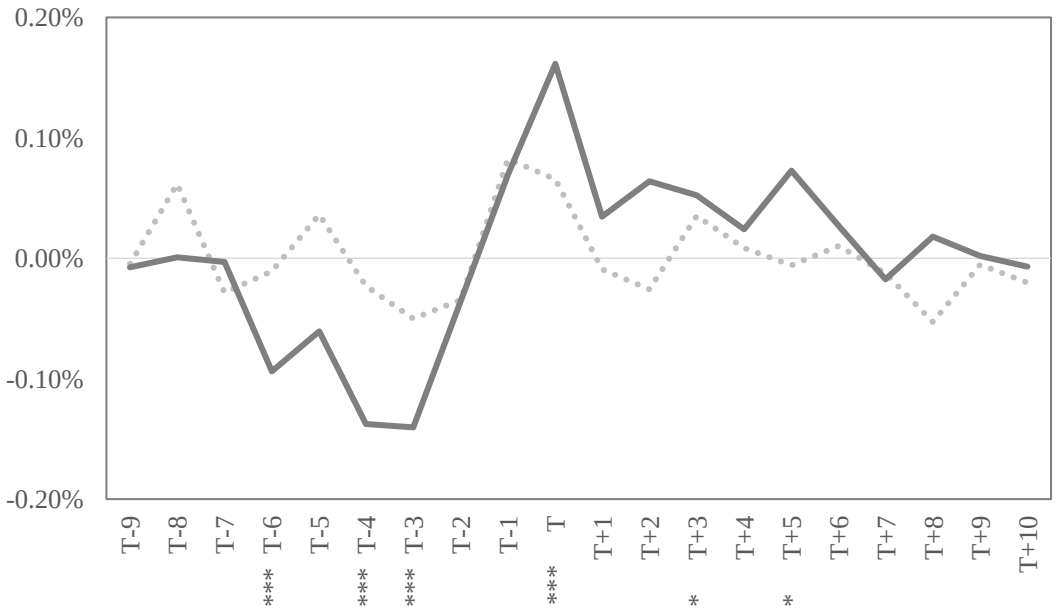


Figure 8

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

This figure shows the 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. The sample consists of all CRSP stocks from July 1995 to December 2013 and the decile portfolios are formed using the Thomson Reuters Mutual Fund Holdings database. 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, i.e., stocks that have the highest mutual fund ownership. *T* refers to the last trading day of the month. *, **, and *** denote the statistical significance at the 10%, 5%, and 1% levels, respectively.

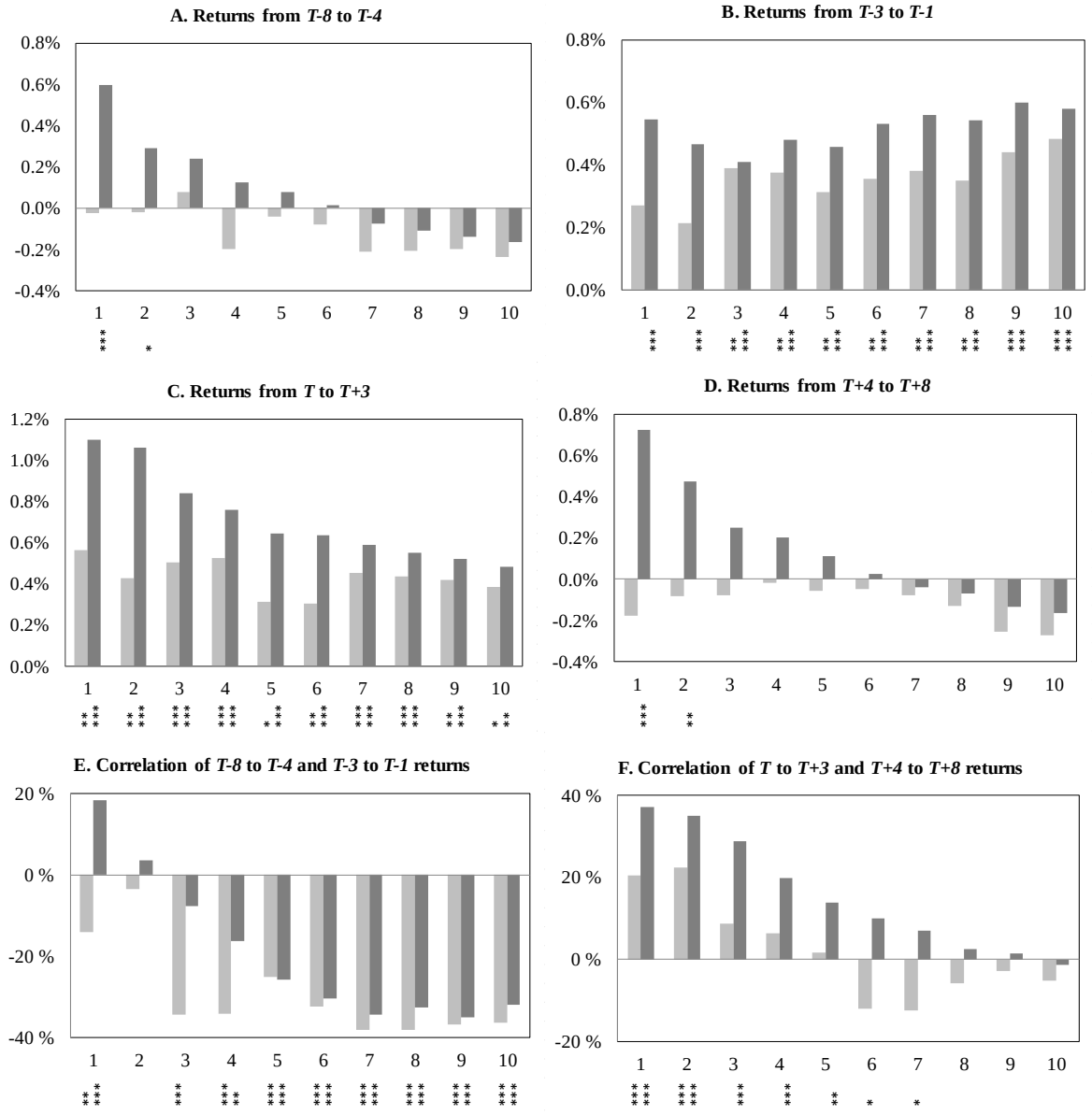


Figure 9
Mutual fund ownership and the correlation between *T-8* to *T-4* and *T-3* to *T-1* returns across countries

This figure shows mutual funds' domestic stock holdings as a percentage of total market capitalization (dark bar) and the correlations between *T-8* to *T-4* and *T-3* to *T-1* stock market returns for different countries (dotted line, reprinted from Table 2). 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.

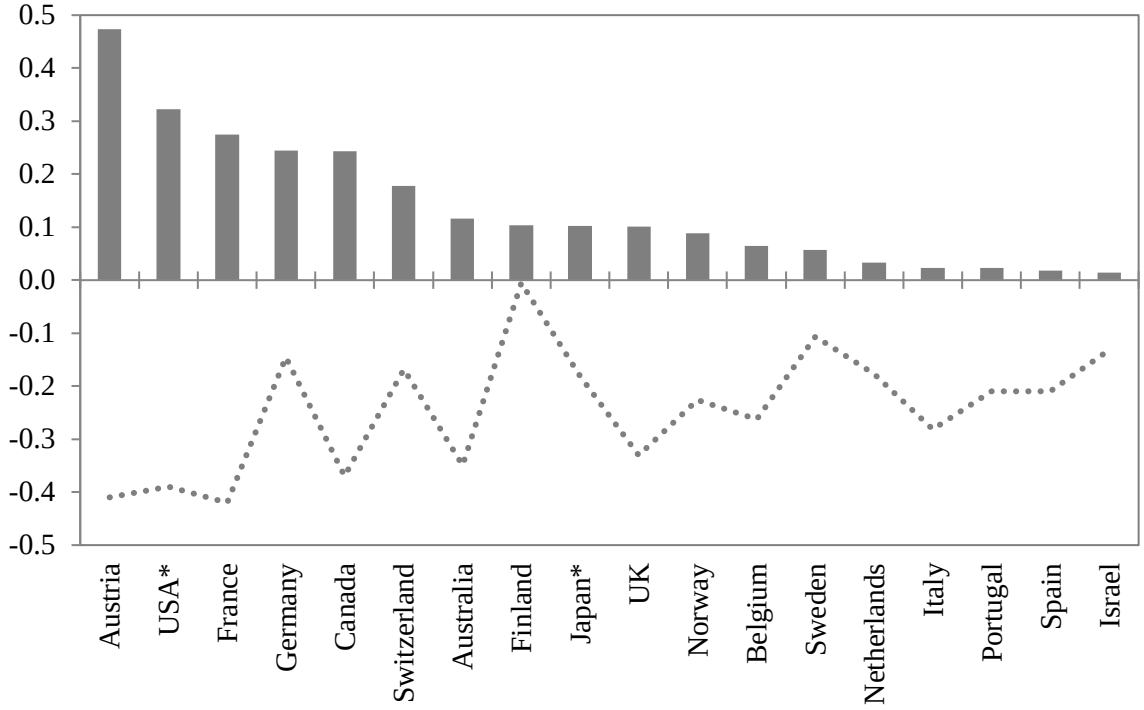
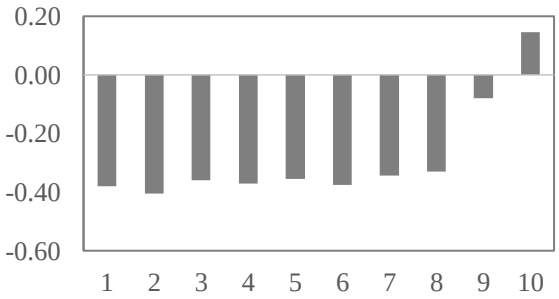


Figure 10
Stock-level liquidity, size, and turn of the month return patterns

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 (2002) *ILLIQ* measure (the 10th being the most illiquid). Panel B shows the same correlations for stocks sorted into deciles based on their market capitalization (the 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.

A: Stock-level liquidity and *T-8* to *T-4* and *T-3* to *T-1* return correlation



B: Size and *T-8* to *T-4* and *T-3* to *T-1* return correlation

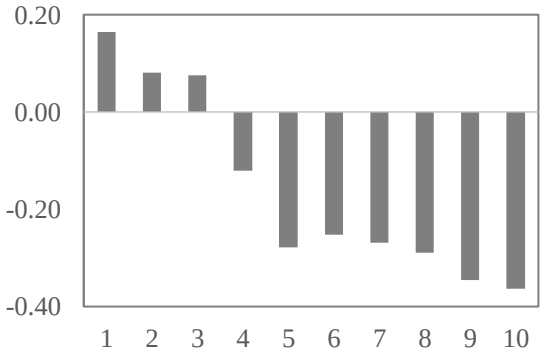


Figure 11
Correlation between *T-8* to *T-4* and *T-3* to *T-1* returns

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. 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 from July 1995 to December 2013.

