Price Pressure and the Turn-of-the-month Effect: Evidence from Retirement Accounts*

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Abstract

One popular explanation behind the turn-of-the-month (ToM) effect – the fact that stock returns are higher on days surrounding the turn of calendar months – is that people typically get their salaries at this time, and their investment in equities creates price pressure around those days. We test this hypothesis using a hand-collected comprehensive sample of mutual funds contained in 401K retirement accounts in the US, which constitute a substantial chunk of equity investments of the salaried. We find no evidence to support this hypothesis. While the ToM effect is still present in the data, stocks held by retirement funds which get large inflows of capital at ends-of-month do not exhibit a stronger ToM effect. On the other hand, we find evidence that stocks heavily held by retirement account funds have significantly higher returns in the middle-of-the-month. Evidence from Target date funds corroborates both these results.

JEL Classification: G4, G23

Keywords: Retirement Account Flows, Price Pressure, Turn-of-the-month Effect, 401(K) data

I. Introduction

A curious feature of many financial markets has been the existence of a Turn of the Month (ToM) effect – that the average daily return on stocks close to the end of a calendar month is significantly higher than that on other days of the month. In spite of many studies documenting the existence of the effect over the last three decades, there is very little direct empirical evidence regarding its drivers.

One explanation, which has gained much prominence in the media and in industry, comes from Ogden (1990): stock prices surge at the end of the month because most people get their salary around those days, from which they invest some proportion in the stock market. However, Ogden does not provide any direct evidence on this hypothesis, mainly due to a lack of availability of data at the time. Instead, he suggests that ToM returns should vary inversely with the stringency of monetary policy, because the magnitude of the price surge in any month depends on the magnitude of aggregate payments realized, which in turn, depends on the monetary policy. Consistent with this hypothesis, Ogden shows evidence that ToM returns are higher when monetary policy is less stringent. While this evidence is interesting, there are other alternative explanations, which are also consistent with these findings. For example, one alternative is that managers take corporate financial decisions at the end of the month, which makes firms especially risky at these times, and hence, ToM returns reflect due additional compensation for bearing this risk. If managers are more likely to alter firm policy when monetary policy is loose (e.g., Gordon and Shoven, 1982; Barry et al., 2008), then Ogden's evidence is consistent with this explanation as well.

The objective of our study is to provide direct and causal evidence on Ogden's investment-flows-from-salary channel. We do so using information on stocks most heavily held by mutual funds

in retirement accounts, which get substantial passive flows when salaries are deposited into employees' retirement accounts.

In order to do so, we hand collect publicly available data from the SEC's Edgar database on regulatory filings of retirement savings plans (Form 11-K) in the US. The plan filings include information on the mutual funds that are included as savings options, and the aggregate allocation to these funds, for each individual company's 401K plan.

We exploit two well-known facts about 401K funds to motivate our study. First, many investors exhibit an inertia with respect to investments in their retirement plans— they change fund allocations very infrequently. So, we expect large sums of money (a fixed percentage of salary for every employee) to go into these 401K funds at the end of the month. Second, we use the well-known observation that mutual funds, in general, buy more of the same stocks that they were holding previously when they attract more inflows (see e.g., Coval and Stafford, 2007, or Lou, 2012). We use the standard holdings database from Thomson Reuters to identify what stocks the 401K funds were holding. Then, at the ToM, as these retirement funds receive inflows, we expect them to buy more of these stocks that they hold creating the type of pressure Ogden (1990) talks about.

Following this logic, our main test checks whether stocks that are held in greater proportion by 401K mutual funds experience greater ToM effects. If they do, then this will be direct evidence in favor of the personal liquidity view – these 401K funds basically attract passive inflows –which have nothing to do with their underlying stocks, it is just a fixed proportion of people's salary – and this drives up the prices of stocks these funds buy.

We first construct one of the most comprehensive samples of 401K mutual funds, used by retirement plans in the 2000 largest companies, that we hand-collect and hand-match to Thomson

Reuters holdings data. In this dataset, we have detailed information on the usage of 4692 mutual funds used by firms filing 11K forms with the SEC during the 2000-2012 period.

Using this sample, we conduct our tests as follows. First, we document the continued existence of the ToM effect in markets. We find that trading volume is indeed higher at the end of the trading month (Figure 1). When we examine daily returns, we find that the ToM effect still exists, even in the recent period, but primarily on an equal-weighted basis. This means that the effect is stronger for smaller stocks, which is not surprising as most price-pressure studies find larger effects for smaller stocks. At the stock-by-stock level, in terms of economic magnitude, the effect is about 15-20 basis points.

However, we find that the ToM is *not* stronger for high 401k-exposure stocks. If anything, our evidence indicates that the ToM effect is actually slightly weaker (although not significantly so) for stocks that are predominantly held by 401K plans. Figure 2 presents this finding visually. Here we sort stocks into deciles depending on their 401K exposure, and plot the trading-day-of-month returns to each decile and their difference. The key visual in this figure is that high-401K-exposure and low-exposure stocks both have high ToM daily returns, so that their difference is not particularly high during these times. This goes against Ogden's liquidity hypothesis.

While we show that there appears to be no relationship between the proportion of *an average* stock's market cap held by 401K funds and its ToM effect, it is still possible that there is a relationship of the type Ogden proposed for *less liquid* stocks – that are perhaps subject to more month-end- flow-pressure. We take this possibility seriously, and study the interaction between three different liquidity measures and 401K flows in jointly determining the ToM effect. The liquidity measures we use are the Amihud price-impact measure, bid-ask spreads, and the proportion of days with zero returns in the past year. The different liquidity measures convey the same message: First,

the ToM effect is indeed higher for less liquid stocks. So, it is indeed the case that the ToM effect seems to be related to liquidity. However, this relationship does not manifest itself through month-end equity investments related to salary payments in 401K plans. This is evidenced by the fact that when we study the triple interaction between the ToM effect, liquidity, and 401K plan exposure of the underlying stocks, the interaction coefficient is insignificant, with the t-statistic rising above 1 (1.33) in only one of 12 cases.

If price pressure due to heavy buying by funds when they receive month-end payments is causing the ToM effect, this might also leave its trace in trading volumes. In other words, when 401K funds buy stocks heavily at the end-of-the-month, we should see a spike in trading volumes. We examine this hypothesis using differences in ToM volume depending on a stock's 401K exposure. Results are consistent with those in earlier tables on lack of relationship between ToM activity and 401K exposure. The interaction term between ToM and 401K exposure is insignificant, and again, has the wrong sign with respect to the Ogden hypothesis.

Finally, we consider the possibility that our results are simply reflecting our inability to accurately capture retirement fund flows in 401K accounts, or that the noise in our sample/data construction process is too high to uncover the true relationship. This is a possibility that needs to be ruled out using data from outside our hand-collected sample, which is especially prone to such concerns.

To do so, we use a sample of all target date funds in the CRSP database. Target date funds are not only typically used in retirement plans, but they are also often the default allocation in many 401K accounts (Mitchell and Utkus (2012)). Using this target-date fund holdings data, we study the relationship between the exposure to Target date funds and the ToM effect. Weight calculated using target date funds is correlated with the stk401kwt (our main measure constructed using our 401K

sample) with a correlation of 0.168. Since target date funds' holdings are available at the quarterly level, we follow Kacperzczyk, Sialm and Zheng (RFS, 2008) to estimate each funds' month end holdings, and then construct stocks' target date fund exposure (in %).

Our results again paint a very similar picture to our hand-collected data. The ToM effect exists, but is in fact weaker, although not significantly so, for stocks held heavily by target date funds. While target date funds do not cover all flows into retirement accounts – something that we set out to do using our main measure – and our measure may have noise, the strikingly consistent results across these two samples is reassuring.

In sum, we find no evidence to support the hypothesis that systematic month-end flows, related to the monthly *retirement savings* payment cycle, causes the ToM effect. When we look at a well-identified setting of automatic flows into retirement account plans, we find no relationship between month-end payment exposure in 401K plans and the ToM effect. Our evidence, instead, is more consistent with McConnell and Xu (2008), who examined Ogden's hypothesis of personal liquidity using aggregate data, and found that month-end buying pressure is not significantly related to the ToM effect. The key difference in our studies is that McConnell and Xu (2008) had a sample of about 20% of equity funds, whereas our sample is comprehensive – so our study suggests that a lack of econometric power was not driving their results.

