

# The Unintended Consequences of the Zero-Bound Policy

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## **Abstract**

We investigate the effect of the zero-bound interest rate policy on money market funds industry. We find that, as the Fed funds rate approaches zero bound, money funds display reaching for yield incentives in that they invest in riskier asset classes and hold less diversified portfolios. The reduction in interest rates also increases the likelihood of funds exiting the market and lowers expenses funds charge to investors. Consistent with the reputation concerns at stake, we find that funds affiliated with large financial institutions are more likely to exit the market while funds managed by independent asset management companies take on relatively more risk. Additional evidence from the Fed's forward guidance policy corroborates the findings.

## I. Introduction

In the aftermath of the financial crisis of 2007-2008, the Federal Reserve took an unprecedented decision to lower short-term nominal interest rates to zero, a policy commonly called a zero-bound policy. Although this decision had a positive intention of stimulating a faltering economic growth and boosting employment in the U.S. economy, it has also produced an adverse shock to competitiveness of money market funds. Since money market funds invest in instruments that offer rates that are close to the Fed funds rate, their gross profit margins collapsed nearly to zero and many fund investors were facing investment opportunities with guaranteed negative returns after paying their fund expenses. In this paper, we analyze the consequences of the interest rate policy for the behavior of money market funds.

The traditional business model of money market funds used to rely on the idea that such funds offer relatively low returns for the provision of ultimate safety. While this idea has been somewhat shattered with the collapse of the Reserve Primary Fund and the run on money market funds in September 2008, until then, money market funds offered positive rates to investors, even after taking into consideration fund expenses. The consequence of the unprecedented change in the interest rate to levels close to 0% has been that returns on traditional money market instruments, such as Treasuries, repos, or deposits declined to similarly low levels. As a result, any fund investing in such assets would guarantee negative net of expense returns to investors. Hence, it has become obvious that this business model cannot be sustained as money would flow out of funds with negative returns.

Such dire situation posed a dilemma for money market funds. On the one hand, they could accept the situation and keep their risk profile as is. This, however, would force them to first reduce or even waive their fees, and in the end, if the low-rates situation persist, to exit the market. On the

other hand, funds could reach for yield by shifting their risk into securities with higher interest rates, thus accepting higher risk in their portfolios.

Money funds might increase the return offered to fund investors by means of reducing expenses charged to investors, especially if they are part of larger financial institutions which can be willing to subsidize the operation of the money funds. However, funds which struggle to generate positive returns to their investors can also find it optimal to increase risk in their portfolios, which would then lead to an increase in fund returns and potentially fund flows. As has been documented in Kacperczyk and Schnabl (2013), money market funds face a typical positive flow-performance relationship. Given that fund compensation is an increasing function of flows such strategy would potentially improve the profitability of the funds themselves. Moreover, boosting fund net returns above zero would likely prevent the fund from ultimate distress and exit from the market. The cost of increasing risk, however, would be a higher chance of being run on in the event of distress in the money market industry. The consequence of such runs would be distress of individual funds themselves, which could generate high costs either in terms of the necessity to bail out the fund or through the significant loss of reputation for the fund organization and other related business centered on fund sponsor.

In this paper, we provide empirical evidence of the equilibrium response of money funds to the low interest rates environment. We exploit both a time-series and cross-sectional variation in the data to identify the effect of monetary policy on money market funds' strategies. Specifically, we first look at the effect of the Fed funds rate on the funds return, expenses, probability to exit from the industry, and the funds' incentives to take risk. We show that there exists a strong discontinuity in the effect of the Fed funds rate on these variables, because the Fed interest rate policy has no significant effect when the rate is above one percent, but it becomes very significant both economically and statistically in a low interest rate regime. In particular, we find that a reduction in

interest rate leads to a significant increase in risk-taking incentives, a reduction in charged expenses, an increase in fund subsidies, and an increased probability to exit from the market.

Moreover, consistent with the differential incentives shaped by reputational concerns, we find that the reaching for yield phenomenon is particularly pronounced for independent funds, that is, funds that are not affiliated with a commercial bank, an investment bank, or an insurance company. In contrast, rather than ramping up risk, affiliated funds are more likely to take the path of exiting the market altogether. At the same time, we do not find significant differences across fund types in terms of their expense policy.

To avoid any contamination of our results from other concurrent macro events and further sharpen our empirical identification, we next turn to evidence from event studies related to an unprecedented zero-bound interest rate policy introduced by the Fed in the aftermath of the financial crisis. In particular, we study the money fund response to four FOMC announcements, which signaled that interest rates would be kept low in the future. Those include the original decision in December 2008 to lower Fed funds rate to zero, and subsequent four decisions of forward guidance policies that provided more details on how long the bound would be maintained. Important, these decisions were unlikely endogenous with respect to the behavior of money funds. Within these event windows, we compare the money funds' risk choices, exit decisions, and expense ratios both in the cross-section and in the time series.

We find that in the period of three to six months after these announcements, there is a significant increase in the probability of exit from the fund industry, fund risk taking increases, as measured by the funds' spread and by the fraction of portfolio invested in riskier asset classes, and expenses charged by money funds go down and the fund subsidies go up. Interestingly, while we do not find any variation in the expenses *incurred* by these funds over time, the expenses *charged* are

significantly reduced during a zero interest rate period. This result suggests that money funds were actively trying to maintain their net returns positive as a way of keeping their business alive and did not simply witness a period of lower operating costs altogether. We also find significant differences in the cross-section of funds consistent with our previous findings. Following the FOMC decisions, funds that are affiliated with an independent sponsor take on relatively more risk but are less likely to leave the money fund industry. At the same time we do not observe significant differences in the cost policy across the two groups. These results are consistent with the explanation in which reputational concerns shape up the strategic decisions of money funds.

Altogether, our results suggest that the unconventional monetary policy implemented during the financial crisis by the Fed might have produced unintended consequences regarding the fragility of an important part of financial markets, the market for short-term financing and shadow banking. Specifically, low interest rates can decrease rather than increase the liquidity available for banks, as one of the main sources of such wholesale funding, the money market funds, are incentivized to invest in riskier securities when they are not forced to exit the market altogether.

Furthermore, the results highlight one important channel for monetary policy that has been completely overlooked by the academic literature, but that is extremely relevant for practitioners and policy makers. For instance, in August 2009 Fitch released a report about U.S. money market funds stating that "Over the longer term, more conservative portfolio composition, combined with the current low interest rate environment, may result in fund closures, fund consolidation, and/or a resurgent appetite for credit and liquidity risk."<sup>1</sup>

In the same spirit, a recent article on the Financial Times summarized the risks associated with the zero interest rates as follows:

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<sup>1</sup> "U.S. Prime Money Market Funds: Managing Portfolio Composition to Address Credit & Liquidity Risks" is available on Fitch's web site at [www.fitchratings.com](http://www.fitchratings.com).

“The risks are that as rates will plunge to zero or negative, money market funds and their investors would panic as their sources of yield disappeared, and that banks will follow Bank of New York Mellon's lead last year and consider the possibility of charging fees on deposits. Money market funds would likely be subsidized for a time by their sponsors, but that can't be counted on to the extent that it was before the crisis. Were this to pass, we couldn't with any certainty predict the consequences—but given the panic that ensued when Reserve Primary broke the buck, it's worth taking none of this lightly.”<sup>2</sup>

The rest of the paper proceeds as follows. In Section II, we discuss the related literature. Section III provides further details about the institutional setting of money market funds. The empirical design and data, as well as the empirical results are discussed in Section IV and Section V, respectively. Section VI concludes.

## **II. Related Literature**

Several papers have studied the role of money market funds during the financial crisis, the European debt crisis, or outside the crisis. These include Christoffersen (2001), Christoffersen and Musto (2002), Baba, McCauley, and Ramaswamy (2009), Duygan-Bump, Parkinson, Rosengren, Suarez, and Willen (2010), McCabe (2010), Adrian, Kimbrough, and Marchioni (2011), Kacperczyk and Schnabl (2013), Strahan and Tanyeri (2012), Wermers (2012), Chernenko and Sunderam (2012), and Di Maggio (2012).