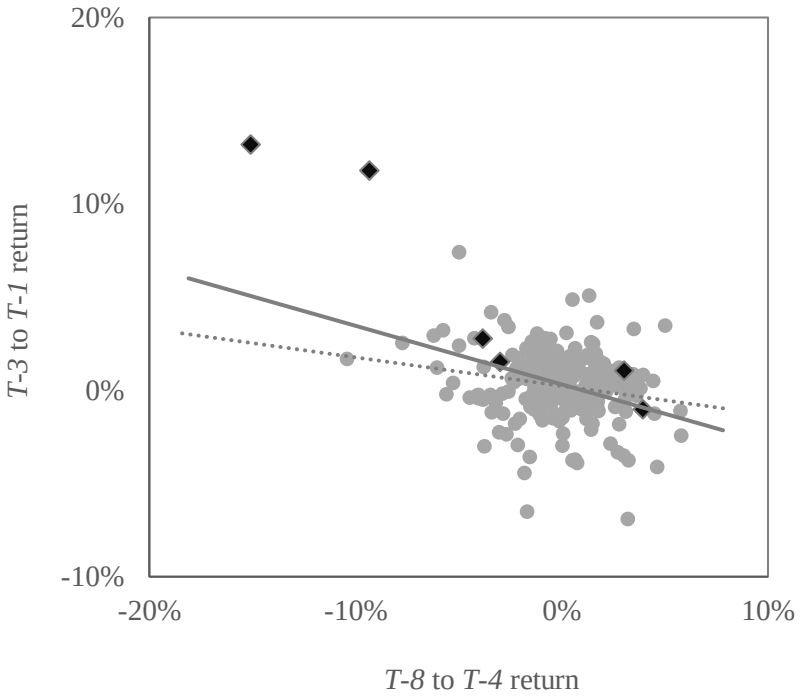


Table 1
Stock market returns near the turn of the month around the world

This table presents average daily stock market returns near the turn of the month in the United States as well as in other developed countries as defined by FTSE, MSCI, and S&P. *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 3-days 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 (days)**	**Sample starts**	From *T-8* to *T-4*	From *T-3* to *T-1*	On *T*	From *T+1* to *T+3*	From *T+4* to *T+8*	Average daily return
United States (S&P 500)	3	Jul-95	-0.04%	**0.11%**	-0.04%	**0.13%**	-0.03%	**0.04%**
United States (CRSP VW)	3	Jul-95	-0.03%	**0.12%**	0.04%	**0.12%**	-0.03%	**0.04%**
United States (S&P 500)	5 or 3	Jan-80	-0.01%	**0.11%**	0.08%	**0.13%**	-0.01%	**0.05%**
United States (CRSP VW)	5 or 3	Jan-80	-0.02%	**0.11%**	**0.14%**	**0.13%**	-0.01%	**0.05%**
Other developed countries								
Australia (S&P/ASX200)	3	Feb-99	-0.02%	**0.14%**	0.10%	0.09%	-0.02%	**0.04%**
Austria (ATX)	3	Feb-98	0.00%	**0.18%**	0.17%	**0.19%**	-0.07%	0.04%
Belgium (BEL20)	3	Jan-90	-0.05%	0.06%	**0.20%**	**0.15%**	-0.03%	**0.03%**
Canada (S&P/TSX C)	3	Jul-95	0.00%	0.06%	**0.21%**	0.09%	-0.03%	**0.04%**
Denmark (OMXC20)	3	Dec-89	-0.06%	0.07%	**0.14%**	**0.18%**	0.00%	**0.04%**
Finland (OMXH25)	3	Jan-91	-0.02%	0.12%	**0.33%**	**0.16%**	-0.02%	**0.06%**
France (CAC40)	3	Oct-00	-0.07%	**0.18%**	0.15%	0.07%	-0.11%	0.01%
Ireland (ISEQ OVER)	3	Mar-01	-0.05%	0.02%	**0.35%**	**0.17%**	-0.05%	0.01%
Italy (FTSE MIB)	3	Jan-98	-0.06%	**0.12%**	0.09%	0.08%	-0.07%	0.02%
Japan (NIKKEI225)	3	Jan-80	0.01%	**0.11%**	0.11%	0.07%	-0.06%	0.02%
Netherlands (AEX)	3	Jan-83	0.00%	**0.07%**	**0.15%**	**0.18%**	-0.02%	**0.05%**
New Zealand (NZX50)	3	Jan-01	0.00%	**0.12%**	**0.25%**	**0.07%**	-0.04%	**0.03%**
Norway (OBX)	3	Jan-87	-0.02%	0.07%	**0.26%**	**0.17%**	-0.02%	**0.05%**
Portugal (PSI-20)	3	Dec-98	-0.08%	0.05%	**0.14%**	**0.12%**	-0.01%	0.00%
Singapore (STI)	3	Sep-99	-0.02%	0.10%	**0.17%**	**0.15%**	0.01%	0.03%
Spain (IBEX35)	3	Mar-97	-0.06%	0.11%	0.10%	**0.18%**	-0.07%	0.04%
Sweden (OMXS30)	3	Jan-86	-0.03%	**0.12%**	**0.16%**	**0.20%**	0.00%	**0.06%**
Switzerland (SMI)	3	Jul-88	-0.04%	**0.09%**	0.11%	**0.15%**	-0.01%	**0.04%**
U.K. (FTSE100)	3	Aug-96	-0.04%	**0.11%**	0.04%	**0.16%**	-0.03%	**0.03%**
Countries with settlement period less than 3-days								
Germany (DAX)	2	Jan-80	-0.03%	0.06%	**0.16%**	**0.21%**	-0.04%	**0.05%**
Hong Kong (HSI)	1 or 2	Jan-80	-0.01%	0.08%	**0.26%**	**0.15%**	0.03%	**0.07%**
Israel (TA-25)	1	Jan-92	0.00%	0.08%	0.17%	**0.17%**	0.04%	**0.06%**
Average of all indices excluding U.S.			-0.03%	0.10%	0.17%	0.14%	-0.03%	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 3-days or shorter. For the U.S., we also show 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 (days)**	**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)	3	Jul-95	**-0.38**	-0.11	**-0.07**	**-0.08**
United States (CRSP VW)	3	Jul-95	**-0.39**	-0.06	**-0.04**	-0.06
United States (S&P 500)	5 or 3	Jan-80	**-0.30**	-0.09	**-0.03**	**-0.05**
United States (CRSP VW)	5 or 3	Jan-80	**-0.32**	-0.03	0.01	-0.02
Other developed countries						
Australia (S&P/ASX200)	3	Feb-99	**-0.35**	**-0.16**	**-0.04**	-0.06
Austria (ATX)	3	Feb-98	**-0.41**	-0.09	**0.06**	-0.01
Belgium (BEL20)	3	Jan-90	**-0.26**	**-0.23**	**0.07**	-0.03
Canada (S&P/TSX C)	3	Jul-95	**-0.37**	0.03	0.00	**-0.09**
Denmark (OMXC20)	3	Dec-89	**-0.38**	-0.02	**0.06**	-0.05
Finland (OMXH25)	3	Jan-91	-0.01	**-0.19**	**0.04**	0.02
France (CAC40)	3	Oct-00	**-0.42**	**-0.18**	**-0.04**	**-0.09**
Ireland (ISEQ OVER)	3	Mar-01	**-0.26**	**-0.32**	**0.05**	-0.05
Italy (FTSE MIB)	3	Jan-98	**-0.28**	-0.04	0.00	-0.01
Japan (NIKKEI225)	3	Jan-80	**-0.18**	0.00	-0.02	-0.02
Netherlands (AEX)	3	Jan-83	**-0.18**	**-0.21**	0.00	0.03
New Zealand (NZX50)	3	Jan-01	-0.03	0.05	**0.05**	0.04
Norway (OBX)	3	Jan-87	**-0.23**	-0.10	**0.03**	0.02
Portugal (PSI-20)	3	Dec-98	**-0.21**	**-0.16**	**0.08**	0.01
Singapore (STI)	3	Sep-99	**-0.35**	-0.06	0.03	0.03
Spain (IBEX35)	3	Mar-97	**-0.21**	**-0.15**	0.02	-0.06
Sweden (OMXS30)	3	Jan-86	-0.11	**-0.11**	**0.04**	-0.02
Switzerland (SMI)	3	Jul-88	**-0.17**	**-0.24**	**0.03**	**-0.07**
U.K. (FTSE100)	3	Aug-96	**-0.33**	**-0.24**	-0.03	**-0.08**
Countries with settlement period less than 3-days						
Germany (DAX)	2	Jan-80	**-0.15**	**-0.15**	0.00	-0.02
Hong Kong (HSI)	1 or 2	Jan-80	**-0.19**	-0.04	**0.03**	**0.08**
Israel (TA-25)	1	Jan-92	**-0.13**	-0.08	0.02	**-0.07**
Average of all indices excluding U.S.			**-0.24**	-0.12	0.02	-0.02

Table 3

Difference in differences test around a 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, 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	**-0.777**	**-0.777**
	(-3.66)	(-3.20)
Treatment group	0.178	
	(1.31)	
After change	0.336	0.336
	(1.80)	(1.51)
Intercept	**-0.313**	
	(-2.84)	
Country fixed effects	No	Yes
N	40	40
R^2	0.397	0.786

Table 4

Return correlations before the turn of the month: Evidence from Treasury yields

This table shows the results from a regression in which the changes in Treasury yields from *T-3* to *T-1* are regressed on the changes in Treasury yields from *T-8* to *T-4*. Here *T* refers to the last trading day of the month. The Treasury yields are those of 52-week Treasury Bill and 3-year Treasury Note. Both regressions include thirteen unreported dummy variables for Treasury auctions that occur in the same maturity during days *T-9* to *T+3*. The dummy variables control for the Treasury auction effects documented in Lou, Yan, and Zhang (2013): significant price pressure during 4 days preceding Treasury auctions and the subsequent 6-day return reversal. The yield data are from Datastream. The sample period is from July 1995 to December 2013.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 = yield change from *T-3* to *T-1*	52-week Treasury Bill	3-year Treasury Note
T-8 to *T-4* yield change	**-0.189**	**-0.186**
	(-2.48)	(-2.58)
Intercept	-0.008	-0.005
	(-1.00)	(-0.69)
R^2	0.081	0.043

Table 5

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 return from *T-3* to *T-1* is regressed on the *T-8* to *T-4* index return, and on institutional investors' net sales during *T-8* to *T-4*. Here, *T* refers to the last trading day of the month. Institutional investors' net sales is defined as the difference between the value of all ANcerno institutions' stock sales and purchases during the days *T-8* to *T-4*, or, alternatively, during the days *T-5* to *T-4*, when the difference is positive, and 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 = market return from *T-3* to *T-1*					
Market return (*T-8* to *T-4*)	**-0.352**			**-0.344**	**-0.344**
	(-2.51)			(-2.71)	(-2.71)
Institutional investors'		35.27		**40.37**	
net sales (*T-8* to *T-4*)		(1.50)		(2.14)	
Institutional investors'			**117.25**		**111.09**
net sales (*T-5* to *T-4*)			(2.53)		(3.49)
Intercept	**0.003**	0.002	0.000	0.001	-0.001
	(2.39)	(0.98)	(-0.09)	(0.32)	(-0.52)
R2	0.184	0.020	0.084	0.209	0.259

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 shown in the parentheses. 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
Returns from	**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)
Returns from	**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
Returns from	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

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 = market returns from *T-3* to *T-1*			
Market return (*T-8* to *T-4*)	**-0.315**	0.627	0.627
	(-2.58)	(1.52)	(1.53)
Mutual fund industry AUM		0.043	0.048
		(1.51)	(0.32)
Interaction of mutual fund industry AUM and market return (*T-8* to *T-4*)		-4.450	**-4.446**
		(-1.96)	(-1.98)
Linear trend			0.000
			(-0.03)
Intercept	**0.003**	0.006	0.006
	(2.55)	(-0.98)	(-0.31)
R2	0.150	0.200	0.200

Table 8

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 fund industry outflow. Here, *T* refers to the last trading day of the month. Mutual fund industry outflow (normalized by the U.S. total stock market capitalization) is defined as the negative of the aggregate net flow to mutual fund industry (equity, hybrid and bond funds; see Footnote 38 for motivation) 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 outflow on *T-8* to *T-4* returns

y = returns from *T-8* to *T-4*		
Mutual fund industry outflow	**-190.00**	**-176.34**
	(-2.87)	(-2.55)
Past 20-day returns		0.052
		(0.53)
Intercept	0.001	0.000
	(0.28)	(0.10)
R^2	0.189	0.193

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

y = returns from *T-3* to *T-1*		
Mutual funds industry outflow	**212.51**	**136.43**
	(4.30)	(2.63)
T-8 to *T-4* return		**-0.345**
		(-3.00)
Intercept	0.002	0.002
	(0.81)	(1.09)
R^2	0.296	0.437

Table 9

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 month based on this correlation. Alphas are calculated using the monthly returns of equal-weighted mutual fund portfolios controlling for standard risk factors with different versions of the following regression: $R_i - R_F = \alpha + \beta_M(R_M - R_F) + \beta_{SMB}R_{SMB} + \beta_{HML}R_{HML} + \beta_{MOM}R_{MOM} + \varepsilon$. Decile 10 contains the funds with the highest correlation in their *T-8* to *T-4* and *T-3* to *T-1* returns. Both daily and monthly mutual fund returns are from CRSP. The sample period is from September 2000 to December 2013. T-statistics are shown below the coefficients in parentheses.