Finally, we examine whether there is any evidence at all in the data on price pressure exerted by retirement account flows. On the one hand, these flows are likely to be large, given that most retirement accounts now have 401K options, and most employees have at least some of their retirement savings go into these accounts every month. Such large flows of money might have an impact on asset prices. On the other, the move from directly held retirement savings to investing through many passive and other institutional managers in these 401K funds might imply more

sophisticated strategies employed by these managers to minimize price impact. We find evidence of both in the data. Our evidence suggests that stocks held heavily by retirement funds in our 401K dataset have higher returns in the middle of the trading month, typically around days 10 and 11 (out of a typical 23 trading days in a month). We also find similar evidence when we examine stock held most heavily by Target date funds, again providing some out-of-sample assurance for this result.

Our evidence here is consistent with the view that retirement account managers understand that there is buying pressure surrounding the turn-of-the-month days. To avoid having an even bigger price impact, they avoid the start and the end of the month when they trade retirement flows into the market. This middle-of-the-month effect we document is, to the best of our knowledge, new to the literature.

The rest of the paper is organized as follows. Section II discusses the literature, Section III introduces our data, Section IV presents our main hypotheses, Section V describes our empirical methodology, Section VI discusses our results, and Section VII concludes.

II. Literature Review

Recent research on the Turn-of-the-Month (ToM) effect in equity markets has received considerable attention from academics, practitioners, and policy-makers. This study is closest to Etula et al (2020), who show that the monthly payment cycle induces systematic patterns in financial markets around the world. In particular, they document temporary increases in the costs of debt and equity capital that coincide with key dates associated with month-end cash needs. They also present evidence on the role of institutions in the genesis of these patterns. The main difference between our paper and this study is in our ability to directly link actual retirement account holdings of stocks

through 401(K) pension plans. Once we do that, we do not uncover any evidence consistent with the Etula et al findings are driven by passive flows into retirement accounts.

A pattern related to day-of-the-month returns first appears in Ariel (1987), who uses data from 1963-1981 to show that daily returns at the beginning of the month are greater than those after the 15th. Lakonishok and Smidt (1988) are the first to find strong ToM stock returns on the Dow Jones Industrial Average index for the period 1897-1986. They show that stock returns in the US are significantly higher on turn-of-the-month trading days than on other days. Ogden (1990) shows that this effect is stronger when monetary policy is less stringent. Extending the analysis to nine other countries, Cadsby and Ratner (1992) report that the ToM effect seems to work in Australia, Canada, Switzerland, UK, and (the former) West Germany. Continuing this line of work, Hensel and Ziemba (1996) investigate the trading profits obtainable by exploiting the ToM pattern in the US stock market from 1928 to 1993 and found that a strategy that switches between the S&P500 and T-bills at times consistent with the ToM effect beats a S&P500 buy-and-hold strategy by about 63 basis points a year. Pham (2002) further shows that the ToM effect continues to be present in the data, both in the US and in Canada, even in an extended sample.

Even more recently, McConnell and Xu (2008) present evidence that the ToM effect in US equity markets was so strong during 1926-2005 that, in their words, "…on average, investors received no reward for bearing market risk except at turns of the month," underlying the economic significance of this pattern. They also look at a much broader sample of countries, and find the pattern to be present in 31 of the 35 countries they examine. Finally, Desai and Trivedi (2012) show that the ToM effect is still present, using data from 10 of the biggest markets in the past two decades.

Although many papers have established the robust existence of the ToM effect, few have

attempted to provide any explanation. One of the earliest papers to do so was Ogden (1990), who suggests that stock prices surge at the end of the month as most people get their salary around those days, from which they invest some proportion in the stock market. However, Ogden does not provide any direct evidence on this hypothesis. Instead, he suggests that ToM returns should vary inversely with the stringency of monetary policy, because the magnitude of the price surge in any month depends on the magnitude of aggregate payments realized, which in turn, depends on the monetary policy. Consistent with this hypothesis, Ogden shows evidence that ToM returns are higher when monetary policy is less stringent. While this evidence is interesting, there are other alternative explanations, which can also be consistent with these findings. For example, one alternative is that managers take corporate financial decisions at the end of the month, which makes firms especially risky at these times, and hence, the extra compensation. If managers are more likely to alter policy in lax monetary policy regimes, then Ogden's evidence is consistent with this explanation as well.

In fact, when McConnell and Xu (2008) examine Ogden's hypothesis of personal liquidity using aggregate data, they find that month-end buying pressure is *not* significantly related to the ToM effect, as would be predicted by Ogden. Neither is NYSE trading volume different on ToM days, nor is there any pattern in aggregate net flows into their sample of mutual funds. However, their sample represents only about 20% of equity mutual funds. They conclude by saying that, "In summary, neither of our tests could rule out that the turn-of-the-month pattern is a result of a payday effect in equity returns but neither of them provided any support for it either," underscoring the unsolved nature of this economically important and interesting, and statistically robust phenomenon.

The main difference between this paper and the pervious literature is that we hand-collect

data on funds that are actually available in retirement plan menus, and hence are more likely to get passive capital inflows when salaries are paid every month. Identifying retirement funds precisely can result in greater power for our empirical tests, and therefore show whether earlier results were limited due to data issues.

Finally, our proposed usage of the 11-K data on 401K investment options follows Cohen and Schmidt (2009), Sialm, Starks and Zhang (2014), and Pool, Sialm and Stefanescu (2014). Cohen and Schmidt (2009) show that family trustees significantly overweight, and are reluctant to sell, their 401(k) client firm's stock when other mutual funds sell the stock to support its stock price. Sialm, Starks and Zhang (2014) show that although investors in 401K plans show inertia in adjusting their portfolio allocations, plan sponsors adjust the menu. Pool, Sialm and Stefanescu (2014) show that poorly-performing funds are less likely to be removed from a 401(k) menu if they are affiliated with the plan trustee family. We plan to use the same data, but intend to be the first to examine the consequences of capital allocation in retirement plan accounts, which is a very different question.

III. Hypotheses

This section outlines the major hypotheses we want to test. First, we test for the continued existence of the ToM effect in US equity markets in the period for which we have 401K plan data:

Hypothesis I:

H_0 (ToM_Existence): There exists a strong ToM effect even during the period under study.

This is critical, because if the ToM effect no longer exists, then there is not much value in studying its drivers. Next, we test our main hypothesis – that stocks that are held in greater proportion by 401K mutual funds experience greater ToM effects.

Hypothesis II:

H_0 (Flow_induced_ToM): There is no relationship between proportion of a stock held by 401K mutual funds and the ToM effect it experiences.

If this null of no effect is rejected, then this is evidence in favor of the Ogden's liquidity-driven-price-pressure view. These 401K funds attract purely passive inflows – which have nothing to do with the underlying stocks held, and is just a fixed-proportion of people's salary – and that drives up the prices of stocks these funds buy.

Our next hypothesis concerns whether the ToM effect is equally strong for passive investor flows. To do so, we check whether the 401K fund-held proportion of market cap is a stronger predictor of ToM effects for stocks that are less liquid. This is likely to be the case if flow-induced price-pressure is stronger for less liquid stocks. Given a similar capital supply shock, less liquid stock prices should be affected more.

Hypothesis III:

H_0 (Liquidity, flows, and ToM): The 401K fund-held proportion of market cap of a stock is a stronger predictor of its ToM effect if the stock is less liquid.

Next, we check whether our findings are robust to defining retirement-oriented mutual funds from outside our sample, using the sample of all Target date funds. Since Target date funds are typically used in retirement plans – and typically used as the default fund in many of these plans

(Mitchell and Utkus (2012)), we should expect the ToM effect to be stronger for stocks held by these funds if the liquidity view is correct.

Hypothesis IV:

H_0 (Target-date_Funds_ToM): There is no relationship between proportion of a stock held by Target-date mutual funds and the ToM effect it experiences.

Finally, we examine whether there is any evidence to suggest that there is some price pressure when retirement funds trade their inflows into the equity market. If fund managers know that there is a turn-of-the-month effect, they might be unwilling to send in their orders on those days to minimize price impact, and might choose to trade instead at the middle-of-the-month. If that is true, then stocks heavily held in retirement fund accounts might see high returns in the middle-of-the-month, rather than at the turn-of-the-month.