To the best of our knowledge ours is the first paper to examine the role of monetary policy in affecting the risk-taking incentives of money fund managers. In this regard, the closest papers to ours are Kacperczyk and Schnabl (2013), Strahan and Tanyeri (2012), and Di Maggio (2012) all of

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<sup>2</sup> Available at <http://ftalphaville.ft.com/2012/07/20/1083261/ioer-negative-rates-and-ben/>

which investigate the risk-taking incentives of money market funds before and after the collapse of Lehman Brothers, and during the European debt crisis, respectively. The key difference between these papers and ours is that we examine the role of the monetary policy to quantify the incentives to reach for yields, to adjust fund expense policy, and to moderate the entry and exit dynamics of the money fund industry.

More broadly, our paper sheds new light on the incentives for asset managers to reach for yield, which has been identified as one of the core factors contributing to the buildup of credit that preceded the financial crisis (Rajan (2010), Yellen (2011), and Stein (2013)). There might be several explanations of the reaching-for-yield phenomenon. It could be driven by competition among fund managers, or it could be a reflection of different preferences for risk or a desire to offset constraints imposed by regulation. The contribution of this paper is to provide a setting in which the incentives to reach for yield are on the one hand limited by strict regulation, yet on the other hand they are significantly affected by changes in interest rates and expectations about future changes.

Our paper is also related to studies on the importance of monetary policy for asset prices. Several papers investigate the response of the Treasury rates and asset prices to the FOMC announcements (see among others, Krishnamurthy and Vissing-Jorgenson (2011), Gürkaynaka, Sack, and Swanson (2005)) and of the term structure of interest rates to monetary policy surprises. We contribute to this literature by examining the role of monetary policy in shaping fund managers' incentives to reach for yield.

Finally, our paper has important implications for the vast literature on conducting the zero interest rate monetary policy (for summary, see Woodford (2003), and Bernanke, Reinhart, and Sack (2004)). In this regard, we highlight an important instability outcome that might be triggered by conducting the zero-bound policy.

### III. The Institutional Setting: Money Market Funds

Money market funds (MMFs) are important intermediaries between investors who want low-risk, liquid investments and banks and corporations that have short-term borrowing needs. The funds are key buyers of short-term debt issued by banks and corporations: commercial paper, bank certificates, and repurchase agreements, with an aggregate volume of \$1.8 trillion. Given the importance of short-term credit markets to both investors and businesses, any disruption represents a potential threat to financial stability. MMFs have recently drawn attention of academics as illustrated by a strand of literature exploring their behavior during the financial crisis in 2007-2009 (Kacperczyk and Schnabl (2013) and Gorton and Metrick (2012)) and the more recent Sovereign debt crisis (Chernenko and Sunderam (2012) and Ivashina, Scharfstein, and Stein (2012)). We contribute to this literature by showing the impact of the zero interest rates on the funds' trading, cost, and exit strategies.

Money market funds emerged in the 1970s as an alternative to bank deposits. At that time, bank deposits were highly regulated and paid lower interest rates than did money market instruments, which made money funds attractive to investors as they paid higher interest for taking on comparable risks. Even though the regulation of bank deposits was eventually abolished, the size of the fund industry grew steadily over time up to \$2.4 trillion at the beginning of 2007 (see Federal Reserve Flow of Funds Data).

An important characteristic of money funds is that, contrary to bank deposits, investments in the funds are not insured by the government. But, contrary to regular mutual funds, money funds seek to preserve the value of their assets at \$1 per share. They do so by using historical cost accounting, rather than market value pricing, to assess the value of their holdings. This allows them to sell demand deposits that are considered almost as safe as bank deposits. The downside of this



approach is that it exposes them to runs. If the market value of a fund's holdings is expected to drop below its amortized cost, investors tend to redeem their shares, which can exacerbate the market value drop due to forced liquidation at re-sale prices. Also, funds may suffer losses on their investments because of changes in interest rates or individual securities' defaults.

In the United States money market funds' holdings are regulated by Rule 2a-7 of the Investment Company Act of 1940. The funds are prohibited from purchasing long-term assets such as mortgage-backed securities, corporate bonds, or equity and can only hold short-term assets; and even these short-term liabilities must be of high quality. As an additional requirement, to enhance diversification, the funds cannot hold more than 5% of their assets in the securities of any individual issuer with the highest rating and not more than 1% in the securities of any other issuer.

In January 2009, after a tumultuous year for money market funds, the SEC voted to amend the 2a-7 rules to strengthen money market funds. The new rules seek to limit the risk and improve on fund disclosure. For instance, funds are now required to have enhanced reserves of cash and readily liquidated securities to meet redemption requests and they can invest only 3 percent (down from 5 percent) of total assets in tier-2 securities, the term on which is limited to a maximum maturity of 45 days.

Under the new rules, starting in November 2010 money market funds have make monthly disclosure of detailed data, including each fund's holdings and shadow net asset value (NAV). This information becomes available to the public after 60 days. The new N-MFP form on which it is filed constitutes one the main sources of data for the present study.

## IV. Research Design and Data

### IV.A. Research Design

In our empirical tests we aim to identify the role of the interest rate policy for money funds' risk-taking behavior, the expense policy, and the likelihood to exit from the market. To this end, we entertain two empirical strategies. In our first test, we examine the consequences of the changes in the Fed funds rate over the longer period of 2005-2013. We restrict our attention to the period of January 2005–December 2013 in order to have a relatively balanced panel around the time in which the zero-bound policy was introduced. This period includes two distinct interest rate regimes: A regime in which the rate is higher than zero percent (2005-2008) and a regime with zero interest rates (2009-2013). As Figure 1 indicates, in the first regime the interest rate had been gradually going up from 2% at the beginning of 2005 to 5.25% in the middle of 2007 and then subsequently going down to 0-0.25% by the end of 2008. The second regime has been manifested by a continuous zero interest rate policy (in fact, the rate has been cut to zero on December 16, 2008).

Our identification in this test comes from the various changes in interest rates over the sample period. In addition, we examine the differences in fund behavior in periods of high rates and low rates. In particular, we are interested to learn whether approaching zero bound alters fund incentives in a significant way relative to other periods. To this end, we study fund responses separately in periods with interest rates higher than 1% and in periods with rates equal to or less than 1%.

In our second test, we refine our empirical strategy by looking only inside the zero interest-rate regime. Our analysis of that sub-period allows us to keep the level of interest rates constant at zero and further explore the importance of the additional communication from the Federal Reserve regarding the duration of the zero-rate policy. In our context, the duration of zero rate policy is

crucial as it directly determines how long the money market fund business is subject to profit stress. In particular, one could imagine that short-lasting policy would have different equilibrium implications as money funds could withstand temporary headwinds by taking short-term losses. The situation differs when the pressure is held for longer time.

In our analysis, we concentrate on the money fund behavior around events related to FOMC meetings during which at least one of the following outcomes occurred: (1) a change in the interest rates, (2) forward guidance announcement. Table 1 provides a short description of the events in a chronological order. The first event date is December 16, 2008, which is the date of the meeting at which the Fed funds rate was cut to 0-0.25%, while the other four event dates capture the meetings in which the Fed gave its forward guidance regarding the duration of the zero-rate regime. Specifically, on March 18, 2009, the Fed announced that the rates will be zero for “an extended period of time”, while on August 9, 2011, January 25, 2012, and September 13, 2012 the Fed stated that the rates will remain at zero until 2012, 2014, and 2015, respectively.

Our event-study analysis requires constructing reasonable windows around event dates. Given that various money funds decisions can be adapted with different speed we consider two horizons: a short-term horizon of three months after the event and a long-term horizon of six months after the event. In both cases, the pre-event window is set at one month as we want to ensure that no pre-event trends drive the patterns in our data. Our empirical strategy is to compare the average fund behavior around the event date.