	Mutual fund deciles based on correlation of *T-8* to *T-4* and *T-3* to *T-1* returns										
	1	2	3	4	5	6	7	8	9	10	10-1
CAPM											
Alpha	-2.42%	-2.86%	-2.50%	-1.78%	-0.11%	0.67%	1.50%	3.17%	4.04%	4.84%	7.43%
	(-1.91)	(-2.93)	(-3.22)	(-2.58)	(-0.17)	(0.89)	(1.47)	(2.31)	(2.44)	(2.24)	(2.66)
$R_M - R_F$	1.07	1.13	1.10	1.09	1.06	1.02	1.01	0.99	0.95	0.84	-0.23
	(28.99)	(39.60)	(50.33)	(62.63)	(72.41)	(54.79)	(39.73)	(25.98)	(20.92)	(16.06)	(-3.38)
Fama-French Three Factor Model											
Alpha	-2.48%	-2.65%	-2.56%	-2.10%	-0.90%	-0.51%	-0.11%	0.94%	1.39%	2.37%	4.96%
	(-2.16)	(-3.43)	(-3.84)	(-3.44)	(-1.77)	(-0.91)	(-0.16)	(0.96)	(1.18)	(1.41)	(2.37)
$R_M - R_F$	1.04	1.10	1.07	1.06	1.02	0.99	0.96	0.93	0.89	0.78	-0.26
	(28.24)	(52.87)	(65.45)	(79.97)	(85.45)	(69.12)	(50.45)	(35.54)	(27.10)	(16.85)	(-4.59)
SMB	0.13	0.12	0.14	0.16	0.19	0.20	0.25	0.29	0.33	0.34	0.21
	(2.59)	(3.78)	(3.71)	(5.46)	(8.84)	(8.68)	(9.87)	(8.56)	(8.88)	(5.79)	(2.93)
HML	-0.09	-0.13	-0.09	-0.06	0.01	0.07	0.11	0.20	0.24	0.20	0.29
	(-1.66)	(-3.71)	(-2.96)	(-2.11)	(0.35)	(2.03)	(2.57)	(3.36)	(3.40)	(2.26)	(2.32)
Fama-French Four Factor Model											
Alpha	-2.51%	-2.63%	-2.56%	-2.13%	-0.91%	-0.58%	-0.16%	0.88%	1.28%	2.15%	4.76%
	(-2.13)	(-3.37)	(-3.79)	(-3.46)	(-1.78)	(-1.02)	(-0.22)	(0.87)	(1.05)	(1.24)	(2.18)
$R_M - R_F$	1.05	1.10	1.07	1.06	1.03	1.00	0.97	0.94	0.91	0.83	-0.22
	(26.74)	(46.11)	(51.41)	(62.28)	(66.89)	(54.65)	(43.32)	(30.11)	(23.68)	(15.86)	(-3.29)
SMB	0.13	0.12	0.14	0.16	0.19	0.20	0.25	0.29	0.33	0.34	0.21
	(2.60)	(3.74)	(3.67)	(5.44)	(8.78)	(9.13)	(10.11)	(8.81)	(9.55)	(6.17)	(2.92)
HML	-0.09	-0.13	-0.09	-0.06	0.01	0.07	0.11	0.20	0.24	0.19	0.28
	(-1.65)	(-3.71)	(-3.01)	(-2.19)	(0.34)	(2.03)	(2.56)	(3.32)	(3.38)	(2.27)	(2.30)
MOM	0.01	-0.01	0.00	0.01	0.01	0.03	0.02	0.02	0.04	0.09	0.08
	(0.26)	(-0.50)	(-0.03)	(0.62)	(0.33)	(1.49)	(1.03)	(0.81)	(1.42)	(2.97)	(1.57)

Table 10

Mutual fund characteristics and exposures to month-end return reversals

This table shows the active equity mutual funds' returns and 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 month based on this correlation. *Annualized mutual fund return in excess of the risk-free rate* shows mutual funds' returns during specific days in the calendar month following the ranking month. *Mutual fund portfolio composition* shows the funds' portfolio composition (in %) at the end of ranking month using CRSP data. *Other mutual fund characteristics* shows mutual funds' size (in million USD) at the end of ranking month, 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 month. 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 and fund characteristics of active domestic equity mutual funds are from CRSP. The sample period is from September 2000 to December 2013.

	Mutual fund deciles based on correlation of *T-8* to *T-4* and *T-3* to *T-1* returns										
	1	2	3	4	5	6	7	8	9	10	10-1
Trailing 2-year correlation of *T-8* - *T-4* and *T-3* - *T-1* returns											
Correlation	-0.45	-0.37	-0.34	-0.31	-0.29	-0.26	-0.23	-0.19	-0.14	-0.02	0.43
Annualized mutual fund return in excess of the risk-free rate											
T-8 through *T-4*	-4.51%	-5.25%	-5.01%	-4.79%	-4.44%	-4.04%	-3.87%	-3.32%	-3.09%	-1.99%	2.52%
T-3 through *T-1*	5.29%	5.25%	5.30%	5.62%	6.16%	6.13%	6.63%	7.06%	7.13%	6.91%	1.61%
Other days	0.87%	1.39%	1.43%	1.58%	2.30%	2.61%	2.72%	3.28%	3.76%	3.32%	2.45%
All days	1.35%	1.10%	1.38%	2.07%	3.65%	4.30%	5.07%	6.61%	7.32%	7.72%	6.37%
Mutual fund portfolio composition during the ranking month											
Cash-%	3.47%	3.03%	3.26%	3.28%	3.28%	3.19%	3.24%	3.53%	4.02%	6.57%	3.09%
Equity-%	91.77%	93.03%	93.11%	92.79%	93.42%	93.15%	93.26%	92.58%	91.77%	87.60%	-4.16%
Bond-%	0.62%	0.57%	0.54%	0.55%	0.57%	0.58%	0.65%	0.67%	0.66%	1.38%	0.76%
Other mutual fund characteristics											
Size	1,346	1,625	1,421	1,316	1,241	1,272	1,146	1,156	1,129	884	-462
Median size	251	293	275	259	252	242	239	232	212	193	-58
Active share	78.6%	74.7%	73.9%	73.9%	74.9%	76.0%	79.0%	81.2%	83.5%	87.9%	9.3%
Institutional fund	20.5%	25.3%	26.8%	27.7%	27.5%	27.2%	26.1%	24.4%	22.8%	18.3%	-2.2%
Turnover	113.7%	94.3%	92.0%	91.3%	93.3%	93.8%	93.4%	94.6%	98.2%	134.0%	20.3%
Expense ratio	1.37%	1.26%	1.24%	1.24%	1.26%	1.26%	1.29%	1.31%	1.35%	1.51%	0.14%

Table 11

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 index returns around the turn of the month (*T-5* to *T+5*) 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 July 1995 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	**-0.114**	**-0.078**	**-0.044**	-0.031	**0.145**
	(-16.15)	(-8.90)	(-3.73)	(-0.75)	(4.12)
T-4	**-0.091**	**-0.111**	**-0.216**	-0.084	**0.082**
	(-12.71)	(-11.93)	(-19.20)	(-1.76)	(2.19)
T-3	**-0.025**	**-0.047**	**0.057**	**0.094**	**0.393**
	(-3.75)	(-5.66)	(4.29)	(2.05)	(9.63)
T-2	**-0.087**	**-0.142**	-0.004	-0.065	-0.041
	(-13.28)	(-15.16)	(-0.42)	(-1.88)	(-1.10)
T-1	**-0.062**	**-0.056**	**-0.071**	**0.082**	-0.048
	(-10.42)	(-8.81)	(-7.28)	(2.12)	(-1.08)
T	**-0.177**	**-0.244**	**0.054**	**-0.120**	**-0.128**
	(-21.29)	(-24.89)	(4.10)	(-2.47)	(-2.46)
T+1	**0.136**	**0.249**	**0.048**	0.037	**0.181**
	(20.69)	(30.66)	(5.13)	(0.96)	(4.58)
T+2	**0.259**	**0.381**	**0.176**	0.073	**0.249**
	(33.88)	(37.35)	(18.06)	(1.57)	(6.39)
T+3	**0.168**	**0.231**	-0.010	**0.112**	**0.109**
	(25.01)	(24.17)	(-1.09)	(2.47)	(2.43)
T+4	**0.103**	**0.069**	**0.107**	0.012	**-0.078**
	(16.30)	(8.17)	(12.25)	(0.29)	(-2.48)
T+5	**0.043**	**0.034**	**0.163**	0.006	-0.038
	(5.73)	(3.99)	(13.95)	(0.17)	(-0.93)
N	7,732	5,183	3,853	312	515

Internet Appendix for

Dash for Cash: Monthly Market Impact of Institutional Liquidity Needs

Erkko Etula
Goldman, Sachs & Co.

Kalle Rinne
Mandatum Life

Matti Suominen
Aalto University School of Business

Lauri Vaittinen
Mandatum Life

Contents:

1. **Monthly payment cycle**
2. **Evidence of other systematic trading and return patterns**
3. **Why don't institutions sell already at *T-9*?**
4. **More results on the turn of the month return patterns**
5. **Cross-sectional evidence on turn of the month price pressures**
6. **Mutual fund related price pressures around the turn of the month**
7. **Funding constraints and turn of the month returns**

1. Monthly payment cycle

1.1 Deposits around the turn of the month

Many of the largest non-bank payments are heavily clustered around the turn of the month leading to a large systematic liquidity demand in the economy a few days prior to the month end, as documented in the paper. This monthly payment cycle is reflected in an increase in the amount of deposits in U.S. commercial banks at the turn of the month. Figure A1 shows that aggregate deposits in U.S. commercial banks first decrease during the selling pressure period, from *T-8* to *T-4*, and then increase until they peak at *T+1* (we use *T* to refer to the last day of the month). Deposits revert back to their normal levels after the end of the buying pressure period, i.e., after *T+3*.

[INSERT FIGURE A1 HERE]

Interesting patterns emerge when we analyze separately the amounts of deposits in checking and savings accounts around the turn of the month.[44] [45] Figure A2 shows that checkable deposits rise to abnormally high levels already at *T-4* and remain high until *T+2*, implying that the money cycle ties up cash for almost the entire duration of the high return period, from *T-3* to *T+3*. In contrast, the savings deposits fall toward the end of the month, reaching their lowest level on *T-2* and *T-1*, implying that investors regularly liquidate their savings for end of month liquidity. The savings deposits revert back to normal and beyond in the beginning of the month.

Figure A2 thus shows that on an aggregate level, households, institutions, and companies switch from long-term savings deposits to short-term checkable deposits well before the turn of the month. These monthly changes are both economically meaningful and statistically significant. The economic significance of these systematic, several percentage point changes is clear, as at the end of our sample period in December 2013 the total checkable deposits accounted for 1.5 trillion U.S. dollars and savings deposits 7.2 trillion U.S. dollars. This finding constitutes an additional direct piece of evidence that month-end liquidity needs force investors to liquidate savings (savings deposits) to obtain cash (checkable deposits) prior to the turn of the month in large and significant volumes.

[INSERT FIGURE A2 HERE]

1.2 Obtaining month-end liquidity for turn of the month payments

Figure A3 illustrates the timing of events necessary to obtain end of month liquidity for turn of the month payments.

[44] Checkable deposits consist of all demand deposits and other readily available deposits.
[45] Savings deposits consist of passbook-type savings deposits as well as money market deposit accounts at banks and thrift institutions.

[INSERT FIGURE A3 HERE]

For instance, pension payments due on *T* must be in the recipients' accounts in the morning of the last day of the month (NACHA operating rules). To make these payments, funds need to have cash in their account at the end of the day *T-1* and thereby sell stocks by the market close on day *T-4* (cash settled by the market close on day *T-1*). On the other side, investors receiving cash on the morning of *T* can provide liquidity from the morning of day *T-3* onwards as the purchases need to be paid three days later in the afternoon of day *T*. This creates an overnight liquidity gap in equity markets from the close of *T-4* to the open of *T-3*.[46]

2. Evidence of other systematic trading and return patterns

2.1 Placebo test

To compare the magnitude of the market return reversals around *T-4* to potential return reversals around other days of the month (a "placebo" test), Figure A4 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. 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.[47] 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. In fact, in the next subsection we demonstrate that similar but less pronounced return patterns to those reported in Table 1 of the paper are observable also around the 15th of the month in the U.S. and elsewhere.