Hypothesis V:

H_0 (Middle-of-the-Month Effects): There is no relationship between proportion of a stock held by 401K mutual funds and its returns in the middle-of-the-month.

IV. Data

We hired multiple research assistants to manually collect data on mutual fund investment options in 401K plans. All retirement plans which offer own-company stock as an investment option (which is almost the entire universe of firms) are required to file 11-K forms with the SEC, from where we intend to collect this information. The 11-K form usually contains a schedule of assets which contains information on the options in the retirement plans, and how much money is invested

in each option. This dataset is at the company-mutual fund-year level. As a first step, this data was collected by writing a code to scrape the SEC's EDGAR system. Then we again used a code to search for the Schedule of Assets within each 11K filing, and copied the information in a separate file.

Since there is no standardization requirement for these filings, once the Schedule of Assets was collected, considerable work had to be done to clean the data manually across more than 25,000 distinct excel files before collating them to get the data in a format suitable for statistical analysis. The Sample period runs from 2000-2012 for all common stocks (require shrcd (10,11), exchcd (1,2,3) and price>=1;) held by matched 401k funds (i.e., with 401k exposure available). Once we collected this data, we matched funds listed in it to the following databases:

i) Thomson Reuters database on the holdings of the funds on the different plan menus. This database is compiled from both mandatory SEC filings (13F, which requires disclosure of the names of institutional investment managers, the names and the CUSIP numbers of the securities, as well as the number of shares held) and voluntary disclosures by mutual funds.

ii) CRSP: Stock prices and returns were obtained from this database.

iii) CRSP US Mutual Fund (MFDB): Mutual fund returns and total net assets data were taken from this database.

This matching exercise was done using a fuzzy name-matching algorithm, followed by manual checking when the algorithm match score fell below a threshold. The following section presents summary features of our data and sample.

V. Summary Statistics

First, we present detailed summary statistics for our data, given that this is hand-collected. These are presented in Table 1. Panel A shows the average number of funds, average matched number of funds, average plan value, and matched funds value in the plan every year; the non-fund assets denotes the cash, common stock, and participants' loans in the 11k filing. This panel shows that we have 4692 unique matched mutual funds in our study, which constitutes one of the largest samples of retirement plans in the literature.

Panel B shows the summary statistics for the 401k plan. # items refers to the number of options (including both fund and non-fund options) in the 401k plan; # funds refers to the number of funds options in the plan; Matched # funds refers to the number of matched mutual funds in the plan (matched to crsp_fundno); Plan value represents the total 401k plan value in millions; Fund value and Matched fund value refers to the total fund value and matched mutual fund value in millions. From this panel, we can see that the average plan size is about 394 million US$, with a significant variation across funds, as reflected by the high standard deviation of size.

Panel C shows the summary statistics for the funds that we are able to match to the 13F mutual funds holdings database; Fund 401 exposure is the 401K asset value out of total funds size in percentage; "included by # firms" refers to the number of firms that include this fund in their 401K plan; # stk held by fund refers to the number of stocks held by the fund as of December end. The typical fund is about US$3 billion in size, and is part of about seven 401K menus. The average expense ratio for these funds is 1.13%.

Panel D shows the summary statistics for the stocks held by the matched 401 funds. *stk401wt* is our variable of interest; it is calculated as follows. First, we calculate the 401K asset

proportion for each fund; this is the total dollar holdings in the fund across all 401K plans in that year, divided by the total size of the fund. Then we calculate *stk401wt* as the sum of the product of funds' 401K exposures and the percent of each company's equity held by that fund (that is, shares held by the fund/shares outstanding). Panel E shows the correlation between stocks' 401k exposure and other characteristics.

VI. Empirical Methodology

After cleaning the data, we first check whether the ToM effect holds for the period for which we have data.

First we test Hypothesis I: H_0 *(ToM_Existence)*: There exists a strong ToM effect, even for the period under study. We examine this by running the following regression using daily market returns for the stocks which are held by 401K plans:

$$R_t = \beta_0 + \beta_1 . ToM\_dummy_t + \beta_2 . X_{i,t-1} + \varepsilon_{i,t} \qquad (I)$$

Where ToM_dummy_t takes a value of 1 if the day-of-month is either the last day of a month (e.g., 31 January, 30 April), or the first three to five days of the (following) month. We run this regression twice, for value-weighted as well as the equal weighted market. A test of H_0 will be provided by a test for $\beta_1=0$. The ToM effect exists if $\beta_1>0$.

Next, we test our main hypotheses, Hypotheses II: H_0 *(Flow_induced_ToM)*: There is no relationship between proportion of a stock held by 401K mutual funds and the ToM effect it experiences.

The first step in these tests is to construct measures for our analysis. Since the 11-K data we examine is at an annual frequency, we need to assume that the menu and allocation to funds available do not change within a year. For each fund in the menu, we obtain its stock holdings from the Thomson Reuters database.

In the next step, we obtain from CRSP MFDB database the size of the fund, and calculate the proportion of the fund's capitalization that is held cumulatively through all 401K plans that it participates in, and call it *401K_wt*. So, for example, suppose Fund A has a total size of $50 million. It appears in two 401K plans with $5 million and $7 million being allocated to it through each plan. Then, the *401K_wt* of the fund is (5+7)/50=24%.

Finally, for each stock, we calculate the proportion of its market capitalization that is funded by 401K plans. Assume a stock is held by two funds, A and B, which have the following information:

Variable	**Fund A**	**Fund B**	**Source**
Proportion of stock's market cap owned by fund	5%	10%	Thomson Reuters for holding size, CRSP for market cap
401K_wt	24%	50%	Calculated from 11K data, CRSP MFDB fund size

Then we calculate the proportion of the stock's market cap funded by 401K accounts is as *Cap_from_401K*= 0.24*5%+0.5*10%=0.062, i.e., 6.2%. This is the main explanatory variable we use to test Hypothesis II. Finally, we run a regression of the form below.

$$r_{i,t} = \beta_0 + \beta_1.\text{ToM} + \beta_2.\text{ToM}*Cap\_from\_401K_{i,t} + \beta_3.\, X_{i,t} + \varepsilon_{i,t} \qquad \text{(II)}$$

Our test for Hypothesis II is given by a test of $\beta_2=0$ against an alternative of $\beta_2>0$. If we find $\beta_2>0$, then this will mean that stocks that are held more by 401K plans – where a bulk of corporate America's workers deposit a part of their income as retirement savings, every month, around payday – show a stronger ToM effect. This will be consistent with Ogden's Hypothesis.

Next is Hypothesis III: *H_0 (Liquidity, flows, and ToM)*: The 401K fund-held proportion of market cap of a stock is a stronger predictor of its ToM effect if the stock is less liquid. Our test of Hypothesis III is conducted by running the following regression:

$$r_{i,t} = \beta_0 + \beta_1.\text{ToM} + \beta_2.\ \text{ToM}*Liquidity_{i,t} + \beta_3.\ \text{ToM}*Cap\_from\_401K_{i,t}*\ Liquidity_{i,t} + \beta_4.\ X_{i,t} + \varepsilon_{i,t} \quad \text{(III)}$$

Our test for Hypothesis III is given by a test of $\beta_3=0$ against an alternative of $\beta_3>0$. If we find $\beta_3>0$, then this will mean that *less liquid stocks* that are held by 401K plans show a stronger ToM effect. We can use different measures of liquidity, among them the Amihud illiquidity measure, bid-ask spread and the proportion of days with zero returns over the last year.

Next, we test Hypothesis IV: *H_0 (Target-date_Funds_ToM)*: There is no relationship between proportion of a stock held by Target-date mutual funds and the ToM effect it experiences. For Hypothesis IV, we use the same technique, but only count target-date funds, which are typically used as default funds in 401K plans, e.g., Mitchell and Utkus (2012) suggest that "a complex choice architecture including automatic enrollment, reenrollment, and fund mapping, is increasing the number of participants defaulting into employer-selected target-date funds."

Finally, for Hypothesis V: *H_0 (Middle-of-the-Month Effects)*. For this test, we use the same specification as Equation (II), but examine middle-of-the-month returns instead of the ToM variable.

VII. Results

This section presents empirical results from hypotheses tests described above.