In both empirical tests, we also exploit cross-sectional differences across money market funds. In particular, we distinguish between funds whose sponsors are affiliated with a large financial institution, such as commercial bank, investment bank, or insurance company and funds whose sponsors are affiliated with an independent asset management company. We believe the two

groups might exhibit distinct responses to the events of interest rate changes. For example, the bank-affiliated funds might exhibit weaker incentives to reach for yield than independent funds to limit the probability of the bad outcome in which the bank would be forced to invest resources to save the fund. Independent funds, in turn, have stronger incentives to reach for yield in order to provide investors with higher returns, which should compensate the investors for giving up the implicit insurance of the bank. Moreover, bank-affiliated funds might have reputation at stake in which case they might prefer to exit the less risky yet unprofitable fund industry rather than improve its profitability by ramping up risk.

#### IV.B. Data

We collect data from four sources. First, we obtain data on the universe of taxable money market funds from iMoneyNet, which cover the period from January 2005 to December 2013 and include weekly fund-level data on yields, expense ratios (charged and incurred), average maturity, holdings by instrument type, and fund sponsor. Second, we complement the data with information from the CRSP Mutual Fund Database, especially assets under management of the fund sponsor. Third, we use COMPUSTAT and companies' websites for information on fund sponsor characteristics. Similar data, though for a different time period, have been already used and additionally discussed in Kacperczyk and Schnabl (2013). Fourth, we gather detailed information about Fed funds rate changes and the forward guidance policy from the Federal Reserve Board website.

We conduct our analysis at the fund portfolio level. We therefore aggregate all share classes by fund and type of investor (retail, institutional). We compute fund characteristics (e.g., expense ratio) as the weighted average with assets per share class as weights. Some funds offer both retail and institutional share classes. Institutional shares are generally larger; hence, we classify a fund as

institutional if it offers at least one institutional class and as retail if it does not offer institutional share classes.

Table 2 provides the summary statistics of the data. In columns (1) and (2), we provide information about mean and standard deviation of various fund and sponsor characteristics in the entire sample period. Our sample includes 349 different fund portfolios. The average fund size in our sample equals approximately \$8.3 billion. The average portfolio maturity is 40 days and the average fund age equals 15.8 years. The average Fed funds rate in our sample equals 182 basis points while the average gross fund return equals 231 basis points. Out of the abnormal profit of 48 basis points 38 basis points account for expenses, which leaves about 10 basis points accruing to fund investors. Notably, our sample is quite balanced with respect to sponsor type as 59% of funds have bank-affiliated sponsors and 41% are sponsored by independent asset management companies.

In the subsequent four columns, we compare sample properties between the high-rate and low-rate regimes. This sample split is based on the median interest rate equal to 1% and reflects our view of what we consider a period of profit stress. Comparing the two sub-samples we note a number of interesting patterns. First, the spread during the low-rate period is 25% lower than that in the high-rate period; also, the nominal gross return was almost ten times larger in the high-rate period. This suggests that money market funds faced greater challenges in obtaining high returns in a low interest rate environment. Second, if we look at the expenses charged they are significantly lower in the low-rate period, with a drop from 50 to 28 basis points, while the expenses incurred remain almost the same. This suggests that while the costs were not affected by the monetary policy, the stress imposed on the profit margin reduced the possibility for the fund to charge fees to the investors. In other words, funds were more likely to offer subsidies to their fund investors. Third, while fund flows are positive during the earlier period, they become negative in the low interest rate environment. This is consistent with the idea that investors have become less willing to

make investments in money market funds as their returns became less attractive. Finally, we observe a significant decline of more than 50 in the number of funds over the two periods: from 326 to 274 funds in the second period, which constitutes a significant exit from this sector.

In the last four columns of Table 2 we focus only on the period of low interest rates and report separate summary statistics for two major groups of funds: bank affiliated and independent. Bank-affiliated funds are defined as funds sponsored by a commercial bank, an investment bank, or an insurance company. Bank-affiliated funds are on average smaller with the difference of about \$3 billion. They are also less risky as their spreads are lower; they invest in shorter maturity assets as well as in safer assets as repos and Treasuries. They also charge slightly lower expenses, and they face higher outflows, consistent with the flow-performance relationship observed in other studies (Chevalier and Ellison (1997), and Kacperczyk and Schnabl (2013)).

## V. Empirical Results

In this section, we present the main results of the paper. First, we illustrate the importance interest rates play in generating fund returns and illustrate the link between fund returns and subsequent fund flows. Next, we look at the effects on risk taking, fund exit, and expenses of changes in the Fed funds rate *near* the zero interest rate bound and compare them to any other changes in interest rates before the zero-bound policy. Finally, we zero in on the effects within the low interest rate policy and examine similar behavior around the FOMC interest rate and forward guidance announcements.

## V.A. The Effect of the Fed Funds Rate Changes

### *V.A.1 Flow-Performance Relationship*

We begin our analysis by identifying the link between interest rate and gross fund return. To this end, we estimate the regression model of fund returns (*Fund Return*) on the Fed funds rate over the entire sample period. In this regression model, we control for other determinants of fund returns possibly correlated with the level of interest rates, such as the natural logarithm of fund size ( $\text{Log}(\text{Fund Size})$ ), the natural logarithm of fund family size ( $\text{Log}(\text{Family Size})$ ), the level of expenses charged by funds (*Expenses*), the natural logarithm of fund age (*Age*), the percentage change in fund assets accounted for capital appreciation (*Fund Flow*), the standard deviation of fund flows (*Fund Flow Volatility*), and an indicator variable for the fund that is institutional (*Institutional*). Further, we account for any time-invariant fund and sponsor characteristics by introducing fund-fixed and sponsor-fixed effects. To address a potential concern that interest rates do not vary across fund observations within given week and thus Fed funds rate might simply proxy for the time trends in the data we also include year-fixed effects. Finally, we cluster standard errors at the time dimension to address the possibility that interest rates are identical across fund observations. We report the results in Table 3.

Our results show that fund performance is higher in periods of higher interest rates. The effect is statistically and economically highly significant. Specifically, a one-standard-deviation increase in the interest rate leads to an increase of 128-194 basis points in the fund return, more than 60% change in terms of one standard deviation of fund returns. This result underscores the importance of interest rate regimes for generating fund performance.

In the next test, we show that generating superior performance has important implications for fund flows and hence for fund manager compensation. To this end, we estimate the standard

flow-performance relationship. Kacperczyk and Schnabl (2013) demonstrate the presence of such a relationship in the pre-Lehman period for the subsample of institutional money funds. Here we examine this relationship for all prime funds over the longer time period and separately for the high-rate and low-rate regimes. Our set of controls mimics that used in Table 3. However, given the nature of the data in some specifications we account for the finer week-level variation by introducing week-fixed effects. In all regressions we cluster standard errors at the fund sponsor level. Table 4 reports the results.

In column (1) we report the results for the full sample of money funds. We confirm the findings from earlier studies that investors exhibit strong sensitivity to fund past returns. The coefficient of *Fund Return* is positive and highly statistically significant. It is also economically significant: A one-standard-deviation increase in *Fund Return* results in a fund flow of about 1.9% per week, which is approximately 40% of the standard deviation of fund flows in the data. In terms of fund size, it means over the year a fund with a one-standard-deviation higher return than the average would almost double its size relative to the average fund.

In column (2), we also show that fund flows are positively correlated with the Fed funds rate, which is a direct consequence of our earlier findings in Table 3. In column (3), we further show that the flow-performance relationship does not depend on the level of interest rates, as the coefficient of the interaction term *Fund Return\*Fed Rate* is statistically insignificant. This result however is obtained without properly accounting for week-fixed effects and does not account for potential nonlinearities in which interest rates affect the sensitivity. To this end, in columns (4) and (5) we further provide estimates of the flow-performance relationship separately for the period with high interest rates and low interest rates.