[INSERT FIGURE A4 HERE]

2.2 Return patters around the 15th of the month

The placebo test displayed in Figure A4 shows that in addition to our main result – the negative return correlation around *T-4* – the return correlation is statistically significantly negative on *T+7*. We argued

[46] Similarly, investors with payments due on the morning of *T+1* need to sell at the latest at the close on day *T-3;* and those receiving payments on *T+1* can start purchasing stocks on *T-2*.
[47] 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.

in the previous subsection that this coincides with the reversal expected near a second common payment date – the 15th of the month. Table A1 demonstrates that similar but less pronounced return reversal to that documented in Table 2 and return patterns similar to those reported in Table 1 are observable also around the 15th of the month in the U.S. and other countries in our international sample. In unreported tests, we find qualitatively similar effects around the 15th of the month also in bond returns.

[INSERT TABLE A1 HERE]

2.3 Intraday evidence on *T-3*

In the paper, we discuss the result that institutional selling pressure continues until *T-3* despite the fact that on average the market returns are high on that day (see Figure 4 of the paper). 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 should expect some institutions to remain net sellers that day, particularly in the morning. To investigate the investors' intra-day behavior on *T-3*, we compute hourly average excess buy ratios within that day. We find that excess buy ratios are highly negative in the first trading hours of the day, but approach zero by the early afternoon. This intraday evidence is documented in Figure A5. The evidence supports the idea that the negative price pressure from institutional investors' liquidity-related selling disappears during *T-3*, contributing to the high returns observed on that day.

[INSERT FIGURE A5 HERE]

To complement the analysis, we also test whether the S&P 500 index has intraday return reversals around the time when the selling pressure on average disappears according to Figure A5. Indeed, we find significant intraday return reversal on *T-3* between morning and the rest of the day. The correlation between morning and the rest of the day returns is -0.23 and it is significantly different from zero at 5% level.[48] The morning return is calculated from open to 11am and the rest of the day return from 11am to close. The 11am cutoff is selected to match the selling pattern in the ANcerno data shown in Figure A5. Note that the correlation is similar, -0.20, if noon is used instead.

2.4 Evidence of price pressures from liquidity demand

In the paper, we argue that we should expect that the institutions that we identify as liquidity demanders are "marginal investors" that move markets, and their orders are filled at prices that are inferior to

[48] The hourly S&P500 data are from Bloomberg and the sample period is from January 2008 to December 2013.

broader market pricing on a given day. Table A2 below shows such evidence. It appears, that the sales by liquidity demanders during the selling pressure period *T-8* to *T-4* occur below volume weighted average prices, and at more than 2 basis points lower prices than those of the other investors. Similarly, during the buying pressure period, *T* to *T+3,* the liquidity demanders' purchases occur above the volume weighted average prices and at 4 basis points higher prices compared to other investors.

[INSERT TABLE A2 HERE]

3. Why don't institutions sell already at *T-9*?

Why don't investors sell already at *T-9* to avoid the negative returns during the selling pressure period from *T-8* to *T-4*? We suspect the answer lies in agency issues. As argued in the paper, it may be optimal for agents to keep their equity exposure until the end of the last possible selling day that guarantees end of month liquidity, *T-4*, because they may not be punished for this behavior by their principals – but might instead be punished for missing market returns from *T-8* to *T-4* (as improbable these returns might be). Below, we examine two possible explanations for this behavior: reputational concerns and tracking error risk.

3.1 Reputational concerns

For reputational reasons, institutional investors may be reluctant to sell before *T-8* if the returns in the recent selling pressure periods have been positive (and those who rationally sold at *T-9* underperformed the market, thereby damaging their reputations). In line with these expectations, we find that returns from *T-8* to *T-4* are lower and the return reversal is stronger when the average return over the selling pressure periods during the current calendar year has been positive. While the current calendar year can be motivated by the typical reporting or bonus cycle of asset managers, these results are qualitatively similar if we measure past selling pressure period returns over only the last month or the last three months.

As Table A3 shows, most of the negative returns during the selling pressure periods have accrued in months that are preceded by positive returns in the previous selling pressure periods. Similarly, the correlation of *T-8* to *T-4* and *T-3* to *T-1* returns is more negative in those periods and the *T-3* to *T-1* returns are higher. This evidence supports the idea that funds delay selling until *T-8* to *T-4* for reputational reasons.

[INSERT TABLE A3 HERE]

3.2 Tracking error risk

We conjecture that during volatile times institutional investors are more likely to delay their month-end selling until *T-8* to *T-4* in order to minimize deviations from their benchmark indices. Indeed, we find that the turn of the month return reversal is stronger following times of high volatility measured using the past month's daily returns up to *T-9*. As is evident from Table A3, the *T-8* to *T-4* returns are worse and the *T-3* to *T-1* returns higher, and the correlation of returns between these two periods is more negative if market volatility has been high. These results are robust to measuring volatility also using a longer time period such as past three months.

3.3 Combined test of reputational concerns and tracking error risk

To confirm our results, we test both hypotheses – reputational concerns and tracking error risk – also in a regression setting. The results show that positive returns over past selling pressure periods and high market volatility lead to more negative *T-8* to *T-4* returns at 10% and 5% significance levels, respectively (see Table A4). Here, we include past monthly returns as a control to account for autocorrelation in returns. If we regress *T-3* to *T-1* (reversal period) returns on these variables, and use the *T-8* to *T-4* returns as a control, we find that both past selling pressure period returns and market volatility have highly significant effect on the reversal period returns.

[INSERT TABLE A4 HERE]

These results provide indirect evidence that reputational concerns and tracking error risk motivate agents to sell later than what is optimal (which would be to sell at *T-9*). To complete the picture, we examine both above-mentioned motives also using the ANcerno data to obtain more direct evidence on how agency issues delay institutions' month-end selling (see Table A5). More specifically, we run a regression where we regress institutional investors' net sales during the last two days of the selling pressure period (*T-5* to *T-4*) on past selling pressure period's returns, market volatility, and institutional investors' net sales during *T-8* to *T-6*.[49] The results from this regression show that positive past selling pressure period returns and high volatility both increase institutions' selling on *T-5* and *T-4*, i.e., on the very last days that guarantee month-end liquidity (at 5% and 10% significance levels, respectively).[50]

[INSERT TABLE A5 HERE]

[49] Institutional investors' net sales is defined as the difference between the value of the institutions' stock sales and purchases when their sales exceed purchases, and zero otherwise. The figures are normalized by the U.S. total stock market capitalization at the beginning of the selling pressure period. The sample period is from January 1999 to December 2013.

[50] Similar results are obtained if we look at investors' turn of the month selling on days *T-5* to *T-3*, that is, including also the net sales on *T-3* in the regression. Day *T-3* is the last day that guarantees liquidity from equity sales for the first day of the month, the second important payment date for pension funds.

4. More results on turn of the month return patterns

4.1 Turn of the month patterns before July 1995

Our main analysis focuses on the sample from July 1995 onwards because the *3*-day settlement convention was not introduced until June 1995. Before June 1995, there were no official federal rules that mandated a specific settlement cycle even though the *5*-day settlement cycle was adopted as an industry standard beginning on 1968. Prior to 1953, settlement at the American Stock Exchange occurred on the second day after the trade date, and gradually moved to the third day after the trade date in 1953 and to a *4*-day settlement in 1962. In the 1920s, the New York Stock Exchange (NYSE) settled trades based on a one day settlement convention. These different settlement conventions are expected to affect the turn of the month patterns before June 1995.[51]

Table A6 presents the turn of the month returns and correlations for different sample periods dating back to 1926 (the start of the CRSP data). Our main result, the correlation between *T-8* to *T-4* and *T-3* to *T-1* returns, has become monotonically more negative over time. Similarly, the positive reversal period returns are the highest in the most recent sample period. Finally, the average returns over the more recent *T-8* to *T-4* periods are more negative than in the previous fifteen years when *T-5* settlement was dominant.[52]

To conclude, Table A6 shows that the turn of the month patterns have become more pronounced over time. These findings are consistent with the different settlement conventions, smaller role of institutions in the pre- July 1995 sample (see Table 7 in the paper), and a marked decrease in trading costs.[53] One additional factor that may have amplified the turn of the month patterns during the last decades is the gradual adoption of the Automated Clearing House (ACH) payment system over a check-based payment system. The ACH system may also have increased the clustering of the month-end liquidity related equity sales by institutions.

[INSERT TABLE A6 HERE]

[51] See "Securities and Exchange Commission: Securities Transaction Settlement", 58 Federal Register § 52891 (final rule Oct. 13, 1993).

[52] Note that returns over the selling pressure periods and positive reversal periods in the different samples are sensitive to the overall level of stock returns in these samples. As an example, Table A6 indicates that *T-8* to *T-4* returns have been negative not only in the recent post July 1995 sample, but also in the period from 1926 to 1939 and 1960 to 1979. During these periods, however, the average stock market returns were lower (average daily return 0.025% and 0.030% vs. 0.042% from July 1995 to December 2013). Also the returns from *T-3* to *T-1* are significantly lower in these early periods.

[53] Jones (2002) shows that transaction costs in U.S. equity markets have decreased significantly during the 20th century making it more likely for institutions to demand liquidity from the stock markets.

4.2 Turn of the month patterns excluding NBER recessions

In Section 6 of the paper, we show evidence that month-end return reversals get amplified when funding conditions are tight. As documented in the paper, the return reversals are statistically significant however also when funding conditions are not tight. To complement this evidence, we test here whether our results are robust to excluding from our sample NBER recessions, or just the recent financial crisis.

The results in Table A7 show that the returns around the turn of the month are qualitatively similar if we exclude the NBER recession periods. Specifically, the correlation of *T-8* to *T-4* and *T-3* to *T-1* returns remains significantly negative and the relatively poor average returns from *T-8* to *T-4* are followed by high average returns from *T-3* to *T+3*. Similar results prevail if we exclude from our sample only the period of recent financial crisis from January 2008 to June 2009.

[INSERT TABLE A7 HERE]

4.3 Additional international evidence on turn of the month patterns

In the paper, we note that the three countries (Finland, New Zealand and Sweden) where the correlations of *T-8* to *T-4* and *T-3* to *T-1* returns are statistically insignificant are all small and feature pension systems that make a significant portion of payments outside the turn of the month period. Here, we provide more details on the timing of pension payments in these countries. In Finland, a significant part of pensions was paid, until 2013, in alphabetical order throughout the month. In Sweden, a large part of pensions are paid near the middle of the month by law.[54] Finally, in New Zealand the government SuperAnnuation fund has historically followed a 4-weekly payment scheme, while the work and income SuperAnnuation scheme has paid pensions fortnightly.[55] These cross-country findings lend further support to our argument that the return patterns documented in Tables 1 and 2 of the paper are related to month-end liquidity-related selling as driven by the monthly payment cycle.

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

5.1 Mutual fund ownership and turn of the month reversals

In Section 4.2 of the paper, we show that stocks owned in greater proportions by mutual funds exhibit more pronounced turn of the month patterns. In this section, we repeat the analysis for a restricted sample that includes only institutional mutual funds. The sample is shorter than the one used in Figure 8 as the institutional fund data are available only from 1999 onwards.

[54] http://www.riksdagen.se/sv/dokument-lagar/dokument/svensk-forfattningssamling/forordning-2002782-om-ansokan-och-utbetalning_sfs-2002-782

[55] See, e.g., www.gsfa.govt.nz/content/afd1f3e2-9478-4498-89f1-cbd004635ce9.cmr and www.workandincome.govt.nz/map/deskfile/calendars/index.html.