VII.1. Does the Turn-of-the-Month Effect still exist?

First, we examine whether aggregate trading volume is indeed different around the turn of the month. This evidence is presented in Figure 1. The figure shows that volume is indeed higher at the end of the month, relative to other trading days.

Next, we examine regression-based evidence on the ToM effect in various sub-periods. Table 2 shows the continued existence of the ToM effect in markets. Panels A & B show the result on the aggregate market daily returns. Panel A is value weighted, Panel B is equal weighted. Here we regress the market return on dummy variables tday (-4) to tday(6) (for example, tday_4=1 for the -4 trading day of a month and zero otherwise, tday1=1 for the first trading day of a month). The key message from these panels is that the ToM effect still exists, but primarily on an equal-weighted basis. This means that the effect is stronger for smaller stocks.

In Panel C we define one dummy TOM =1 for trading days (-1,1,2,3), based on previous regressions. Again, we find a similar result – the ToM effect is still there for the market, especially on an equal weighted basis.

VII.2. Relation between the Turn-of-the-Month Effect and 401K exposure of stocks

Figure 2 shows the relation between the Turn-of-the-Month Effect and 401K exposure of stocks. Here we sort stocks into deciles depending on their 401K exposure, and plot the trading-day-

of-month returns to each decile and their difference. The key visual in this figure is that high-401K-exposure and low-exposure stocks both have high ToM daily returns, so that their difference is not particularly high during these times.

Table 3 shows the relationship between the exposure to 401K and the ToM effect, as described in Section VI. Standard errors are double clustered by firm and date. This table reports results from regression II.

First, given the results in Table 2, we run these regressions on a stock-by-stock equal-weighted basis. Notice from the first row that the ToM effect is present in the data still, which is the stock-by-stock panel regression version of the same evidence as in Table 2. In terms of economic magnitude, the effect is about 15-20 basis points.

Next, we find from the second row that the TOM is not stronger for high 401k exposure stocks. If anything, the negative coefficient indicates that the ToM effect is actually slightly weaker (although not significantly so) for stocks that are predominantly held by 401K plans. This goes against Ogden's liquidity hypothesis. The different columns of the table show that this result is not an artifact of the structure of fixed effects employed in these regressions. In particular, many of our specifications use Firm X Calendar Month fixed effects, which account for various types of seasonalities. These results are very similar to those employing just firm or firm and calendar month fixed effects.

VII.3. The Role of Liquidity

While we show that there appears to be no relationship between the proportion of *an average* stock's market cap held by 401K funds and its ToM effect, it is still possible that there is a

relationship of the type Ogden proposed for *less liquid* stocks – that are subject to more month-end-payments flow-pressure.

Table 4 shows summary statistics for liquidity measures used to study the interaction of 401K holdings and the ToM effect. We use three measures of liquidity: (a) Amihud (absolute return divided by dollar volume, multiplied by 10000; and (b) bid-ask spread (ask-bid)/((ask+bid)/2) is calculated for each stock each day, and then averaged over the year; (c) fzeros is calculated as the fraction of zero returns within a year; the liquidity measures are winsorized at 1% and 99%. Panel B presents the correlations between these measures. As can be seen from this panel, the liquidity measures are – not surprisingly – correlated. However, their correlations are not very high, so that our tests using these different measures in isolation have independent value.

Table 5 shows the relationship between the exposure to 401K and the ToM effect, conditional on liquidity. Panel A looks at the relation between ToM returns and 401K exposure of stocks, conditional on these different liquidity measures. Panel B is similar to Panel A, except when conditioning on different liquidity levels, it relaxes the linearity assumption by interacting 401K weights with dummy variables indicating less than median liquidity using either of the 3 measures.

The different liquidity measures and panels convey the same message: First, the ToM effect is indeed higher for less liquid stocks (second row). So, it is indeed the case that the effect seems to be related to liquidity. However, this relationship does not manifest itself through month-end equity investments related to salary payments in 401K plans. This is evidenced by the fact that when we study the triple interaction between the ToM effect, liquidity, and 401K plan exposure of the underlying stocks, the interaction coefficient is insignificant, with the t-statistic rising above 1 (1.33) in only one of 12 cases.

VII.4. Turn-of-the-Month Effect and 401K plan exposure: Evidence from trading volumes

If price pressure due to heavy buying by funds when they receive month-end payments is causing the ToM effect, this might also leave its trace in trading volumes. In other words, when 401K funds buy stocks heavily at the end-of-the-month, we should see a spike in trading volumes.

We examine this hypothesis in this sub-section. Table 6 shows results for differences in ToM volume depending on a stock's 401K exposure. Results are consistent with those in earlier tables on lack of relationship between ToM activity and 401K exposure. The interaction term between ToM and 401K exposure is insignificant, and again, has the wrong sign with respect to the Ogden hypothesis.

VII.5. Out-of-sample evidence: Target Date Funds

Are our results simply reflecting our inability to accurately capture retirement fund flows in 401K? This could happen, for example, if our data collection or matching process creates enough noise to engulf true underlying patterns in the data generating process. Such a possibility, then, needs to be ruled out using data from *outside* our hand-collected sample. To do so, we use a sample of all target date funds in the CRSP database. Target date funds are not only typically used in retirement plans, but they are also often the default allocation in many 401K accounts (Mitchell and Utkus (2012)).

Table 7 shows the relationship between the exposure to Target date funds and the ToM effect. Weight calculated using target date funds is correlated with the stk401kwt (our measure) with a correlation of 0.168. Since target date funds' holdings are available very quarter, we follow

Kacperzczyk, Sialm and Zheng (RFS, 2008) to estimate each funds' month end holdings, and then construct stocks' target date fund exposure (in %).

Our results again paint a very similar picture. The ToM effect exists, but is in fact weaker, although not significantly so, for stocks held heavily by target date funds.

VII.6. Retirement Funds and a Mid-month effect

Stock exposure to retirement funds do not seem to be associated with the ToM effect. However, is there no evidence at all of price pressure from retirement fund flows on any particular days? Here we examine that question in more detail. Specifically, we examine every single calendar day of the month, and try to understand whether stocks held most heavily by retirement funds have significantly high returns on any of these days.

We find that stocks exposed to retirement flows – especially those in the top two deciles of retirement fund holdings – have significantly higher returns in the *middle* of the trading month. This is true for days 10 and 11 (out of 23 typical trading days) of the month, which correspond to the middle week of the calendar month.

These results are presented in Table 8. Panel A defines exposure to retirement funds as being in the top two deciles of aggregated 401K fund holdings, while panel B looks at aggregate holdings of all Target Date funds (following the spirit of Table 7). We consistently find that stock returns are not significantly different on average on middle-of-the-month days. However, returns are on average 5 basis points higher in the middle of the month for stocks that are heavily held by retirement funds. This is a new finding in this literature.

There are two possible reasons behind this. The first reason is that it takes time (typically up

to a week, sometimes longer) for the funds to get money from corporate pension plan contributions every month. This lag moves the price-pressure from retirement fund trading into the middle of the month from the beginning of the month (as in the ToM effect). The second explanation could be that retirement fund managers know that there is a ToM effect in the market, and they rationally anticipate that adding their large buy orders during the ToM days would exacerbate the price-pressure issue. So they hold on to retirement account money for a few days into the month to get better prices. They trade their inflows into prices typically after the ToM effect subsides, that is, after the turn-of-the-month days. The resultant price pressure is felt in returns at the middle of the month. Of course, these explanations are neither mutually exclusive nor exhaustive. At the least, there is a need for more work to understand the robustness of this phenomenon and the potential reasons behind it.

VIII. Conclusion

In spite of many studies documenting the existence of a Turn-of-the-Month effect in stocks, there is very little convincing evidence about what causes it. One popular explanation suggests that stock prices surge at the end of the month because most people get their salary around those days, from which they invest some proportion in the stock market.

In this study, we hand collect publicly available data from the SEC's Edgar database on regulatory filings of retirement savings plans (Form 11-K) in the US. The plan filings include information on the mutual funds that are included as savings options, and the employees' allocation to these funds, for each individual company.

Using this sample, we find no evidence to support the hypothesis that systematic month-end

flows, related to the monthly payment cycle, causes the ToM effect. Instead, we uncover that stocks exposed to retirement flows – especially those in the top two deciles of retirement fund holdings – have significantly higher returns in the *middle* of the trading month.