At first glance, it seems that the flow-performance relationship is stronger in periods of lower interest rates as the coefficient of *Fund Return* is about 30% larger in that sample. Hence, we conclude that the changes in interest rates altered considerably the payoff per unit of extra performance. What has also changed is the level of fund performance which made investors less attracted to money funds and triggered significant fund responses in terms of their exit, risk-taking, and expense strategies. We now discuss each of these adjustments.

#### *V.A.2 Adjustments along Exit, Risk-Taking, and Expense Strategies*

Since interest rate environment directly affects profit opportunities it is becoming increasingly more difficult for funds to operate profitably as the interest rates approach zero rate bound. Consequently, they might need to adjust along various margins, such as their exit strategies, their risk, and expense policy.

We begin by analyzing the effect of the Fed rate on the number of active funds and on the probability of their exit. To this end, we estimate the regression model for each of the two dependent variables on the level of Fed funds rate using a full sample of funds and two sub-samples based on the level of interest rates. Apart from the standard controls we used before, all regressions include year/month-fixed effects and sponsor-fixed effects. We cluster standard errors at the week level. Table 5 reports the results.

Overall, we find little effect of higher interest rates on exiting or attrition in this industry in the full sample as highlighted by columns (1) and (4). However, significant differences emerge when we compare results across two interest-rate regimes. While we again find little effect of interest rate changes on exit strategies in the high-rate regime, as evidenced in columns (2) and (5), we find that the changes in interest rates from 1% towards zero have a very important implications for fund exit, as demonstrated in columns (3) and (6). In particular, we find that by reducing the Fed rate from

1% to 0% the number of funds in our sample decreases by about 11.3, and the probability of exiting from the industry increases by 7.2%. Both effects are highly significant both statistically and economically. Notably, in this specification, we include very fine year/month-fixed effects, which makes it highly unlikely that we are picking up the time trend, or the effect of some unobserved macro shock.

We next turn to the funds' incentives to take risk. We use four different measures of risk, similar to those used in Kacperczyk and Schnabl (2013). *Spread* is the difference between *Fund Return* and the rate on Treasury bill; *Holdings Risk* is a long-short portfolio invested long in the riskiest asset class (bank obligations) and short in the safest asset class (Repos and U.S. Treasuries and Agency assets); *Maturity Risk* is the weighted average maturity of the fund; *Concentration* is a Herfindhal index of the portfolio holdings in risky assets, such as commercial paper, asset-backed commercial paper, floating-rate notes, and bank obligations. Higher values of each measure indicate a greater degree of risk taking. We estimate the regression model in which the dependent variables are various risk measures and the main independent variable is *Fed Rate*. As before, all regressions include year/month-fixed effects and sponsor-fixed effects, and standard errors are clustered at the week dimension. We report the results in Table 6. Given our interest in the effects of low-rate policy we only report results for the low-rate regime; the high-rate regime results are significantly weaker and omitted for brevity.

We find a statistically significant positive effect of reducing *Fed Rate* on the level of risk for three out of four risk measures. The effect is negative, but statistically insignificant for *Maturity Risk*. In terms of economic values, a reduction in the *Fed Rate* from 1% to 0% increases *Spread* by almost 95 basis points *Holdings Risk* by 6.8 percent, and *Concentration* by 2.4%. These are sizable effects, especially for the money funds with returns close to zero.

Our last dimension of adjustment is the expense policy. It is apparent that in the wake of low interest rates and thus low returns fund companies might want to maintain their client relationship by reducing the fees charged to their investors, effectively increasing these investors' net returns. We want to contrast this behavior with the expenses that are truly incurred by the funds which are more difficult to adjust. In addition, we measure the degree of subsidies that funds offer to their investors by taking the difference between incurred and charged expenses. We estimate the regression model in which *Charged Expenses*, *Incurred Expenses*, and *Subsidy* are our dependent variables and *Fed Rate* is our main independent variable. All other controls are the same as before. However, in contrast to previous regressions, we cluster standard errors at the sponsor level since fund expenses seem to be quite persistent over time and thus this dimension of dependence produces more conservative standard errors. Table 7 reports the results from the estimation for the full sample and the two sub-samples of high and low rates.

The results, in columns (1), (4), and (7), indicate a general negative effect of interest rates on fund expenses, both charged and incurred, and a positive effect on fund subsidies. However, this result is largely driven by the high-rate regime (columns (2), (5), and (8)), that is, fund expenses are generally lower when interest rates are higher, perhaps because funds have generally higher profit margins and do not need to charge much for their service. However, the opposite is true when interest rates approach zero bound: Lower rates reduce the expenses charged by the funds. As the *Fed Rate* goes down from 1% to 0% funds charge 7.6 basis points less for their service, as presented in column (3). This reduction occurs despite the fact that fund incurred expenses are generally unaffected by the interest rate change, as demonstrated in column (6). This asymmetric response in expenses is equivalent to an increase in fund subsidies offered to investors. As presented in column (9), a decrease in *Fed Rate* from 1% to 0% increases fund subsidy by an economically large 6.6 basis points. This effect is statistically and economically highly significant.

### *V.A.3 Evidence from the Cross-Section of Funds*

So far, we based our results on the time-series identification strategy, that is, we compared changes in fund behavior across different levels of the Fed funds rate. In this section, we further buttress our identification strategy using cross-sectional variation in the incentives to respond to profit margin squeeze across different fund sponsors. As we have demonstrated, fund sponsors might want to respond to margin deterioration either by changing their exit, their risk, or expenses strategies. However, these responses also might depend on other concerns. In particular, fund sponsors with greater reputation concerns at stake or greater ability to provide funding in case of the run might want to internalize these negative spillovers by either taking less risk or leaving the industry altogether. They might also entertain different pricing strategies. In our sample, we postulate that the important dimension of differences is whether the fund is sponsored by a financial institution (with large concerns and greater ability to pay) or is sponsored by an independent asset management company (usually with less reputation concern and smaller ability to pay).

We explore these differences empirically using a difference-in-differences regression approach. In particular, we want to compare exit, risk taking, and expenses strategies for funds with different sponsor type across High-Rate and Low-Rate regimes. To this end, we define two indicator variables: *Independent Sponsor* equal to one if the sponsor is an independent company and zero if it is a financial institution; *Low Rate* equal to one if the *Fed Rate* is at most 1% and zero if the rate is above 1%. The differential effect of the change in the interest rate regime across two fund types will be measured by the coefficient of the interaction term *Independent Sponsor\*Low Rate*.

In Table 8, we present the results for the number of funds and exit strategies. All regressions include year/month-fixed and sponsor-fixed effects. We find a positive and statistically significant effect of the interaction term for the number of funds: There are relatively more funds

sponsored by independent companies in the low-rate regime. At the same time, the results indicate little evidence of differences across fund types in terms of their exit strategies.

Table 9 reports the results for the risk measures. In all regressions, we include week-fixed effects; thus eliminating any possible effects due to time trends. Consistent with our hypothesis that independent funds might have less at stake in terms of their risk taking, we find that such funds, on average, take on more risk when the monetary policy shifts to lower interest rate regime. This effect is statistically and economically large for all four measures of risk. Specifically, relative to affiliated funds, the spread of independent funds increases by 2.4 basis points, holdings risk increases by 7.3 basis points, funds maturity risk increases by one third of the standard deviation, or equivalently by 4.5 days on average, and concentration increases by 3.8 percentage points. In all regressions, the coefficient of *Independent Sponsor* is not statistically different from zero, which suggests the two groups of funds are similar to each other in high-rate periods.

We entertain similar tests for two measures of expenses and subsidy and report the results in Table 10. Although independent sponsors are on average less likely to subsidize their funds, we find no statistically significant differential effect between the independent funds and the bank-affiliated funds in terms of expense strategies. These results suggest that even though funds, in general, lower their expenses in the low-rate regime they do not execute this strategy in economically distinct ways.