Figure A6 shows that the same patterns as in Figure 8 of the paper prevail in the sample of institutional funds and, as one might expect, the results are even stronger here. Namely, we find that the stocks that are held to a greater extent by institutional 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*. Finally, the correlation between *T-8* to *T-4* and *T-3* to *T-1* returns is more negative and statistically highly significant for the stocks that are more commonly held by these funds. Here, institutional funds are defined as mutual funds with at least one share class marked as institutional.[56]

[INSERT FIGURE A6 HERE]

5.2 Stock characteristics and turn of the month returns

In Section 4.3 of the paper we claim that the return reversals are largest among liquid but volatile stocks. Figure A7 presents this evidence.

[INSERT FIGURE A7 HERE]

We argue that sophisticated investors should try to avoid end of month trading costs by focusing their end of month liquidity related selling on liquid stocks to minimize price impact and transaction costs. In the paper, in support of that idea, we show 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 (see Figure 10). Here, we extend our analysis by looking at investor behavior using the ANcerno data.

ANcerno data confirms that institutional investors mainly sell liquid stocks between *T-8* and *T-3*. Concretely, we first calculate the institutional buy ratios, similarly as in Figure 6 of the paper, for the most liquid stocks (i.e. the lowest decile of stocks based on Amihud Illiquidity measure) and for other stocks (other deciles) separately. The results in Figure A8 show that month-end selling is stronger for liquid stocks: the excess buy ratios of the most liquid stocks are significantly negative in *T-6*, *T-4* and *T-3* with 10%, 1% and 1% significance levels, respectively. The excess buy ratios of the other stocks instead are not statistically significantly negative during the selling pressure period except on *T-3*, when the excess buy ratio is significantly negative at 10% level. Note however that more generally the institutions are mainly trading the most liquid stocks, as their share of institutional trading volume is 62% in our data. The results are similar if we define liquidity by the stocks' market capitalization instead of the Amihud Illiquidity measure.

[56] The results are robust to using an alternative measure of institutional mutual fund holdings: mutual fund holdings multiplied by the share of the institutional share classes of the funds' total assets under management.

[INSERT FIGURE A8 HERE]

6. Mutual fund related price pressures around the turn of the month

6.1 Evidence from mutual fund betas and return volatility around the turn of the month

In this section, we provide additional evidence that mutual funds increase their cash holdings before the turn of the month to meet their month-end cash demands. First, we estimate the market betas of mutual funds for days around the turn of the month. Table A8 shows that the average betas of mutual funds are abnormally low from *T-5* to *T-3*. We hypothesize this reflects the average mutual fund's need to sell assets prior to *T-4* to meet its month-end cash demands.[57]

Next, we calculate for each day the cross-sectional daily return volatility within our sample of mutual funds. Figure A9 shows that mutual funds' return volatility decreases toward the month-end although there is no corresponding decrease in market volatility. This finding can also be linked to the average mutual fund's tendency to accumulate cash to meet its payments near the month-end.

[INSERT FIGURE A9 AND TABLE A8 HERE]

6.2 Mutual fund flows and price pressures in bond markets

In Table 4, we show that Treasury bonds also experience significant return reversals between *T-8* to *T-4* and *T-3* to *T-1*. The fact that the return reversals in treasuries coincide with those in the equity market suggests that selling pressure in the treasury market is affected by settlement conventions in equity and corporate bond markets (3-day during our sample period), in addition to those in the Treasury bond market themselves (1-day).

Table A9 also provides additional evidence on the impact of institutional trading on month-end return reversals, as it shows the impact of aggregate mutual fund industry outflows on Treasury bond yield changes. Specifically, we regress Treasury bond yield changes over the reversal period (*T-3* to *T-1*) on mutual fund industry outflow up to *T-4*, controlling for yield changes over the selling pressure period (*T-8* to *T-4*). Mutual fund industry outflow is defined as the negative of the net flow to all mutual funds (equity, hybrid and bond funds; see footnote 38 of the paper for motivation) from the first Wednesday of the month until the last Wednesday before *T-3* (normalized by total stock market capitalization). The results show that the past mutual fund industry outflow significantly explains the month-end *T-3* to *T-1* yield changes for treasuries, consistent with the price pressure hypothesis. Also

[57] We estimate mutual funds' betas using daily mutual fund returns from the CRSP Mutual Fund Database and daily S&P500 index returns from the CRSP. More detailed, the average market betas of mutual funds are obtained from fund specific regressions where mutual funds' daily returns (excess of the risk-free rate) are regressed on daily S&P 500 index returns (excess of the risk-free rate), dummies for days corresponding to their location relative to the turn of the month, and their interactions. The average coefficients of the interaction terms show the mutual funds' excess betas and reveal systematic variation in mutual funds' betas around the turn of the month.

here, the explanatory powers are considerable, up to 50% (40% when ignoring the dummy variables). Consistent with our cross-sectional results showing the return reversals around *T-4* are stronger among liquid stocks as investors prefer to sell assets with smaller price impacts, also the bond reversal results are stronger at the short-end of maturity spectrum which typically commands higher liquidity.

[INSERT TABLE A9]

6.3 Mutual fund alphas and exposure to month-end return reversals

Table 9 of the paper provide evidence that links the performance of equity mutual funds to their exposures to month-end return reversals. More detailed, we find that alphas are significantly larger for those funds whose past returns revert the least around *T-4*. Here, in Table A10, we provide additional test results that demonstrate the robustness of our findings.

[INSERT TABLE A10]

First, Table A10 shows that our results are robust to using mutual funds' asset under management to weight fund returns in the deciles of funds ranked by their *T-8* to *T-4* and *T-3* to *T-1* return correlation, instead of equal weighting. Again, the results show that mutual funds that are less exposed to month-end return reversals perform better than highly-exposed funds. Second, we demonstrate that the regression results are robust to controlling also for the short-term return reversal factor *ST_Rev* from Ken French's website. Finally, we show that the results are robust to updating fund portfolios annually rather than monthly. This finding is consistent with our unreported finding that the correlation ranks are persistent among funds in the extreme correlation deciles. For example, 38% of the funds in the highest correlation decile remain in that decile and 68% of the funds remain in the three highest deciles over the next 12 months.

7. Funding constraints and turn of the month returns

7.1 The case of the 2008 Financial Crisis

In the paper, we show 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. Figure A10 demonstrates the large price pressures following the Lehman bankruptcy. In the months following the Lehman Brothers bankruptcy, the selling pressure period (*T-8* to *T-4*) returns are exceptionally poor while the subsequent *T-3* to *T-1* returns are exceptionally high.

[INSERT FIGURE A10 HERE]

7.2 Evidence from regression analysis

To examine the role of funding constraints on return reversals near the month-end, we study using regression analysis whether return reversals are higher during periods of high TED spread. Consistent with this, Table A11 shows that the interaction of the TED spread with *T-8* to *T-4* returns is a significant predictor of *T-3* to *T-1* returns.

[INSERT TABLE A11 HERE]

References

Jones, C. (2002). A century of stock market liquidity and trading costs. Working Paper, Columbia University.

Figure A1
Deposits around the turn of the month

This figure shows the average amount of deposits in U.S. commercial banks on specific days around the turn of the month, relative to the average amount of deposits in those banks during the two months surrounding the observation date. Day *T* denotes the last trading day of the month. The deposit data are from FRED. The sample period is from July 1995 (start of the 3-day settlement period in U.S. equity and corporate bond markets) to December 2013.

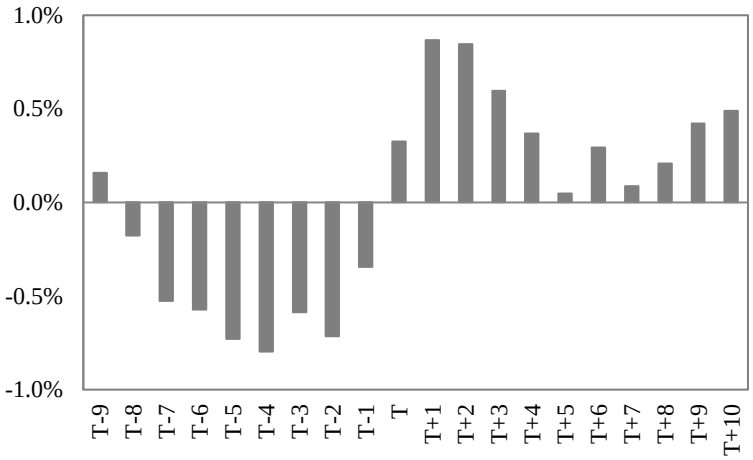
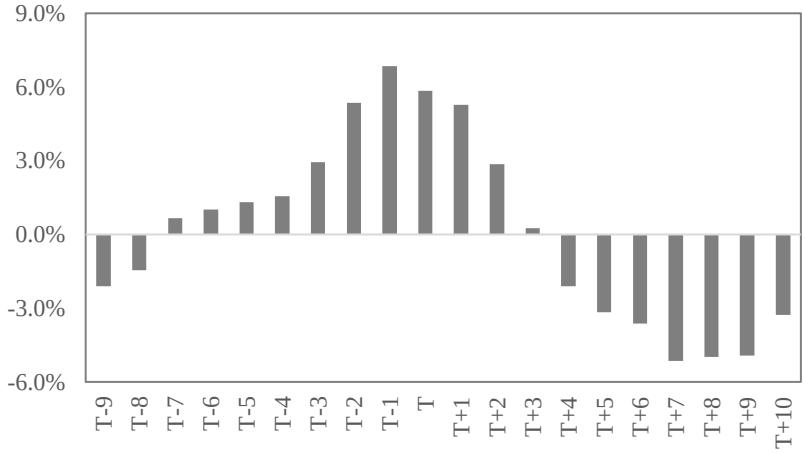


Figure A2
Checkable and savings deposits around the turn of the month

This figure shows the average amount of deposits on specific days around the turn of the month, relative to the average amount of deposits during the two months surrounding the observation date. Panel A relates to checkable deposits and Panel B to savings deposits. *T* denotes the last trading day of the month. Deposit data are retrieved from FRED. The sample period is from July 1995 to December 2013.

A. Checkable deposits



B. Saving deposits

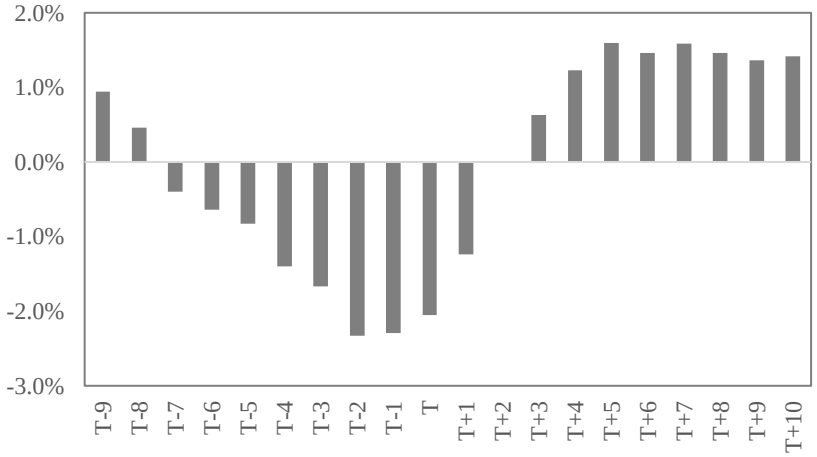


Figure A3
Timing of events around *T-4* and *T-3*

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*.