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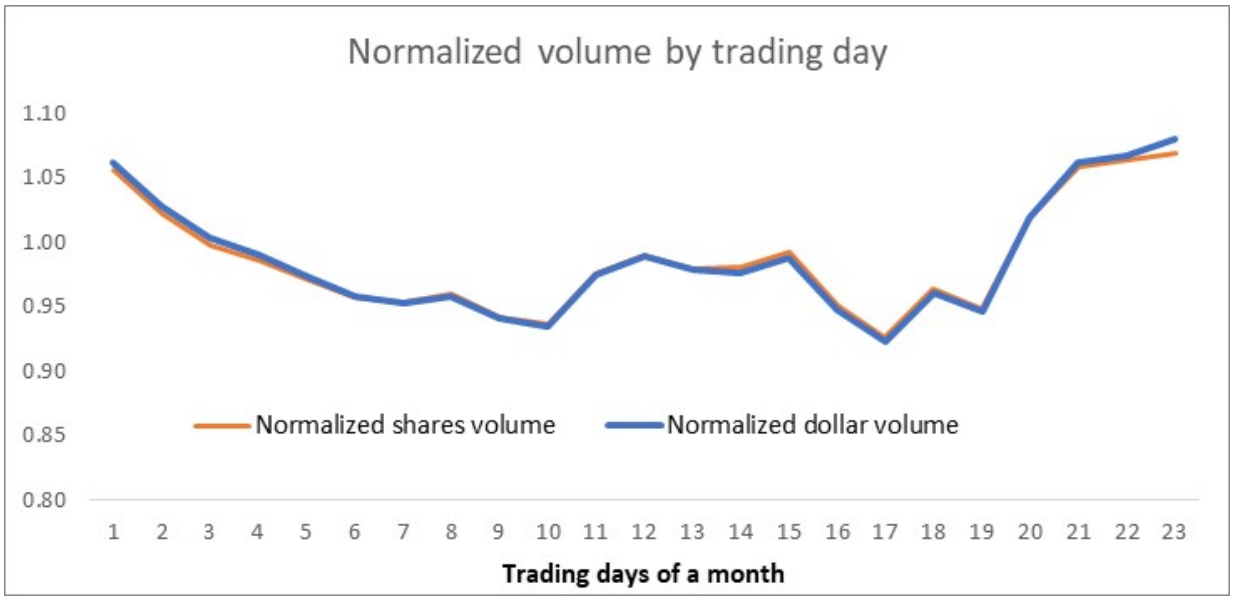

Figure 1: Volume around Turn-of-the-Month

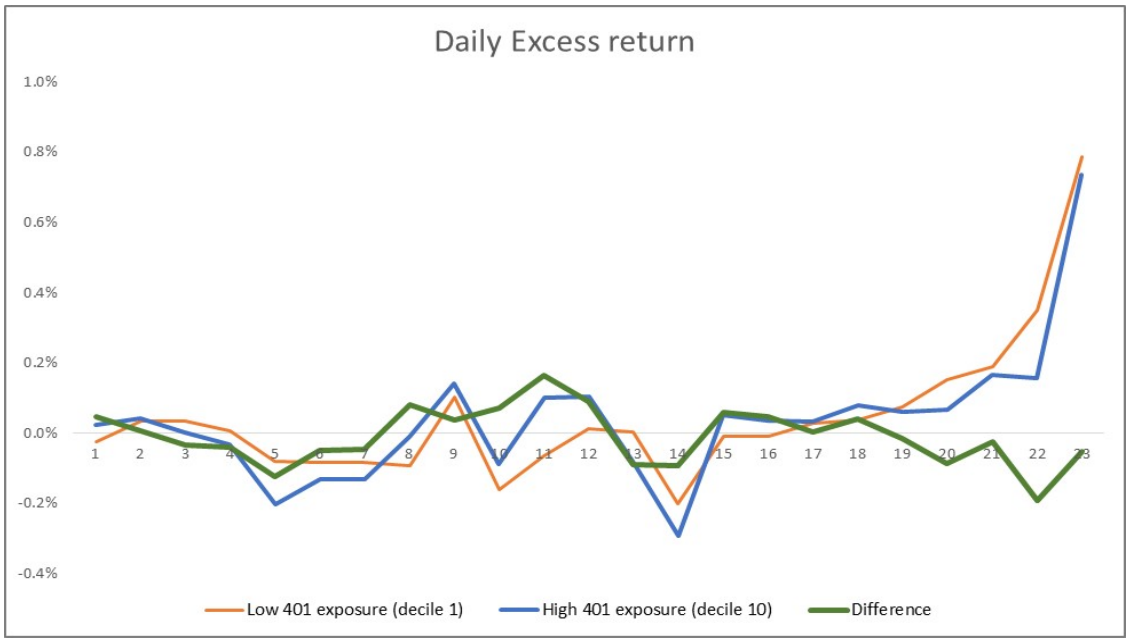

Figure 2: Daily excess returns, by 401(K) exposure of stocks

Table 1: Summary Statistics

This table shows the summary statistics of our data sample. Panel A shows the average number of funds, average matched number of funds, average plan value, and matched funds value in the plan every year; the non-fund assets denotes the cash, common stock, and participants' loans in the 11k filing. Panel B shows the summary statistics for the 401k plan. # items refers to the number of options (including both fund and non-fund options) in the 401k plan; # funds refers to the number of funds options in the plan; Matched # funds refers to the number of matched mutual funds in the plan (matched to crsp_fundno); Plan value represents the total 401k plan value in millions; Fund value and Matched fund value refers to the total fund value and matched mutual fund value in millions. Panel C shows the summary statistics for the 401 funds that we are able to match to the 13F mutual funds holdings database; Fund 401 exposure is the 401k asset value out of total funds size in percentage; "included by # firms" refers to the number of firms that include this fund in their 401k plan; # stk held by fund refers to the number of stocks held by the fund as of December end. Panel D shows the summary statistics for the stocks held by the matched 401 funds. stk401wt is our variable of interest, it is calculated following the grant proposal. Firstly, calculate the 401k asset proportion for each fund; Second, stk401wt is the sum of the product of fund's 401 exposure and stock's shares held by the fund/shares outstanding. Panel E shows the correlation between stock's 401k exposure and other characteristics.

Panel A: Plan characteristics, by year

						Mean			Median				
Year	# firm	# unique matched funds	# items (include cash, common stock)	# funds	Matched # funds	Plan value	Fund value	Matched fund value	Plan value	Fund value	Matched fund value	matched %(value)	matched %(#)
2000	830	1246	17.3	14.2	8.0	294.8	202.5	95.5	57.7	45.2	23.3	47.1%	56.5%
2001	907	1058	19.8	16.5	7.0	289.9	200.6	100.6	54.4	41.7	15.3	50.1%	42.4%
2002	994	1150	20.8	17.5	7.2	294.8	198.7	77.0	57.9	42.5	13.9	38.8%	41.2%
2003	834	1257	22.2	18.8	8.8	296.9	211.0	84.6	57.6	43.9	18.3	40.1%	47.0%
2004	811	1340	22.1	19.0	9.3	327.6	237.0	108.5	73.9	57.6	28.3	45.8%	48.8%
2005	1185	1528	23.6	20.5	9.8	348.4	251.7	114.3	83.5	61.9	27.0	45.4%	48.1%
2006	986	1449	25.0	21.7	10.4	399.7	305.0	122.9	86.6	66.4	26.9	40.3%	47.9%
2007	931	1385	24.9	21.7	11.0	513.1	405.5	154.8	108.7	85.2	37.1	38.2%	50.7%
2008	899	1444	26.6	23.5	12.5	525.7	423.6	175.2	115.8	97.2	41.5	41.4%	53.4%
2009	879	1636	27.4	24.5	14.7	377.5	301.7	128.6	84.8	69.1	35.4	42.6%	60.0%
2010	844	1666	28.1	25.1	15.1	433.1	345.0	164.2	115.2	99.4	49.9	47.6%	60.0%
2011	807	1678	28.7	25.8	16.0	517.3	406.7	200.6	139.4	114.5	62.6	49.3%	62.0%
2012	787	1546	28.8	26.1	16.4	536.4	421.0	196.8	140.8	117.0	61.7	46.8%	63.0%
Total	1943	4692											