## **V.B. Fund Strategies around the FOMC Announcements**

Up to this point we have analyzed the effect of Fed funds rate on different outcome variables over different sample periods, also taking advantage of the cross-sectional differences across fund sponsors. In this section, we turn into our second empirical strategy in which we evaluate fund behavior, both in the time series and in the cross-section around the important decisions taken by the FOMC during the low interest rate period. As we have argued before there are five events in

which the Fed has signaled important information regarding the level and duration of the zero interest rate policy. We study the changes in fund behavior before and after such events, also conditional on fund sponsor type. Our main variable in all tests is *Event* which is an indicator variable equal to one for the period after the event date and zero beforehand.

In our analysis, we consider two types of windows: We first look at the interval between one month before and three months after the event, then we investigate the effect over a longer time interval as we compare the outcome over the six months after the event compared to the month before the event. We restrict attention to one month before the event to avoid any contamination with other potential events. We analyze these two types of windows because there are strategies that the funds can immediately alter, such as the riskiness of their portfolio or expense policy, but also other strategies for which we might not observe any effect for an extended period of time, such as the exit from the market.

We begin with the analysis of the exit strategy. Panel A of Table 11 reports the results. We find that, on average, three funds drop after the event both in the shorter and longer time window. Similarly, we find that the probability of exiting the industry increases significantly in both horizons following the event. We have reported the results for all the events together, but we find consistent results for each event separately. Moreover, later events are more important than early ones, perhaps the forward guidance policy extended the low-rate regime into a longer future with more certainty. In sum, our results indicate that there is indeed tension in the industry generated by the monetary policy.

Panel B shows a similar event study analysis but conditional on the sponsor type. The incremental effect of change with respect to sponsor type is measured by the coefficient of the interaction term *Event\*Independent Sponsor*. We find that the independent funds are more likely to stay

and less likely to exit because these are the funds which are less wary of any reputational concerns due to runs. Instead, these funds offset their profits' squeeze by increasing their risk taking to attract more investors. The result is particularly strong for the longer six-month window, which is consistent with our premise that adjustments, such as exit might take longer to materialize.

Next, we perform a similar analysis for the risk-taking incentives. The results are reported in Panel A and Panel B of Table 12. We find that as a result of strengthening the policy of the zero interest rate, three out of four measures of fund riskiness increase. The only one that in fact goes down is *Maturity Risk*. But this is likely driven by the provision in the Dodd-Frank Act which implemented a significantly higher lower bound for the fraction of assets maturing within the next seven days that money market funds need to hold. The results in the cross-section of funds, reported in Panel B, generally paint a picture that funds sponsored by independent asset management companies take on more risk following the change in the interest rate policy. This result is true again for the same three measures of risk as before. Overall, these results are consistent with our earlier finding that lowering interest rates makes such funds reach for yield relatively more.

Finally, we investigate changes in the expense policy. The results are reported in Panel A (for the time series) and Panel B (for the cross-section) of Table 13. Consistent with the previous findings, we find that the expenses charged (fund subsidies) get reduced (increased) following the FOMC events. These effects are particularly strong for the longer, six-month window, which might reflect some stickiness with which fund companies generally respond in terms of their expense policies. Again, we find no differences across fund types in terms of their expense policies. Notably, many funds often waive their expenses to investors, especially in the low-rate regimes, another dimension of adjustment which can be used to alleviate the pressure due to low interest rate policy.

To the extent that the FOMC events trigger attrition in the fund industry the worry is that our results for risk taking might be mechanically different by differences in the sample selection before and after the events. To the extent that safer funds were more likely to exit we could observe an increase in average risk taking even though individual funds might not change their policies at all. We address this concern by focusing on a subset of funds that are present in both periods around the event date. In Table 14, we present the results from the estimation of regression models similar to those in Table 12. The results we find are qualitatively and quantitatively very similar to those reported before; thus, our results are unlikely to be driven by the differential selection within the event window.

In sum, our results corroborate our earlier findings that money funds respond to pressures in their business due to unusually low interest rates either by increasing the riskiness of their portfolios, lowering (increasing) the expenses (subsidies) they charge to their investors, or leaving the fund industry altogether. The strength of these effects tends to vary with the fund sponsor, especially when it comes to dimensions of risk and exit.

## **VI. Conclusion**

This paper investigates the consequences of the zero interest rate policy on the money market funds' behavior. The monetary policy has a direct effect on money market funds as these primarily invest in asset classes whose returns are linked to the Fed funds rate. This constitutes a great setting to explore the unintended consequences that monetary policy may have on financial markets.

We uncover novel empirical evidence showing that the low interest rate regime leads fund managers to increase the risk of their portfolios in order to generate positive returns. The effect is more pronounced for funds sponsored by asset management companies. Almost all funds significantly reduced their expenses charged, even if the incurred expenses did not vary much over



time, as an attempt to deliver non-negative net returns to their investors. These subsidies amounted to an economically large value of \$27 million per average fund and about \$7.3 billion for all funds. We also show that the funds that are not successful in retaining their investors' base, or are worried about possible negative reputation spillovers, are more likely to leave this market as a response to the cuts in interest rates.

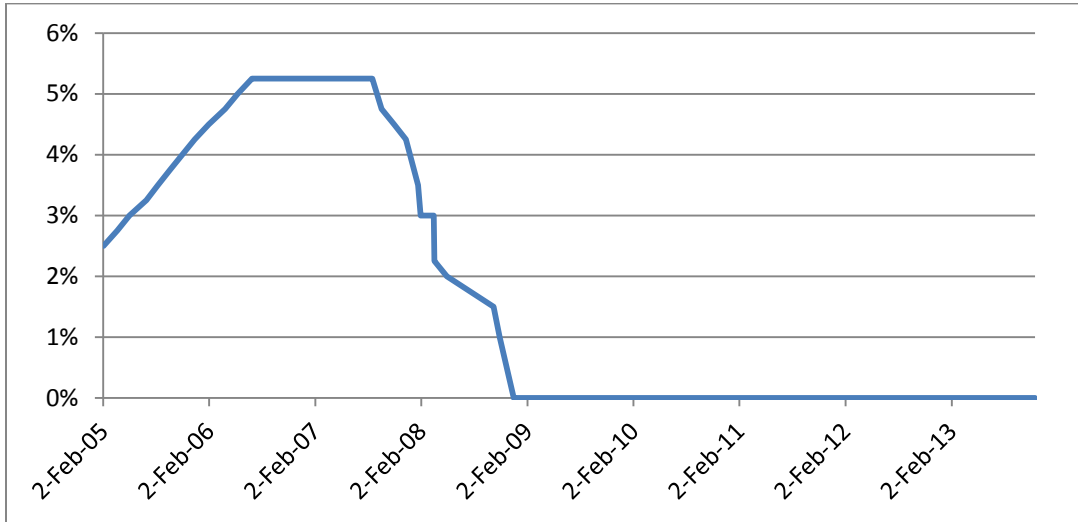
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**Figure 1: Fed Funds Rate: 2005-2013**

The figure presents the evolution of Fed funds rate over the period 2005-2013.