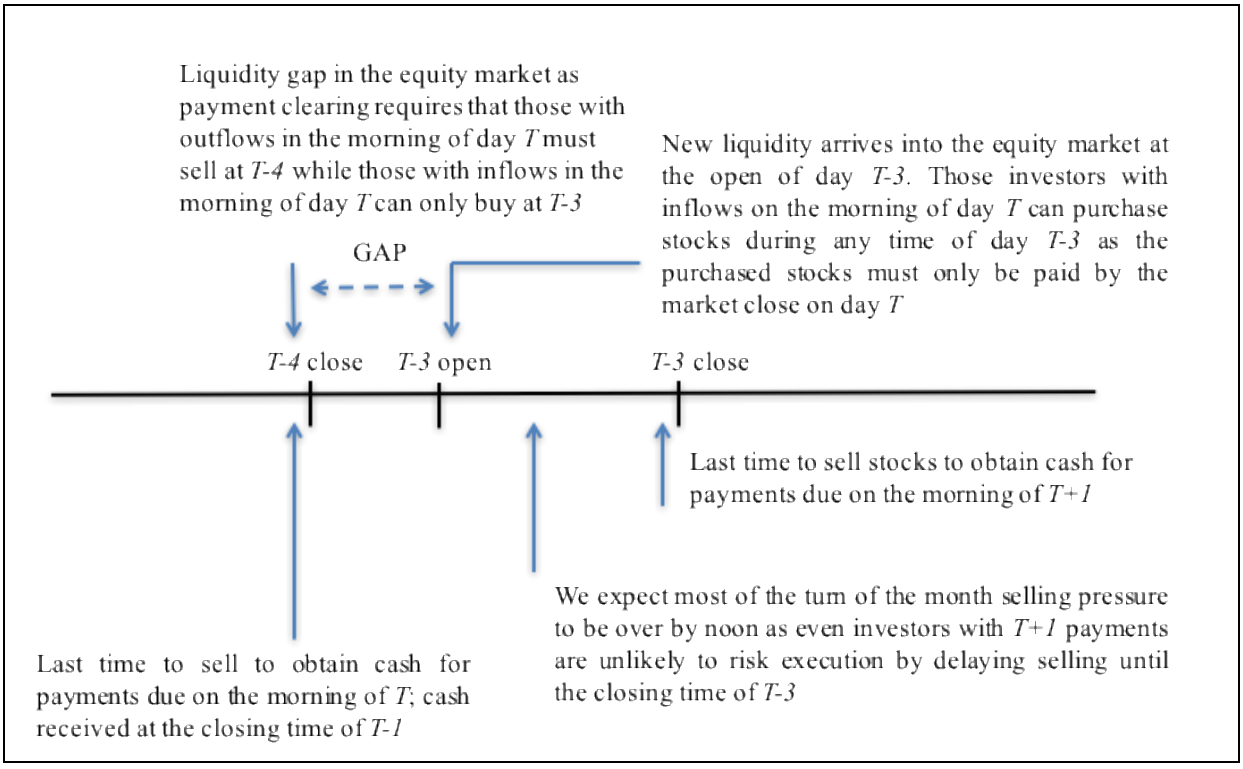


Figure A4
Placebo test: Return reversals around different days of the month

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. Dashed lines denote the critical values for non-zero correlation at the 5% significance level. The sample period is from July 1995 to December 2013.

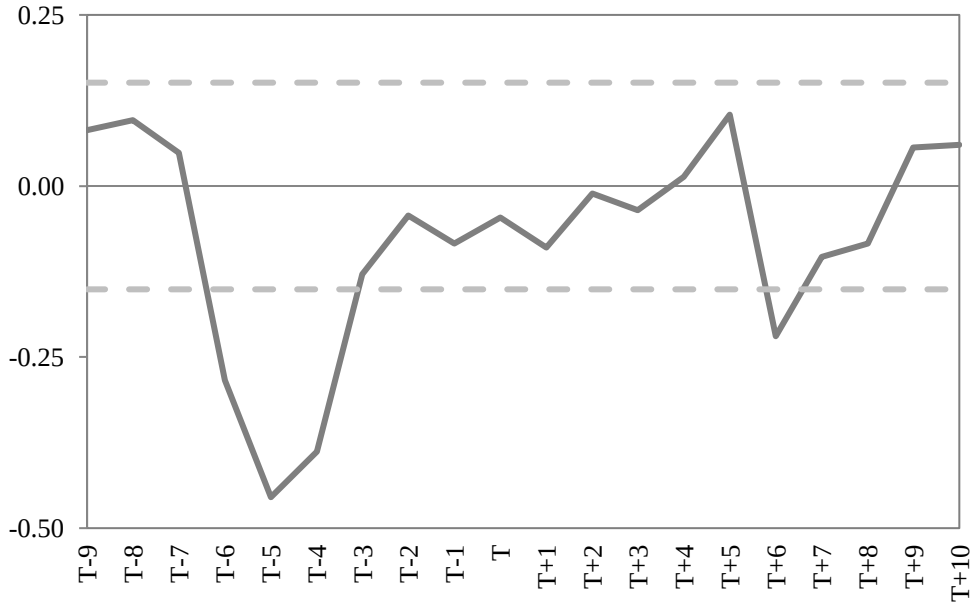


Figure A5

Institutional investors' buy ratios around the turn of the month: Intraday evidence *T-3*

This figure shows institutional investors' average hourly buy ratios on *T-3* and their average daily buy ratios on other days around the turn of the month, in excess of the respective sample averages. Buy ratio is defined as the dollar value of buy transactions divided by the dollar value of both buy and sell transactions during the relevant time period. Day *T* denotes the last trading day of the month. For day *T-3*, time stamp *10H* includes trades from 9.30am until 10.29am, etc. The sample includes all institutions in the ANcerno database and the sample period is from January 1999 to December 2013. *, ** and *** denote the statistical significance at 10%, 5% and 1% levels, respectively.

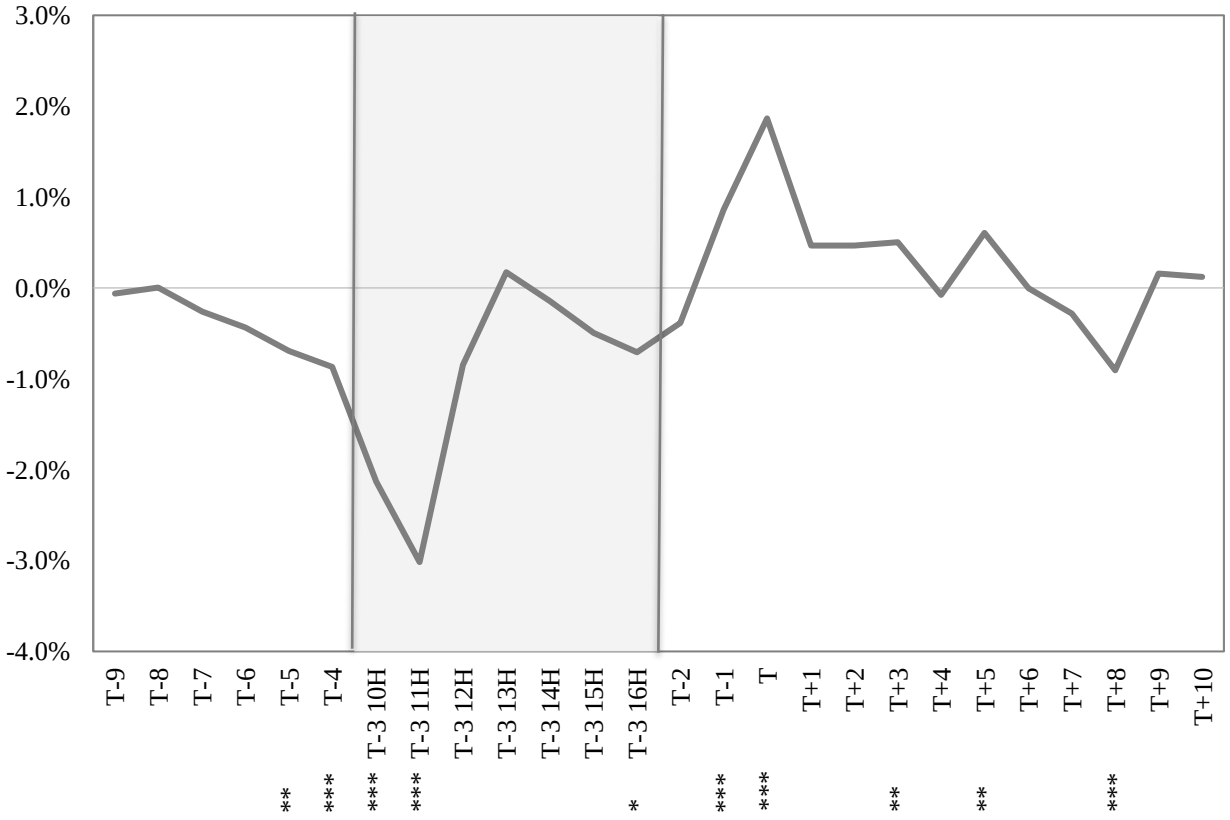


Figure A6
Impact of institutional fund holdings on turn of the month return patterns

This figure shows the value- (light gray) and equal-weighted (dark gray) average returns, and selected correlations of returns, around the turn of the month for deciles of stocks sorted on institutional funds' (mutual funds with at least one share class institutional) total ownership percentages in the previous month. The sample consists of all CRSP stocks from May 1999 to December 2013 (the sample period is limited by the availability of institutional flags), and the decile portfolios are formed using the Thomson Reuters Mutual Fund Holdings database. Panels A to D document the returns over relevant days around the turn of the month for each decile. Panels E and F show correlations of returns. 10 = highest ownership decile, i.e., stocks that have the highest institutional fund ownership. *T* refers to the last trading day of the month. *, **, and *** denote the statistical significance at the 10%, 5%, and 1% levels, respectively.

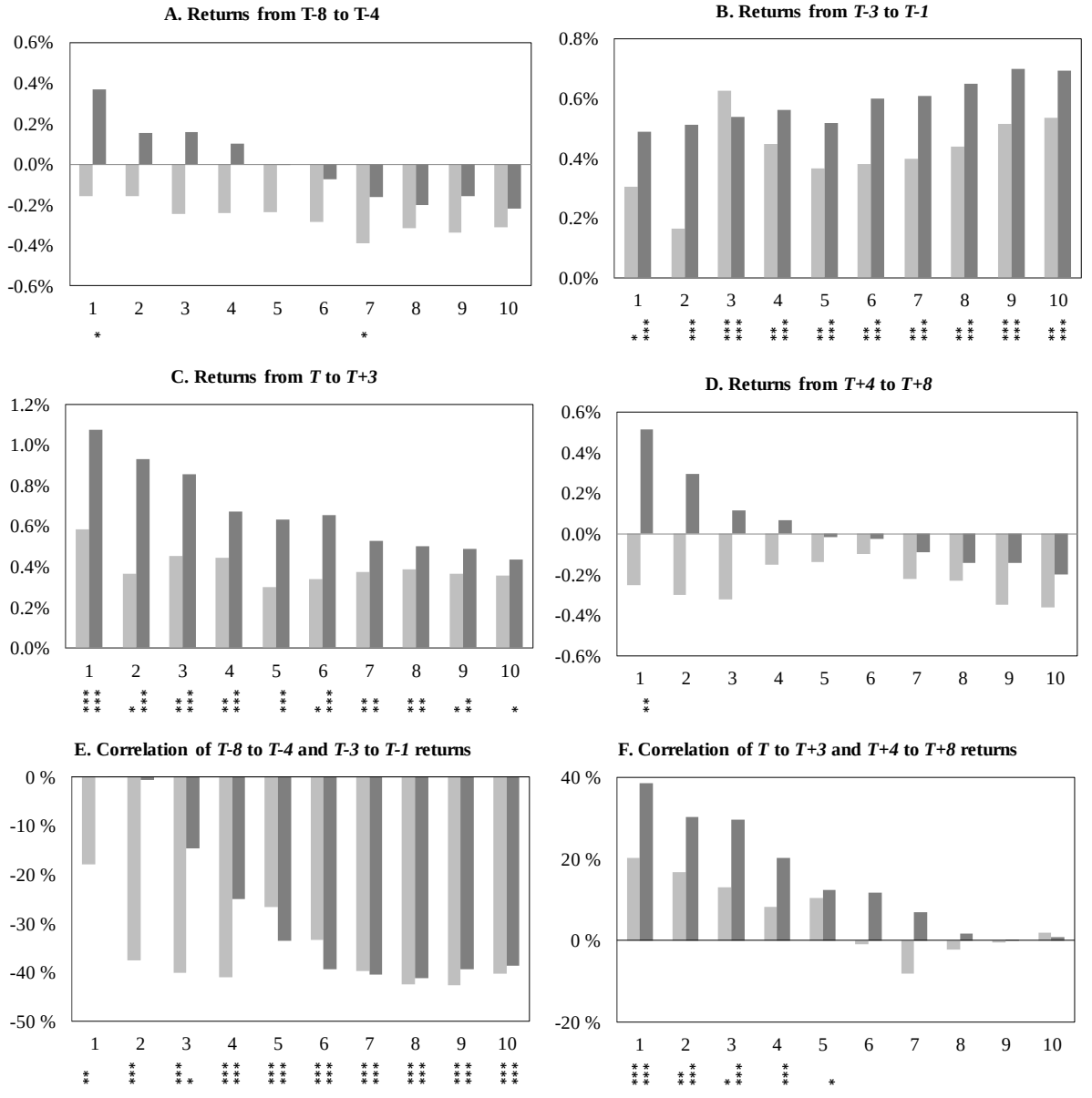


Figure A7
Stock-level volatility and turn of the month return patterns

This figure shows the effect of stocks' past 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 double sort stocks based on their liquidity and volatility. Our sample, covering data from July 1995 to December 2013, includes all stocks in CRSP listed in NYSE or Amex. Volatility is calculated using the last six-month's daily returns until the 10th trading day of the corresponding month. The Amihud (2002) *ILLIQ* measure is calculated as a rolling one-year average until the 10th trading day of the corresponding month. Stocks 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.