Panel B: Summary statistics for plan characteristics, all years

Variable	N	Mean	Min	Q1	Median	Q3	Max	Std.
# items	11694	24.17	1.00	14.00	20.00	27.00	736.00	20.88
# funds	11694	21.04	1.00	12.00	17.00	24.00	498.00	18.60
Matched # funds	11694	11.11	0.00	4.00	8.00	15.00	426.00	13.12
Plan value	11694	394.07	0.00	24.07	82.04	283.97	37733.22	1237.01
Fund value	11694	298.35	0.00	18.12	64.37	214.46	26000.21	920.60
Matched fund value	11694	131.03	0.00	5.67	29.52	114.97	12546.16	353.70

Panel C: Summary statistics for matched funds (with holdings data, fund-year panel)

Variable	N	Mean	Median	Min	Q1	Q3	Max	Std
Expense ratio	5153	0.0113	0.0111	0.0002	0.0082	0.0139	0.1258	0.0053
Fund 401 exposure	5468	6.26	1.06	0.00	0.21	4.12	70.78	14.81
TNA (Equity, mil)	5468	3197.0	853.3	0.0	245.3	2625.8	151629.6	8577.5
included by # fims	5468	6.88	2.00	1.00	1.00	6.00	213.00	13.82
# stk held by fund	5468	207.84	110.00	1.00	69.00	194.00	3789.00	348.52

Panel D: Summary statistics for the stocks held by the matched 401 funds

Variable	N	Mean	Median	Min	MAX	Q1	Q3	Std
stk401wt	52142	0.21	0.10	0.00	1.26	0.02	0.30	0.27
Price	43956	57.07	17.00	0.03	177900.00	6.73	32.41	1921.96
marcap (mil)	43956	4.075	0.493	0.000	511.887	0.136	1.898	17.650
logsize	43956	13.17	13.11	8.75	18.06	11.82	14.46	1.95
MOM (t-12,t-2)	51578	0.11	0.01	-1.00	91.00	-0.27	0.29	0.93
ret1m(t-1)	43952	0.03	0.02	-0.89	4.04	-0.03	0.08	0.15
BEME	42416	0.73	0.56	0.04	4.25	0.33	0.90	0.67
flow-induced pressure	52142	0.00	0.00	-2.12	2.48	-0.20	0.13	0.61
IO	50479	0.54	0.56	0.01	1.15	0.29	0.79	0.30
Coverage	50479	6.85	4.00	0.00	35.00	1.00	10.00	7.77

Panel E: Correlations between stock's 401k exposure and other characteristics

	stk401wt	Price	ret1m	MOM (t-12,t-2)	logsize	BEME	flow-induced pressure	IO	Coverage
stk401wt	1.00	0.00	0.04	-0.01	0.30	-0.05	-0.10	0.53	0.27
Price	0.00	1.00	0.00	0.00	0.05	0.00	0.00	-0.02	-0.01
ret1m	0.04	0.00	1.00	-0.02	0.04	0.03	-0.07	0.04	-0.01
MOM (t-12,t-2)	-0.01	0.00	-0.02	1.00	0.05	-0.14	0.15	0.06	0.05
logsize	0.30	0.05	0.04	0.05	1.00	-0.35	-0.07	0.52	0.64
BEME	-0.05	0.00	0.03	-0.14	-0.35	1.00	-0.03	-0.13	-0.19
flow-induced pressure	-0.10	0.00	-0.07	0.15	-0.07	-0.03	1.00	-0.02	-0.02
IO	0.53	-0.02	0.04	0.06	0.52	-0.13	-0.02	1.00	0.44
Coverage	0.27	-0.01	-0.01	0.05	0.64	-0.19	-0.02	0.44	1.00

Table 2: Turn-of-the-month Effect in different sample periods

This Table shows the continued existence of the ToM effect in markets. Panels A & B show the result on the aggregate market daily returns. Panel A is value weighted, Panel B is equal weighted. Here we regress the market return on dummy variables tday (-4) to tday(6) (for example, tday_4=1 for the -4 trading day of a month and zero otherwise, tday1=1 for the first trading day of a month). In Panel C we define one dummy TOM =1 for trading days (-1,1,2,3), based on previous regressions. *, **, and *** indicate statistical significance at the 10%, 5% & 1% levels respectively.

Panel A

Value weighted market daily return (%)					
	1926-2017	1926-1950	1951-1970	1971-1990	1991-2017
tday_4	0.035	-0.096	0.04	0.059	0.129
	(1.06)	(1.2)	(0.92)	(1.15)	(1.97)**
tday_3	0.028	-0.068	0.067	0.009	0.098
	(0.84)	(-0.81)	(1.19)	(0.16)	(1.66)*
tday_2	0.091	0.143	0.124	-0.019	0.098
	(2.78)***	(1.87)*	(2.56)**	(-0.33)	(1.49)
tday_1	0.145	0.201	0.172	0.2	0.029
	(4.77)***	(2.75)***	(3.94)***	(3.57)***	(0.51)
tday1	0.118	0.095	0.132	0.073	0.159
	(3.59)***	(1.36)	(3.02)***	(1.16)	(2.23)**
tday2	0.145	0.189	0.218	0.157	0.036
	(4.46)***	(2.39)**	(5.15)***	(2.86)***	-0.56
tday3	0.15	0.275	0.148	0.162	0.023
	(4.72)***	(3.52)***	(3.65)***	(2.66)***	(0.4)
tday4	0.057	0.144	0.065	0.03	-0.015
	(1.57)	(1.5)	(1.61)	(0.53)	(0.22)
tday5	0.021	0.105	0.038	-0.011	-0.05
	(0.63)	(1.22)	(1.01)	(-0.17)	(-0.85)
tday6	-0.036	-0.069	-0.059	0.036	-0.044
	(-1.14)	(-0.95)	(-1.4)	(-0.67)	(-0.68)
_cons	0.007	-0.006	0.001	0.011	0.023
	(0.73)	(-0.28)	(0.08)	(0.63)	(1.24)
R^2	0.00	0.00	0.01	0.00	0.00
N	24,289	7,373	5,060	5,053	6,803

Panel B

Equal weighted market daily return (%)					
	1926-2017	1926-1950	1951-1970	1971-1990	1991-2017
tday_4	-0.021	-0.178	0.00	-0.006	0.101
	(-0.68)	(2.12)**	(0.00)	(-0.14)	(1.96)*
tday_3	0.021	-0.044	0.046	-0.022	0.097
	(0.6)	(-0.46)	(0.8)	(-0.47)	(1.86)*
tday_2	0.1	0.173	0.1	0.008	0.104
	(3.11)***	(2.00)**	(2.24)**	(0.16)	(1.88)*
tday_1	0.263	0.295	0.189	0.272	0.285
	(8.22)***	(3.33)***	(3.97)***	(5.80)***	(5.66)***
tday1	0.135	0.225	0.135	0.103	0.08
	(4.29)***	(2.95)***	(3.01)***	(2.07)**	(1.28)
tday2	0.139	0.18	0.182	0.129	0.079
	(4.42)***	(2.19)**	(4.12)***	(2.79)***	(1.4)
tday3	0.152	0.307	0.109	0.17	0.031
	(4.80)***	(3.47)***	(2.58)***	(3.68)***	(0.62)
tday4	0.099	0.217	0.06	0.1	0.024
	(2.70)***	(2.01)**	(1.42)	(2.24)**	(0.41)
tday5	0.042	0.131	0.058	0.043	-0.05
	(1.34)	(1.47)	(1.53)	(0.97)	(1.02)
tday6	-0.029	-0.034	-0.052	0.023	-0.042
	(-0.94)	(-0.42)	(-1.22)	(-0.55)	(-0.72)
_cons	0.043	0.057	0.022	0.024	0.055
	(4.65)***	(2.62)***	(1.76)*	(1.70)*	(3.47)***
R^2	0.00	0.01	0.01	0.01	0.01
N	24,289	7,373	5,060	5,053	6,803

Panel C: TOM =1 for trading days (-1,1,2,3)