**Table 1: Zero Interest Rate Policy Events (ZIRP)**

We report the dates of FOMC meetings in which the Fed decided to change the Fed funds rate or provided policy guidance about the prevailing zero interest rate policy.

| Date               | Event                               |
|--------------------|-------------------------------------|
| December 16, 2008  | Fed funds rate reduced to 0-0.25    |
| March 18, 2009     | Zero rates for extended time period |
| August 9, 2011     | Zero rates at least until 2013      |
| January 25, 2012   | Zero rates at least until 2014      |
| September 13, 2012 | Zero rates at least until 2015      |

**Table 2: Summary Statistics**

The sample is all prime money market funds. The data span the period January 2005-December 2013. The first two columns provide the results for the entire sample over the full period. The subsequent two columns (High Rate) restrict the sample to the period of high interest rates (Fed funds rate greater than 1%). In the next two columns (Low Rate), we restrict the sample to the period of low interest rates (Fed funds rate between 0 and 1%). The following four columns focus on the low-rate regime and summarize the data of funds whose sponsors are affiliated with a financial institution (Affiliated) and for funds whose sponsors are independent asset management companies (Independent).

| Variable                       | Unconditional |          | High Rate |          | Low Rate |          | Low Rate: Affiliated |          | Low Rate: Independent |          |
|--------------------------------|---------------|----------|-----------|----------|----------|----------|----------------------|----------|-----------------------|----------|
|                                | Mean          | St. dev. | Mean      | St. dev. | Mean     | St. dev. | Mean                 | St. dev. | Mean                  | St. dev. |
| Fed Rate (in %)                | 1.83          | 2.02     | 3.65      | 1.31     | 0.06     | 0.15     | 0.06                 | 0.15     | 0.06                  | 0.15     |
| Fund Return (in bps)           | 231.07        | 206.28   | 419.13    | 114.58   | 46.95    | 53.23    | 46.41                | 52.78    | 47.72                 | 53.84    |
| Spread (in bps)                | 47.24         | 53.84    | 53.85     | 61.78    | 40.74    | 43.74    | 40.14                | 43.14    | 41.60                 | 44.56    |
| Holdings Risk (in %)           | -8.30         | 27.98    | -5.13     | 26.19    | -11.37   | 29.29    | -14.34               | 27.32    | -7.17                 | 31.38    |
| Maturity (in days)             | 40.29         | 13.05    | 39.55     | 12.85    | 41.00    | 13.21    | 39.12                | 12.77    | 43.66                 | 13.36    |
| Concentration (in %)           | 27.63         | 17.52    | 31.91     | 18.43    | 23.50    | 15.52    | 23.37                | 16.36    | 23.69                 | 14.25    |
| Expenses Charged (in bps)      | 38.54         | 25.38    | 49.69     | 27.98    | 27.63    | 16.37    | 27.16                | 16.60    | 28.29                 | 16.02    |
| Expenses Incurred (in bps)     | 56.99         | 32.38    | 58.36     | 32.62    | 55.65    | 32.10    | 53.74                | 28.30    | 58.34                 | 36.63    |
| Subsidy                        | 18.34         | 27.33    | 8.50      | 20.50    | 27.97    | 29.65    | 26.53                | 25.58    | 30.01                 | 34.48    |
| Fund Size                      | 8303          | 21651    | 7083      | 17173    | 9481     | 25176    | 8102                 | 24211    | 11430                 | 26356    |
| Family Size                    | 151599        | 253903   | 122320    | 204508   | 182160   | 293725   | 113790               | 118291   | 279344                | 415854   |
| Age (in years)                 | 15.80         | 7.86     | 13.40     | 7.04     | 18.13    | 7.91     | 17.28                | 7.87     | 19.33                 | 7.81     |
| Fund Flow (in %)               | 0.05          | 4.78     | 0.26      | 5.24     | -0.16    | 4.28     | -0.19                | 4.64     | -0.12                 | 3.70     |
| Fund Flow Volatility (in %)    | 3.66          | 3.86     | 4.12      | 4.27     | 3.21     | 3.37     | 3.57                 | 3.52     | 2.70                  | 3.08     |
| Independent Sponsor (in %)     | 40.92         | 49.17    | 40.37     | 49.07    | 41.44    | 49.26    | 0                    | 0        | 100                   | 0        |
| Bank Affiliated Sponsor (in %) | 59.08         | 49.17    | 59.63     | 49.07    | 58.56    | 49.26    | 100                  | 0        | 0                     | 0        |
| Sponsor Equity                 | 10117         | 17052    | 9955      | 16742    | 10275    | 17345    | 16580                | 19918    | 1374                  | 5492     |
| U.S. Treasuries & Agency       | 0.10          | 0.16     | 0.07      | 0.13     | 0.13     | 0.18     | 0.13                 | 0.16     | 0.15                  | 0.20     |
| Repurchase Agreements          | 0.13          | 0.15     | 0.11      | 0.15     | 0.14     | 0.16     | 0.16                 | 0.16     | 0.13                  | 0.15     |
| Bank Deposits                  | 0.02          | 0.06     | 0.02      | 0.06     | 0.03     | 0.07     | 0.03                 | 0.06     | 0.02                  | 0.07     |
| Bank Obligations               | 0.15          | 0.14     | 0.13      | 0.13     | 0.17     | 0.15     | 0.14                 | 0.14     | 0.20                  | 0.15     |
| Floating-Rate Notes            | 0.18          | 0.17     | 0.20      | 0.17     | 0.17     | 0.17     | 0.17                 | 0.18     | 0.16                  | 0.15     |
| Commercial Paper               | 0.30          | 0.22     | 0.34      | 0.24     | 0.26     | 0.19     | 0.26                 | 0.19     | 0.26                  | 0.19     |
| Asset-Backed Commercial Paper  | 0.11          | 0.14     | 0.13      | 0.15     | 0.10     | 0.12     | 0.11                 | 0.12     | 0.08                  | 0.11     |
| Institutional Funds (in %)     | 45.94         | 46.76    | 45.73     | 46.71    | 46.14    | 46.81    | 47.63                | 46.81    | 44.02                 | 46.72    |
| Number of Funds                | 349           |          | 326       |          | 274      |          | 159                  |          | 115                   |          |

**Table 3: Fund Returns and Fed Funds Rate**

The sample is all U.S. prime money market funds over the period January 2005–December 2013. The dependent variable is *Fund Gross Return* computed as the annualized return. *Fed Rate* is the annualized Fed funds rate. Control variables include the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow growth, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level. Column (1) includes year-fixed effects, column (2) includes fund-fixed effects, column (3) includes sponsor-fixed effects, and column (4) includes year-fixed and sponsor-fixed effects. Standard errors are clustered at the week level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

| VARIABLES             | (1)                   | (2)                     | (3)                    | (4)                   |
|-----------------------|-----------------------|-------------------------|------------------------|-----------------------|
|                       | Fund Gross Return     |                         |                        |                       |
| Fed Rate              | 62.291***<br>(5.087)  | 93.025***<br>(1.012)    | 94.370***<br>(0.963)   | 62.291***<br>(5.087)  |
| Log(Fund Size)        | 1.260***<br>(0.061)   | 16.683***<br>(1.292)    | 5.170***<br>(0.361)    | 1.260***<br>(0.061)   |
| Log(Family Size)      | 1.038***<br>(0.095)   | 3.556***<br>(0.779)     | 5.754***<br>(1.034)    | 1.038***<br>(0.095)   |
| Expenses              | 20.641***<br>(1.957)  | 118.308***<br>(8.642)   | 86.409***<br>(6.641)   | 20.641***<br>(1.957)  |
| Log(Age)              | 0.453<br>(0.331)      | -5.946***<br>(1.382)    | -8.508***<br>(1.358)   | 0.453<br>(0.331)      |
| Fund Flow             | 21.525***<br>(5.265)  | 10.017<br>(8.677)       | 15.402*<br>(9.193)     | 21.525***<br>(5.265)  |
| Fund Flow Volatility  | -32.930***<br>(4.181) | 104.429***<br>(13.735)  | 98.761***<br>(13.816)  | -32.930***<br>(4.181) |
| Institutional         | 4.842***<br>(0.353)   | -9.791***<br>(1.198)    | 13.391***<br>(1.004)   | 4.842***<br>(0.353)   |
| Constant              | 87.400***<br>(9.498)  | -116.116***<br>(15.848) | -42.169***<br>(12.965) | 87.400***<br>(9.498)  |
| Year-Fixed Effects    | Yes                   | No                      | No                     | Yes                   |
| Fund-Fixed Effects    | No                    | Yes                     | No                     | No                    |
| Sponsor-Fixed Effects | No                    | No                      | Yes                    | Yes                   |
| Observations          | 98,496                | 98,496                  | 98,496                 | 98,496                |