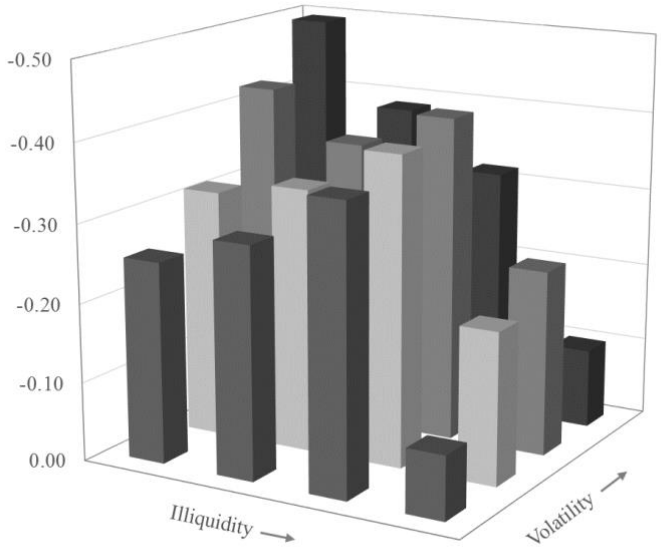


Figure A8
Buy ratios of liquid and illiquid stocks around the turn of the month

This figure shows the buy ratios of the most liquid and other stocks separately around the turn of the month, in excess of the sample average of the institutions' daily aggregate buy ratios within the same liquidity category of stocks. The solid dark gray line shows the buy ratios of the most liquid stocks (decile 1 based on Amihud (2002) *ILLIQ* measure) and the dotted line the buy ratio of the other stocks (deciles 2-10). 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. The data are from ANcerno and the sample period is from January 1999 to December 2013. The Amihud (2002) *ILLIQ* measure is calculated as a rolling one year average until the 10th trading day of the corresponding month. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

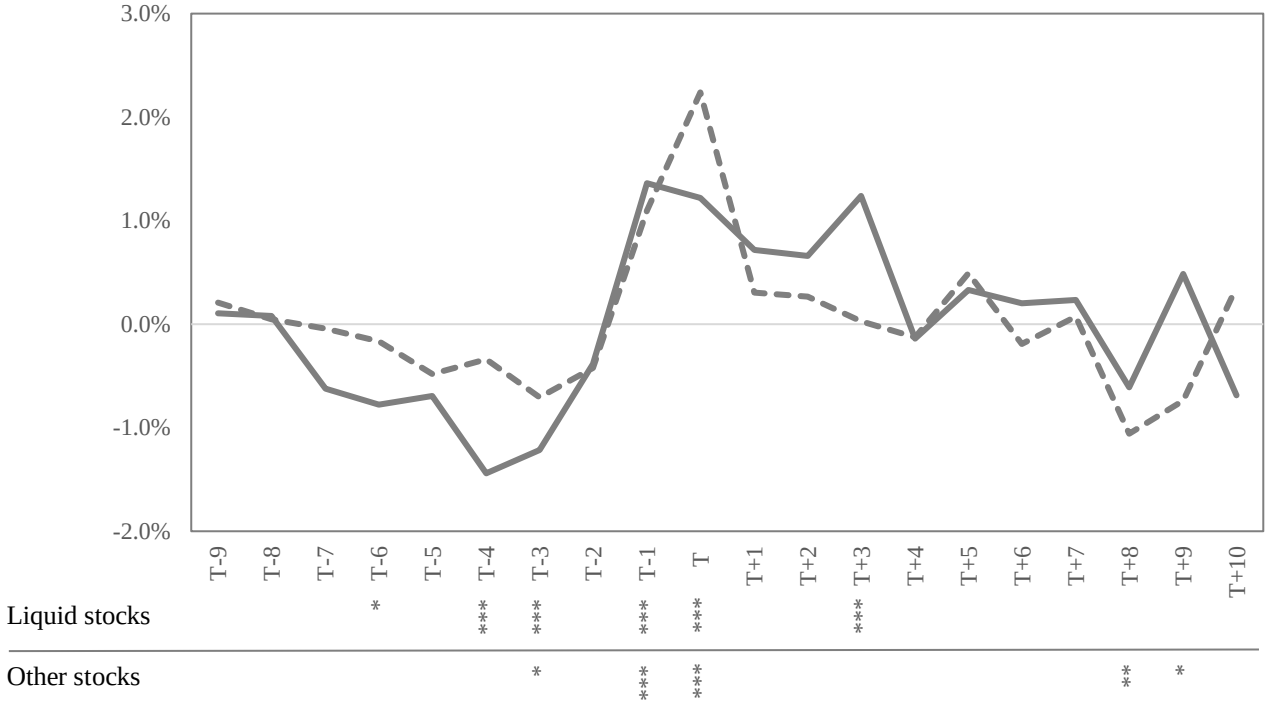


Figure A9
Mutual fund return volatility within a month

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 from September 1998 to December 2013.

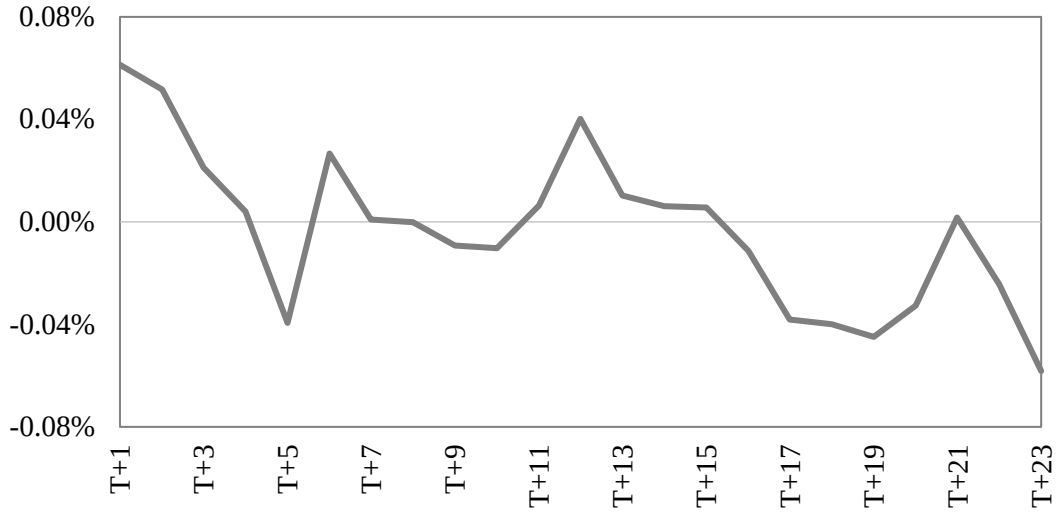


Figure A10
The turn of the month effect around the bankruptcy of Lehman Brothers

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 industry flows (equity and long-term hybrid and bond funds) during the same period (right axis). Sources: Mutual fund flows are from ICI, return data from CRSP, and the Ted spread from Datastream.

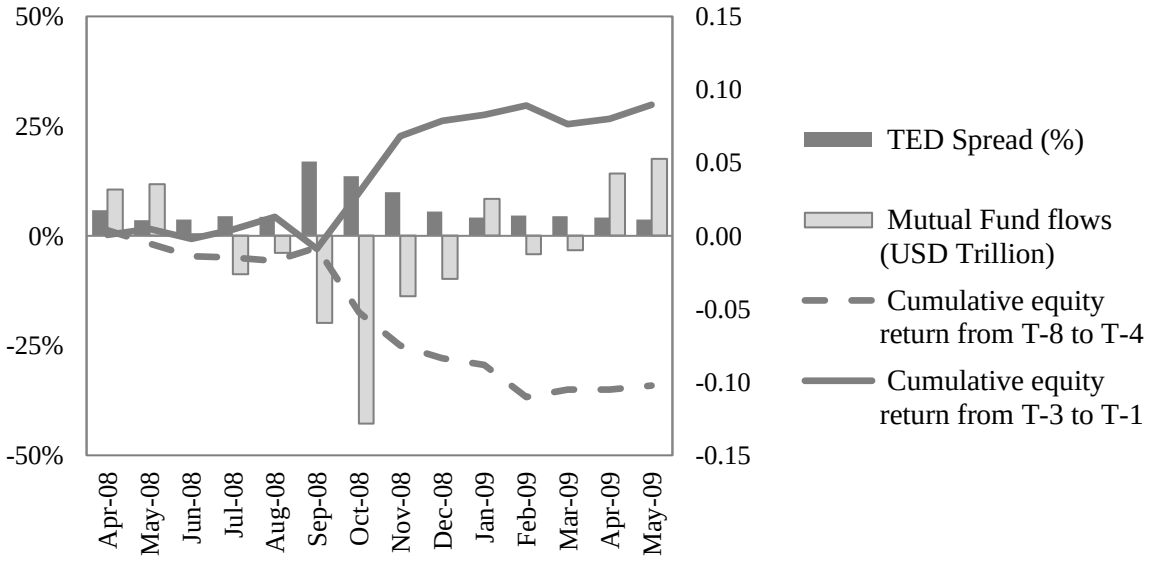


Table A1
Return patterns around the 15th calendar day of the month

Let *S* refer to the last trading day 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 other developed countries, as defined by FTSE, MSCI, and S&P. In addition, the table presents the correlation of the CRSP market returns from *S-8* to *S-4* and from *S-3* to *S-1*, as well as the correlation of the market returns from *S* to *S+3* and from *S+4* to *S+8*. Our sample starts in January 1980 or later as the relevant data become available, and the settlement rule is 3-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**	Returns from *S-3* to *S-1*	Returns on *S*	Returns from *S+1* to *S+3*	Returns from *S-8* to *S-4*	Returns from *S+4* to *S+8*	Correlation of *S-8* to *S-4* and *S-3* to *S-1* returns	Correlation of *S* to *S+3* and *S+4* to *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 developed countries with 3-day settlement rule								
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
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**
Average of all indexes excluding U.S.		0.00%	-0.01%	0.03%	0.03%	0.00%	-0.13	0.02

Table A2
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 during the selling pressure period (*T-8* to *T-4*) and buying pressure period (*T+1* to *T+3*) conditional on the direction of the trade. In the 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 the 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. The data are from ANcerno and the sample period is from January 2000 to December 2010. The sample period ends at 2010 as Abel Noser provides client codes only up to that time. *, ** and *** denote the statistical significance at 10%, 5% and 1% levels, respectively.

Average execution costs		during *T-8* to *T-4*		during *T+1* to *T+3*	
Sales	Liquidity demanders	1.35	***	-0.31	
		(3.48)		(-0.35)	
	Other institutions	-0.91		-0.98	
		(-1.41)		(-1.49)	
Purchases	Liquidity demanders	1.35	***	2.10	***
		(3.28)		(2.97)	
	Other institutions	-1.32	**	-1.90	***
		(-2.38)		(-3.09)	

Table A3

Return patterns before the turn of the month: reputational concerns and tracking error risk

This table presents the correlations of *T-8* to *T-4* and *T-3* to *T-1* returns and the average daily returns of the CRSP value-weighted index before the turn of the month for the entire sample (reprinted from Tables 1 and 2) and subsamples of interest. The first set of subsamples consider reputational concerns by splitting the sample based on the sign of the prior selling pressure period returns (from *T-8* to *T-4*) during the current calendar year. The second set of subsamples consider tracking error risk by splitting the sample based on the market volatility measured using the last 20 daily returns up to *T-9*. Day *T* denotes the last trading day of the month. The sample period is from July 1995 to December 2013. All figures that are statistically significant at 5% level are displayed in bold.