	EWRETD				VWRETD			
	1926-2017	<=1980	>1980	2000-2012	1926-2017	<=1980	>1980	2000-2012
TOM	0.16	0.185	0.124	0.131	0.129	0.157	0.085	0.081
	(9.50)***	(7.90)***	(5.31)***	(2.49)**	(7.55)***	(7.24)***	(3.11)***	(1.36)
_cons	0.054	0.054	0.054	0.038	0.018	0.01	0.03	0.004
	(7.29)***	(5.27)***	(5.39)***	(1.66)*	(2.34)**	(1.03)	(2.48)**	(0.13)
R^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N	24,289	14,958	9,331	3,269	24,289	14,958	9,331	3,269

Table 3: Turn-of –the-month Effect and 401(K) Exposure

This table shows the relationship between the exposure to 401K and the ToM effect. Sample period runs from 2000-2012 for all common stocks (require shrcd (10,11), exchcd (1,2,3) and price>=1;) held by matched 401k funds (i.e., with 401k exposure available). Standard errors are double clustered by firm and date. *, **, and *** indicate statistical significance at the 10%, 5% & 1% levels respectively.

	return (%)						
TOM	0.104	0.139	0.12	0.125	0.137	0.192	0.199
	(1.70)*	(2.39)**	(2.03)**	(2.17)**	(2.38)**	(3.26)***	(1.58)
TOM*stk401wt		-0.16	-0.146	-0.15	-0.157	-0.083	-0.08
		(1.84)*	-(1.62)	(-1.71)*	(-1.81)*	(-1.33)	(-1.3)
MOM (t-12,t-2)			-0.06	-0.046			
			(3.93)***	(5.52)***			
Ret (t-1)			-0.027	-0.029			
			-(0.37)	-(1.02)			
BEME			-0.166	-0.145			
			(7.39)***	(18.64)***			
Price			(0.00)	(0.00)			
			-(1.10)	(1.96)**			
Log(Size)			0.032	0.031			
			(1.98)**	(4.55)***			
Stk401wt			-0.082	-0.039			
			(1.73)*	(2.12)**			
IO*TOM						-0.129	-0.106
						(1.85)*	(-1.46)
MOM*TOM							0.026
							(0.76)
Ret1m*TOM							0.011
							(0.06)
BEME*TOM							0.008
							(0.27)
Price*TOM							0.00
							(0.31)
Logsize*TOM							-0.003
							(-0.33)
Fixed effect	Firm*month	Firm*month	Firm	Firm, month	Firm*month	Firm*month	Firm*month
R^2	0.04	0.04	0	0.01	0.04	0.04	0.04
N	12,040,032	12,040,032	10,019,371	10,019,371	11,932,846	11,881,504	10,019,370

Table 4: Liquidity Measures in our Sample

This table shows summary statistics for liquidity measures used to study the interaction of 401K holdings and the ToM effect. We use three measures of liquidity: (a) Amihud (absolute return divided by dollar volume, multiplied by 10000; and (b) bid-ask spread (ask-bid)/((ask+bid)/2) is calculated for each stock each day, and then averaged over the year; (c) fzeros is calculated as the fraction of zero returns within a year; the liquidity measures are winsorized at 1% and 99%. Panel B presents the correlations between these measures.

Panel A

Variable	N	Mean	Median	Min	Q1	Q3	Max	Std Dev
amihud	12041311	0.0082	0.0001	0.0000	0.0000	0.0012	0.7465	0.0438
bidask	12035174	0.0109	0.0050	0.0002	0.0017	0.0139	0.1416	0.0153
fzeros	12041311	0.0427	0.0238	0.0000	0.0081	0.0556	0.3492	0.0523

Panel B

Correlations			
	amihud	bidask	fzeros
amihud	1	0.482	0.216
bidask	0.482	1.000	0.735
fzeros	0.216	0.735	1.000

Table 5: Exposure to 401(K) and the ToM Effect, Conditional on Stock Liquidity

This table shows the relationship between the exposure to 401K and the ToM effect, conditional on liquidity. Panel A looks at the relation between ToM returns and 401K exposure of stocks, conditional on these different liquidity measures. Panel B is similar to Panel A, except when conditioning on different liquidity levels, it relaxes the linearity assumption by interacting 401K weights with dummy variables indicating less than median liquidity using either of the 3 measures. In that panel, ramihud=1 for above median amihud measure, and zero otherwise; rfzeros =1 for stocks with above median fraction of zero returns; rbidask=1 for stocks with above median bid ask spread. Other controls are Price, log(size), BEME, MOM and Ret1m, as in Table 3. Standard errors are double clustered by firm and date. *, **, and *** indicate statistical significance at the 10%, 5% & 1% levels respectively.

Panel A: Continuous Liquidity Measures

	Daily return (%)								
TOM	0.102	0.138	0.123	0.056	0.083	0.074	0.051	0.08	0.07
	(1.65)*	(2.31)**	(2.08)**	(0.8)	(1.29)	(1.13)	(0.68)	(1.16)	(1.01)
TOM*Amihud	0.139	0.068	0.159						
	(0.62)	(0.29)	(0.66)						
TOM*Amihud*stk401wt		-0.211	-0.611						
		(-0.43)	(-1.33)						
Amihud	-3.917	0.441	0.617						
	(-0.12)	(0.01)	(4.96)***						
Amihud*stk401wt		-83.431	0.088						
		(-0.4)	(0.37)						
TOM*BidAsk				4.296	3.809	3.712			
				(2.34)**	(2.70)***	(2.39)**			
TOM*BidAsk*stk401wt					-0.085	0.289			
					(0.02)	(0.07)			
BidAsk				48.235	-2.186	5.808			
				(0.36)	(-0.02)	(7.59)***			
BidAsk*stk401wt					507.732	1.139			
					(1.05)	(0.91)			
TOM*Fzeros							1.228	1.058	1.041
							(2.22)**	(2.36)**	(2.18)**
TOM*Fzeros*stk401wt								0.211	0.409
								(0.25)	(0.43)
Fzeros							26.033	18.628	1.239
							(1.23)	(0.82)	(4.67)***
Fzeros*stk401wt								162.527	0.59
								(1.02)	(1.94)*
TOM*stk401wt		-0.159	-0.146		-0.097	-0.094		-0.103	-0.1
		(-1.80)*	(-1.65)*		(-1.17)	(-1.09)		(-1.21)	(-1.14)
Stk401wt			-0.038			-0.048			-0.061
			(2.02)**			(2.52)**			(3.11)***
Fixed effect	Firm*month	Firm*month	Firm, month	Firm*month	Firm*month	Firm, month	Firm*month	Firm*month	Firm, month
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.04	0.04	0.01	0.04	0.04	0.01	0.04	0.04	0.01
N	12,040,765	12,040,765	10,026,169	12,034,628	12,034,628	10,019,652	12,040,765	12,040,765	10,026,169

Panel B: Liquidity Groups (high vs. low)

	Daily return (%)								
TOM	0.082	0.135	0.114	0.079	0.131	0.112	0.081	0.127	0.106
	(1.17)	(1.69)*	(1.48)	(1.13)	(1.63)	(1.47)	(1.11)	(1.55)	(1.36)
TOM*rAmihud	0.043	0.006	0.018						
	(1.47)	(0.12)	(0.38)						
TOM*rAmihud*stk401wt		0.048	0.031						
		(0.65)	(0.45)						
rAmihud	-0.008	0.082	0.174						
	(-0.04)	(0.36)	(9.62)***						
rAmihud*stk401wt		-0.583	-0.039						
		(-0.72)	(-1.69)*						
TOM*rBidAsk				0.048	0.011	0.02			
				(1.67)*	(0.21)	(0.43)			
TOM*rBidAsk*stk401wt					0.057	0.039			
					(0.70)	(0.51)			
rBidAsk				-0.037	-0.098	0.118			
				(-0.09)	(-0.24)	(7.42)***			
rBidAsk*stk401wt					0.427	-0.042			
					(0.25)	(-1.82)*			
TOM*rFzeros							0.044	0.019	0.032
							(1.38)	(0.38)	(0.7)
TOM*rFzeros*stk401wt								0.019	-0.003
								(0.28)	(0.05)
rFzeros							1.253	0.259	0.088
							(0.77)	(0.51)	(5.88)***
rFzeros*stk401wt								18.473	-0.045
								(0.75)	(2.34)**
TOM*stk401wt		-0.17	-0.147		-0.169	-0.148		-0.157	-0.133
		(-1.4)	(-1.25)		(-1.36)	(-1.24)		(-1.35)	(-1.2)
Stk401wt			0.004			-0.002			-0.012
			(0.17)			(-0.08)			(-0.5)
Fixed effect	Firm*month	Firm*month	Firm, month	Firm*month	Firm*month	Firm, month	Firm*month	Firm*month	Firm, month
Other controls	yes	yes	yes	yes	yes	yes	yes	yes	yes
R^2	0.04	0.04	0.01	0.04	0.04	0.01	0.04	0.04	0.01
N	12,040,765	12,040,765	10,026,169	12,034,628	12,034,628	10,019,652	12,040,765	12,040,765	10,026,169

Table 6: Turn-of-the-Month Volume and 401 (K) Exposure

This table shows results for differences in ToM volume depending on a stock's 401K exposure. Standard errors are double clustered by firm and date. *, **, and *** indicate statistical significance at the 10%, 5% & 1% levels respectively.