**Table 4: The Flow-Performance Relationship**

The sample is all U.S. prime money market funds over the period January 2005-December 2013. The dependent variable is *Fund Flow*, computed as the percentage change in total net assets from time  $t$  to time  $t+1$ , adjusted for market appreciation. *Fed Rate* is the annualized Fed funds rate. *Fund Return* is the annualized fund return. Control variables include the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include sponsor-fixed effects. *High Rate* restricts the sample to the period of high interest rates (Fed funds rate greater than 1%). *Low Rate* restricts the sample to the period of low interest rates (Fed funds rate between 0 and 1%). Columns (1), (4), and (5) additionally include week-fixed effects. Standard errors are clustered at the fund sponsor level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

| VARIABLES             | (1)                  | (2)                 | (3)                  | (4)                  | (5)                  |
|-----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|
|                       |                      | Full Sample         |                      | High Rate            | Low Rate             |
| Fund Return           | 0.009***<br>(0.001)  |                     | 0.003***<br>(0.001)  | 0.007***<br>(0.002)  | 0.009***<br>(0.002)  |
| Fed Rate              |                      | 0.001***<br>(0.000) | -0.002*<br>(0.001)   |                      |                      |
| Fed Rate*Fund Return  |                      |                     | 0.000<br>(0.000)     |                      |                      |
| Log(Fund Size)        | -0.000***<br>(0.000) | -0.000**<br>(0.000) | -0.001***<br>(0.000) | -0.001***<br>(0.000) | -0.000<br>(0.000)    |
| Log(Family Size)      | 0.002***<br>(0.000)  | 0.002***<br>(0.000) | 0.001***<br>(0.000)  | 0.001<br>(0.001)     | 0.002***<br>(0.001)  |
| Expenses              | -0.003**<br>(0.001)  | -0.001<br>(0.001)   | -0.003**<br>(0.001)  | -0.003**<br>(0.001)  | -0.007*<br>(0.004)   |
| Age                   | -0.001<br>(0.001)    | -0.001*<br>(0.001)  | -0.001<br>(0.001)    | -0.001<br>(0.001)    | -0.000<br>(0.001)    |
| Fund Flow Volatility  | 0.072***<br>(0.014)  | 0.073***<br>(0.015) | 0.071***<br>(0.015)  | 0.092***<br>(0.020)  | 0.042*<br>(0.022)    |
| Institutional         | -0.000<br>(0.001)    | 0.000<br>(0.001)    | -0.000<br>(0.001)    | -0.001<br>(0.001)    | -0.000<br>(0.001)    |
| Constant              | -0.018***<br>(0.005) | -0.013**<br>(0.005) | -0.011**<br>(0.005)  | -0.002<br>(0.009)    | -0.022***<br>(0.008) |
| Sponsor-Fixed Effects | Yes                  | Yes                 | Yes                  | Yes                  | Yes                  |
| Week-Fixed Effects    | Yes                  | No                  | No                   | Yes                  | Yes                  |
| Observations          | 98,948               | 98,974              | 98,948               | 50,572               | 48,376               |

**Table 5: Fund Exit and Fed Funds Rate**

The sample is all U.S. prime money market funds over the period January 2005-December 2013. The dependent variables are *Number of Funds*, defined as the number of funds in a given period, and *Exit*, defined as an indicator variable equal to one if the fund exits the fund industry in week  $t$ . *Fed Rate* is the annualized Fed funds rate. Control variables include the annualized fund return, the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include year/month-fixed and sponsor-fixed effects. *High Rate* restricts the sample to the period of high interest rates (Fed funds rate greater than 1%). *Low Rate* restricts the sample to the period of low interest rates (Fed funds rate between 0 and 1%). Standard errors are clustered at the week level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

| VARIABLES                | (1)                   | (2)                   |  | (3)                   | (4)                  | (5)                  |  | (6)                  |
|--------------------------|-----------------------|-----------------------|--|-----------------------|----------------------|----------------------|--|----------------------|
|                          | Full Sample           | Number of Funds       |  | Low Rate              | Full Sample          | Exit                 |  | Low Rate             |
|                          |                       | High Rate             |  |                       |                      | High Rate            |  |                      |
| Fed Rate                 | 0.654<br>(0.478)      | 0.515<br>(0.697)      |  | 11.310***<br>(3.063)  | 0.002<br>(0.002)     | 0.004<br>(0.002)     |  | -0.072***<br>(0.016) |
| Fund Return              | -0.061<br>(0.061)     | -0.248**<br>(0.101)   |  | 0.174**<br>(0.070)    | -0.014***<br>(0.003) | -0.020***<br>(0.004) |  | -0.001<br>(0.001)    |
| Log(Fund Size)           | -0.001<br>(0.001)     | -0.000<br>(0.001)     |  | -0.002***<br>(0.001)  | -0.001***<br>(0.000) | -0.002***<br>(0.000) |  | -0.001***<br>(0.000) |
| Log(Family Size)         | -0.001<br>(0.002)     | 0.005**<br>(0.002)    |  | -0.000<br>(0.001)     | -0.001*<br>(0.001)   | -0.000<br>(0.000)    |  | -0.001<br>(0.001)    |
| Expenses                 | -0.015*<br>(0.008)    | -0.017*<br>(0.009)    |  | -0.058**<br>(0.028)   | -0.014***<br>(0.002) | -0.023***<br>(0.004) |  | -0.011**<br>(0.005)  |
| Age                      | 0.003**<br>(0.001)    | 0.005*<br>(0.003)     |  | 0.000<br>(0.001)      | 0.001*<br>(0.000)    | 0.000<br>(0.000)     |  | 0.001**<br>(0.001)   |
| Fund Flow                | 0.038<br>(0.081)      | 0.022<br>(0.107)      |  | 0.087<br>(0.113)      | -0.029***<br>(0.008) | -0.018***<br>(0.007) |  | -0.041***<br>(0.015) |
| Fund Flow Volatility     | -0.017<br>(0.020)     | -0.093***<br>(0.025)  |  | 0.034<br>(0.026)      | 0.037***<br>(0.010)  | -0.005<br>(0.010)    |  | 0.076***<br>(0.019)  |
| Institutional            | -0.004**<br>(0.001)   | -0.006**<br>(0.003)   |  | -0.004**<br>(0.002)   | -0.004***<br>(0.001) | -0.008***<br>(0.001) |  | -0.002**<br>(0.001)  |
| Constant                 | 290.883***<br>(0.927) | 291.512***<br>(1.337) |  | 175.000***<br>(0.014) | 0.054***<br>(0.011)  | 0.069***<br>(0.013)  |  | 0.018*<br>(0.010)    |
| Year/Month-Fixed Effects | Yes                   | Yes                   |  | Yes                   | Yes                  | Yes                  |  | Yes                  |
| Sponsor-Fixed Effects    | Yes                   | Yes                   |  | Yes                   | Yes                  | Yes                  |  | Yes                  |
| Observations             | 98,792                | 50,334                |  | 48,458                | 98,792               | 50,334               |  | 48,458               |