	Correlation of *T-8* to *T-4* and *T-3* to *T-1* returns	Average daily return from *T-8* to *T-4*	Average daily return from *T-3* to *T-1*
Full sample	**-0.39**	-0.03%	**0.12%**
Negative returns in previous selling periods	**-0.34**	0.01%	0.06%
Positive returns in previous selling periods	**-0.42**	-0.09%	**0.20%**
Lower than median volatility	**-0.19**	-0.02%	0.07%
Higher than median volatility	**-0.44**	-0.05%	0.17%

Table A4
Impact of reputational concerns and tracking error risk on the return patterns before the turn of the month

This table shows the results from a regression in which CRSP value-weighted index returns from *T-8* to *T-4* (panel A) or *T-3* to *T-1* (panel B) are regressed on the prior selling pressure period returns (from *T-8* to *T-4*) during the current calendar year, the market volatility measured using the last 20 daily returns up to *T-9*, and preceding market returns. *T* refers to the last trading day of the month. The sample period is from July 1995 to December 2013. T-statistics based on Newey-West (1987) standard errors are shown below the coefficients. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

A. Selling pressure period returns (from *T-8* to *T-4)*

y = market returns from *T-8* to *T-4*						
Monthly volatility	-0.966	*			-1.189	**
	(-1.71)				(-1.99)	
Prior selling pressure period returns			-0.140		-0.369	*
			(-0.91)		(-1.73)	
Past 20-day returns	0.573		1.425		0.526	
	(0.57)		(1.00)		(0.54)	
Intercept	0.008		-0.003		0.010	*
	(1.55)		(-1.18)		(1.81)	
R^2	0.064		0.018		0.084	

B. Positive reversal period returns (from *T-3* to *T-1*)

y = market returns from *T-3* to *T-1*						
Monthly volatility	0.851	**			1.073	***
	(2.29)				(2.95)	
Prior selling pressure period returns			0.114		0.343	**
			(1.08)		(2.48)	
Current selling pressure period returns	-0.264	***	-0.312	**	-0.244	***
	(-3.25)		(-2.54)		(-3.21)	
Intercept	-0.006		0.003	***	-0.007	**
	(-1.59)		(2.83)		(-2.09)	
R^2	0.210		0.154		0.235	

Table A5

Institutional investors' selling activity before the turn of the month

This table shows the results from a regression in which institutional investors' net sales from days *T-8* to *T-4*, or days *T-5* to *T-4*, is regressed on the prior selling pressure period returns and market volatility. In the last specification, where we examine determinants of investors' selling during days *T-5* to *T-4*, we also control for the institutional investors' net sales between *T-8* and *T-6*. *T* refers to the last trading day of the month. *Institutional investors' net sales* is defined as in Table 4: as the difference between the value of all ANcerno institutions' stock sales and purchases during the relevant time period, when this difference is positive, and zero otherwise. These 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. T-statistics based on Newey-West (1987) standard errors are shown below the coefficients. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

y = Institutional investors' net sales from	*T-8* to *T-4*		*T-5* to *T-4*		*T-5* to *T-4*	
Monthly volatility	0.091		1.228	*	1.131	*
	(0.09)		(1.70)		(1.78)	
Prior selling pressure period returns	0.114		0.666	**	0.694	**
	(0.19)		(2.19)		(2.40)	
Institutional investors' net sales from *T-8* to *T-6*					0.115	*
					(1.85)	
Intercept	0.061	***	0.024	***	0.019	**
	(4.43)		(2.91)		(2.16)	
R^2	0.000		0.027		0.045	

Table A6

Return patterns before the turn of the month in different sample periods

This table presents the correlations of *T-8* to *T-4* and *T-3* to *T-1* market returns, and the average daily market returns before the turn of the month for sample periods from July 1995 to December 2013, January 1980 to June 1995, January 1960 to December 1979, January 1940 to December 1959, and January 1926 to December 1939. Day *T* denotes the last trading day of the month. Daily market return data are from CRSP (value-weighted). All figures that are statistically significant at 5% level are displayed in bold.

Sample period	Correlation of *T-8* to *T-4* and *T-3* to *T-1* returns	Average daily return from *T-8* to *T-4*	Average daily return from *T-3* to *T-1*	Average daily return
July 1995 to December 2013	**-0.39**	-0.03%	**0.12%**	**0.04%**
January 1980 to June 1995	-0.13	0.00%	**0.09%**	**0.06%**
January 1960 to December 1979	-0.05	**-0.07%**	0.02%	**0.03%**
January 1940 to December 1959	0.02	0.00%	**0.09%**	**0.05%**
January 1926 to December 1939	0.11	-0.04%	-0.07%	0.02%

Table A7

Turn of the month returns and correlations excluding recessions

This table presents the return correlations and the average daily returns of the CRSP value-weighted index around the turn of the month for the full sample (July 1995 to December 2013), a sample which excludes the NBER recessions (April to November 2001, and January 2008 to June 2009), and a sample that excludes only the Financial crisis (January 2008 to June 2009). Day *T* denotes the last trading day of the month. All figures that are statistically significant at 5% level are displayed in bold.

	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	Average daily return from *T-8* to *T-4*	Average daily return from *T-3* to *T-1*	Average daily return from *T* to *T+3*	Average daily return from *T+4* to *T+8*
Full sample	**-0.39**	-0.06	-0.03%	**0.12%**	**0.10%**	-0.03%
Excluding all NBER recessions	**-0.15**	-0.11	-0.01%	**0.10%**	**0.11%**	0.01%
Excluding the Financial crisis	**-0.16**	-0.11	-0.01%	**0.08%**	**0.11%**	0.00%

Table A8

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 excess market betas are obtained from fund specific regressions where mutual funds' daily returns excess of the risk-free rate are regressed on daily S&P 500 index returns (excess of the risk-free rate), dummies for days corresponding to their location relative to the turn of the month, and their interactions. Daily returns of active domestic equity mutual funds are from the CRSP Mutual Fund database. The sample period is from September 1998 to December 2013. All figures that are statistically significant at 5% level are displayed in bold.

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

Table A9
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 changes in Treasury yields from *T-3* to *T-1* are regressed on the changes in Treasury yields from *T-8* to *T-4*, and on the aggregate mutual fund industry outflow. Here *T* refers to the last trading day of the month. Mutual fund industry outflow (normalized by the U.S. total stock market capitalization) is defined as the negative of the net flow to mutual fund industry (equity, hybrid and bond 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). Both regressions include thirteen unreported dummy variables for Treasury auctions that occur in the same maturity during days *T-9* to *T+3*. The dummy variables control for the Treasury auction effects documented in Lou, Yan, and Zhang (2013): significant price pressure during 4 days preceding Treasury auctions and the subsequent 6-day return reversal. The yield data are from Datastream and the weekly mutual funds' flow data are from Investment Company Institute. The sample period is from January 2007 to December 2013. 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	**-0.287**	**-0.311**
	(-1.99)	(-2.53)
Mutual funds industry outflow		**-484.70**
		(-7.97)
Intercept	-0.027	-0.020
	(-1.77)	(-1.34)
R^2	0.314	0.503

B. 3-year Treasury Note

y = yield change from *T-3* to *T-1*		
T-8 to *T-4* yield change	**-0.313**	**-0.316**
	(-3.25)	(-3.24)
Mutual funds industry outflow		**-182.46**
		(-2.12)
Intercept	-0.014	-0.010
	(-1.50)	(-1.01)
R^2	0.148	0.164

Table A10

Mutual fund alphas and exposures to month-end return reversals: Robustness analysis

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 month (in Panel C every year) based on this correlation. Alphas are calculated using the monthly returns of the mutual fund portfolios, controlling for standard risk factors, with different versions of the following regression: $R_i - R_F = \alpha + \beta_M(R_M - R_F) + \beta_{SMB}R_{SMB} + \beta_{HML}R_{HML} + \beta_{MOM}R_{MOM} + \beta_{ST\_Rev}R_{ST\_Rev} + \varepsilon$. 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 and monthly mutual fund returns are from CRSP. The sample period is from September 2000 to December 2013. T-statistics are shown below the coefficients in parentheses.

	Mutual fund deciles based on correlation of funds' *T-8* to *T-4* and *T-3* to *T-1* returns										
	1	2	3	4	5	6	7	8	9	10	10-1
With AUM-weighted (instead of equal-weighted) returns											
CAPM *Alpha*	-2.78%	-3.15%	-2.68%	-1.48%	-0.30%	0.59%	1.02%	3.42%	3.38%	4.32%	7.29%
	(-2.24)	(-3.28)	(-3.63)	(-2.46)	(-0.52)	(0.74)	(1.02)	(2.47)	(1.97)	(2.22)	(2.65)
FF3 *Alpha*	-2.03%	-2.37%	-2.40%	-1.33%	-0.54%	-0.08%	0.16%	1.58%	1.27%	2.66%	4.77%
	(-2.18)	(-3.34)	(-3.54)	(-2.32)	(-0.92)	(-0.11)	-0.19	(1.53)	(0.94)	(1.59)	(2.30)
FF4 *Alpha*	-2.05%	-2.33%	-2.42%	-1.33%	-0.57%	-0.14%	0.11%	1.53%	1.15%	2.50%	4.64%
	(-2.16)	(-3.28)	(-3.55)	(-2.30)	(-0.95)	(-0.19)	(0.13)	(1.44)	(0.82)	(1.42)	(2.13)
Including a short-term return reversal factor											
CAPM *Alpha*	-2.46%	-2.92%	-2.57%	-1.82%	-0.12%	0.67%	1.52%	3.24%	4.14%	4.85%	7.47%
	(-1.91)	(-2.98)	(-3.32)	(-2.63)	(-0.19)	(0.87)	(1.45)	(2.32)	(2.47)	(2.23)	(2.63)
FF3 *Alpha*	-2.48%	-2.66%	-2.57%	-2.09%	-0.88%	-0.48%	-0.07%	1.02%	1.49%	2.41%	5.00%
	(-2.14)	(-3.43)	(-3.89)	(-3.42)	(-1.70)	(-0.86)	(-0.10)	(1.06)	(1.28)	(1.43)	(2.37)
FF4 *Alpha*	-2.50%	-2.63%	-2.57%	-2.12%	-0.89%	-0.55%	-0.11%	0.96%	1.39%	2.19%	4.79%
	(-2.10)	(-3.38)	(-3.85)	(-3.46)	(-1.71)	(-0.96)	(-0.16)	(0.97)	(1.15)	(1.25)	(2.17)
With annual (instead of monthly) updating of the mutual fund portfolios											
CAPM *Alpha*	-1.23%	-2.62%	-2.11%	-1.62%	-0.99%	-0.26%	0.63%	1.42%	2.43%	4.70%	6.00%
	(-0.97)	(-2.66)	(-2.91)	(-2.56)	(-1.70)	(-0.38)	(0.71)	(1.22)	(1.68)	(2.32)	(2.26)
FF3 *Alpha*	-1.68%	-2.87%	-2.48%	-2.24%	-1.85%	-1.28%	-0.79%	-0.19%	0.72%	2.96%	4.71%
	(-1.32)	(-3.50)	(-4.13)	(-4.32)	(-4.05)	(-2.33)	(-1.31)	(-0.23)	(0.65)	(1.77)	(2.03)
FF4 *Alpha*	-1.52%	-2.75%	-2.42%	-2.23%	-1.86%	-1.39%	-0.91%	-0.41%	0.39%	2.56%	4.14%
	(-1.17)	(-3.31)	(-3.88)	(-4.06)	(-3.91)	(-2.59)	(-1.50)	(-0.50)	(0.36)	(1.53)	(1.80)

Table A11
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 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 = market return from *T-3* to *T-1*	
Market 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