	Normalized shares volume						
TOM	0.087	0.09	0.087	0.087	0.089	0.091	0.166
	(10.78)***	(9.70)***	(9.21)***	(9.24)***	(9.65)***	(7.78)***	(6.63)***
TOM*stk401wt		-0.013	-0.011	-0.011	-0.012	-0.009	-0.007
		(-1.09)	(-0.89)	(-0.89)	(-1.03)	(-1.07)	(-0.8)
MOM (t-12,t-2)			0.001	0.001			
			(0.63)	(2.37)**			
Ret (t-1)			-0.003	-0.004			
			(-0.44)	(-2.54)**			
BEME			0	-0.001			
			(0.23)	(-1.4)			
Price			0	0			
			(0.19)	(0.48)			
Log(Size)			0.004	0.004			
			(1.54)	(5.67)***			
Stk401wt			0.006	0.003			
			(1.14)	(1.30)			
IO*TOM						-0.005	0.012
						(-0.47)	(-1.13)
MOM*TOM							-0.004
							(1.46)
Ret1m*TOM							0.015
							(0.84)
BEME*TOM							-0.009
							(-2.49)**
Price*TOM							0.000
							(3.07)***
Logsize*TOM							-0.006
							(-3.84)***
Fixed effect	Firm*month	Firm*month	Firm	Firm, month	Firm*month	Firm*month	Firm*month
R^2	0.01	0.01	0	0	0.01	0.01	0.01
N	12,047,578	12,047,578	10,026,231	10,026,231	11,940,335	11,888,993	10,026,229

Table 7: Target date funds and the Turn-of-the-Month Effect

This table shows the relationship between the exposure to Target date funds and the ToM effect. Weight calculated using target date funds is correlated with the stk401kwt (our measure) with a correlation of 0.168. Since target date funds' holdings are available very quarter, we follow the Return gap study (Kacperzczyk, Sialm and Zheng (RFS, 2008)) to estimate each funds' month end holdings, and then construct stocks' target date fund exposure (in %). Standard errors are double clustered by firm and date. *, **, and *** indicate statistical significance at the 10%, 5% & 1% levels respectively.

				Daily return in %			
TOM	0.084	0.147	0.136	0.141	0.148	0.148	0.603
	(1.31)	(2.52)**	(2.30)**	(2.46)**	(2.52)**	(2.33)**	(3.27)***
TOM*Targetwt		-0.089	-0.085	-0.086	-0.089	-0.087	-0.106
		(-1.35)	(-1.28)	(-1.32)	(-1.35)	(-1.36)	(-1.59)
MOM (t-12,t-2)			0.011	0.012			
			(0.57)	(1.13)			
Ret (t-1)			0.004	-0.151			
			(0.03)	(-2.90)***			
BEME			0.001	-0.001			
			(0.05)	(-0.14)			
Price			0.0000	0.0000			
			(0.31)	(0.49)			
Log(Size)			-0.21	-0.195			
			(-8.27)***	(-15.98)***			
Targetwt			0.026	0.003			
			(0.68)	(0.14)			
IO*TOM						-0.007	0.132
						(-0.11)	(2.10)**
MOM*TOM							0.051
							(1.03)
Ret1m*TOM							0.255
							(0.85)
BEME*TOM							-0.01
							(-0.42)
Price*TOM							0.0000
							(0.18)
Log(Size)*TOM							-0.039
							(-3.19)***
Fixed effect	Firm*month	Firm*month	Firm	Firm, month	Firm*month	Firm*month	Firm*month
R^2	0.04	0.04	0	0.01	0.04	0.04	0.04
N	10,264,386	10,264,386	9,666,205	9,666,205	10,258,747	10,067,166	9,599,521

Table 8: Retirement flows and a Mid-Month Effect

This table shows the relationship between the exposure to 401(K) funds and returns to stocks in the middle of the trading month. Sample period runs from 2000-2012 for all common stocks (require shrcd (10,11), exchcd (1,2,3) and price>=1;) held by matched 401k funds (i.e., with 401k exposure available). Standard errors are double clustered by firm and date. *, **, and *** indicate statistical significance at the 10%, 5% & 1% levels respectively.

Panel A: 401(K) Exposure

	Daily return in %						
midm	-0.021	-0.032	-0.029	-0.025	-0.032	-0.041	-0.313
	(-0.26)	(-0.41)	(-0.35)	(-0.32)	(-0.41)	(-0.48)	(-1.99)**
midm*D_Highwt		0.052	0.05	0.05	0.052	0.048	0.051
		(2.33)**	(2.20)**	(2.21)**	(2.33)**	(1.73)*	(1.81)*
MOM (t-12,t-2)			-0.058	-0.046			
			(3.81)***	(5.52)***			
Ret (t-1)			-0.03	-0.029			
			(-0.41)	(-1.02)			
BEME			-0.172	-0.146			
			(-7.15)***	(-18.71)***			
Price			-0.00	0.00			
			(-0.78)	(2.10)**			
Log(Size)			0.028	0.031			
			(1.65)*	(4.48)***			
D_Highwt			-0.035	-0.037			
			(-6.29)***	(-7.79)***			
IO*TOM						0.017	-0.132
						(0.13)	(-0.98)
MOM*TOM							-0.05
							(-1.11)
Ret1m*TOM							-0.19
							(-0.92)
BEME*TOM							-0.054
							(-1.41)
Price*TOM							0.00
							(3.00)***
Log(Size)*TOM							0.031
							(2.76)***
Fixed effect	Firm*month	Firm*month	Firm	Firm*month	Firm*month	Firm*month	Firm*month
R^2	0.04	0.04	0.00	0.04	0.04	0.04	0.04
N	12,047,586	12,047,586	10,026,169	10,026,169	12,047,586	11,996,162	10,026,168

Panel B: Holdings of Target-date funds

				Daily return in %			
midm	0.005	-0.01	-0.01	-0.007	-0.01	0.034	-0.396
	(0.06)	(-0.12)	(-0.13)	(-0.09)	(-0.12)	(0.43)	(2.81)***
midm*D_Highwt		0.069	0.069	0.069	0.069	0.081	0.111
		(2.23)**	(2.14)**	(2.14)**	(2.23)**	(2.89)***	(3.58)***
MOM (t-12,t-2)			0.008	0.013			
			(0.39)	(1.19)			
Ret (t-1)			-0.002	-0.137			
			(-0.01)	(-2.65)***			
BEME			0.006	0.00			
			(0.41)	(0.08)			
Price			0.00	0.00			
			(0.05)	(0.34)			
Log(Size)			-0.207	-0.198			
			(-8.65)***	(-15.91)***			
D_Highwt			-0.45	-0.455			
			(-34.36)***	(-42.71)***			
IO*TOM						-0.077	-0.196
						(-0.69)	(-1.53)
MOM*TOM							-0.029
							(-0.45)
Ret1m*TOM							0.281
							(-0.73)
BEME*TOM							0.021
							(-0.67)
Price*TOM							0.00
							(2.79)***
Log(Size)*TOM							0.036
							(3.17)***
Fixed effect	Firm*month	Firm*month	Firm	Firm, month	Firm*month	Firm*month	Firm*month
R^2	0.04	0.04	0.00	0.01	0.04	0.04	0.04
N	10,264,386	10,264,386	9,666,205	9,666,205	10,264,386	10,067,665	9,599,521