**Table 6: Fund Risk and Fed Funds Rate (Low-Rate Regime)**

The sample is all U.S. prime money market funds. The dependent variables are: the weekly annualized spread (*Spread*), the fraction of assets held in risky assets, net of the riskless assets (*Holdings Risk*), average portfolio maturity (*Maturity Risk*), and portfolio concentration, defined as a Herfindahl Index of asset classes (*Concentration*). *Fed Rate* is the annualized Fed funds rate. Control variables include the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include year/month-fixed and sponsor-fixed effects. The sample is restricted to the period of low interest rates (Fed funds rate between 0 and 1%). Standard errors are clustered at the week level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

| VARIABLES                | (1)<br>Spread         | (2)<br>Holdings Risk  | (3)<br>Maturity Risk  | (4)<br>Concentration |
|--------------------------|-----------------------|-----------------------|-----------------------|----------------------|
| Fed Rate                 | -94.917**<br>(46.443) | -6.770**<br>(3.070)   | 0.924<br>(4.121)      | -0.024*<br>(0.014)   |
| Log(Fund Size)           | 0.400***<br>(0.099)   | 1.690***<br>(0.042)   | 0.208***<br>(0.026)   | 0.003***<br>(0.000)  |
| Log(Family Size)         | -2.371***<br>(0.604)  | 0.694***<br>(0.260)   | -0.395<br>(0.290)     | 0.009***<br>(0.002)  |
| Expenses                 | 1.996***<br>(0.439)   | 0.243<br>(0.265)      | 0.969***<br>(0.193)   | 0.009***<br>(0.001)  |
| Fund Flow                | -37.591***<br>(2.455) | -6.721**<br>(2.798)   | -12.627***<br>(1.413) | 0.216***<br>(0.012)  |
| Fund Flow Volatility     | 4.346***<br>(0.737)   | -3.275***<br>(1.160)  | 11.074***<br>(0.502)  | -0.030***<br>(0.006) |
| Institutional            | -15.650***<br>(1.479) | -18.582***<br>(1.299) | -15.326***<br>(1.049) | 0.024***<br>(0.007)  |
| Constant                 | -0.070<br>(0.140)     | 2.586***<br>(0.171)   | -1.076***<br>(0.129)  | 0.002<br>(0.001)     |
| Sponsor-Fixed Effects    | Yes                   | Yes                   | Yes                   | Yes                  |
| Year/Month-Fixed Effects | Yes                   | Yes                   | Yes                   | Yes                  |
| Observations             | 45,322                | 46,065                | 46,054                | 46,065               |

**Table 7: Fund Expenses and Fed Funds Rate**

The sample is all U.S. prime money market funds over the period January 2005-December 2013. The dependent variables are *Charged Expenses*, defined as percentage expense rate charged by a fund, *Incurred Expenses*, defined as percentage expense rate incurred by a fund, *Subsidy*, defined as the difference between incurred and charged expenses. *Fed Rate* is the annualized Fed funds rate. Control variables include the annualized fund return, the natural logarithm of fund assets, the natural logarithm of family assets, the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include year-fixed and sponsor-fixed effects. *High Rate* restricts the sample to the period of high interest rates (Fed funds rate greater than 1%). *Low Rate* restricts the sample to the period of low interest rates (Fed funds rate between 0 and 1%). Standard errors are clustered at the sponsor level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

| VARIABLES             | (1)                  | (2)                  |                      | (3)                  | (4)                  |                      |                      | (5)                  | (6)                  | (7)         | (8)       |  | (9)      |
|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|-------------|-----------|--|----------|
|                       | Full Sample          | Charged Expenses     |                      | Low Rate             | Full Sample          | Incurred Expenses    |                      | High Rate            | Low Rate             | Full Sample | Subsidy   |  | Low Rate |
|                       |                      | High Rate            |                      |                      |                      |                      |                      |                      |                      |             | High Rate |  |          |
| Fed Rate              | -0.006***<br>(0.001) | -0.005***<br>(0.001) | 0.076***<br>(0.026)  | -0.002<br>(0.002)    | 0.003**<br>(0.001)   | 0.009<br>(0.011)     | 0.004***<br>(0.001)  | 0.007***<br>(0.001)  | -0.066***<br>(0.021) |             |           |  |          |
| Log(Fund Size)        | -0.020***<br>(0.001) | -0.036***<br>(0.000) | -0.007***<br>(0.000) | -0.052***<br>(0.001) | -0.057***<br>(0.001) | -0.046***<br>(0.001) | -0.031***<br>(0.001) | -0.020***<br>(0.001) | -0.039***<br>(0.001) |             |           |  |          |
| Log(Family Size)      | 0.021***<br>(0.001)  | 0.012***<br>(0.001)  | 0.007***<br>(0.001)  | 0.010***<br>(0.001)  | 0.010***<br>(0.001)  | 0.010***<br>(0.002)  | -0.010***<br>(0.002) | -0.000<br>(0.001)    | 0.004<br>(0.003)     |             |           |  |          |
| Age                   | 0.009***<br>(0.002)  | 0.000<br>(0.001)     | 0.013***<br>(0.002)  | 0.013***<br>(0.002)  | -0.010***<br>(0.001) | 0.027***<br>(0.003)  | 0.005<br>(0.003)     | -0.011***<br>(0.001) | 0.015***<br>(0.003)  |             |           |  |          |
| Fund Flow             | 0.009<br>(0.013)     | 0.018<br>(0.012)     | 0.015<br>(0.023)     | 0.003<br>(0.018)     | 0.031**<br>(0.014)   | -0.038<br>(0.037)    | 0.007<br>(0.019)     | 0.029***<br>(0.010)  | -0.045<br>(0.040)    |             |           |  |          |
| Fund Flow Volatility  | -0.946***<br>(0.023) | -1.104***<br>(0.024) | -0.524***<br>(0.032) | -0.631***<br>(0.035) | -0.734***<br>(0.023) | -0.593***<br>(0.089) | 0.290***<br>(0.037)  | 0.345***<br>(0.015)  | -0.089<br>(0.096)    |             |           |  |          |
| Institutional         | -0.206***<br>(0.006) | -0.323***<br>(0.002) | -0.099***<br>(0.006) | -0.318***<br>(0.001) | -0.336***<br>(0.002) | -0.317***<br>(0.002) | -0.111***<br>(0.005) | -0.012***<br>(0.001) | -0.217***<br>(0.006) |             |           |  |          |
| Constant              | 0.542***<br>(0.019)  | 0.848***<br>(0.013)  | 0.439***<br>(0.022)  | 0.982***<br>(0.023)  | 1.122***<br>(0.018)  | 0.789***<br>(0.035)  | 0.417***<br>(0.027)  | 0.249***<br>(0.013)  | 0.626***<br>(0.038)  |             |           |  |          |
| Sponsor-Fixed Effects | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |             |           |  |          |
| Year-Fixed Effects    | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |             |           |  |          |
| Observations          | 98,792               | 50,334               | 48,458               | 98,484               | 50,186               | 48,298               | 98,484               | 50,186               | 48,298               |             |           |  |          |

**Table 8: Fund Exit and Fed Funds Rate: Conditioning on Sponsor Type**

The sample is all U.S. prime money market funds over the period January 2005-December 2013. The dependent variables are *Number of Funds*, defined as the number of funds in a given period, and *Exit*, defined as an indicator variable equal to one if the fund exits the fund industry in week  $t$ . *Low Rate* is an indicator variable equal to one if the Fed funds rate is less than or equal 1%, and zero otherwise. *Independent Sponsor* is an indicator variable equal one if the fund sponsor is an independent asset management company, and zero otherwise. Control variables include the annualized fund return, the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include year/month-fixed and sponsor-fixed effects. Standard errors are clustered at the week level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

| VARIABLES                    | (1)<br>Number of Funds | (2)<br>Exit          |
|------------------------------|------------------------|----------------------|
| Low Rate                     | -0.623<br>(0.581)      | -0.009<br>(0.008)    |
| Independent Sponsor*Low Rate | 0.003**<br>(0.001)     | 0.000<br>(0.001)     |
| Fund Return                  | -0.046<br>(0.060)      | -0.013***<br>(0.003) |
| Log(Fund Size)               | -0.001<br>(0.001)      | -0.001***<br>(0.000) |
| Log(Family Size)             | -0.001<br>(0.002)      | -0.001*<br>(0.001)   |
| Expenses                     | -0.017**<br>(0.007)    | -0.014***<br>(0.002) |
| Age                          | 0.003**<br>(0.001)     | 0.001*<br>(0.000)    |
| Fund Flow                    | 0.033<br>(0.082)       | -0.029***<br>(0.008) |
| Fund Flow Volatility         | -0.013<br>(0.020)      | 0.037***<br>(0.010)  |
| Institutional                | -0.004***<br>(0.001)   | -0.004***<br>(0.001) |
| Constant                     | 292.123***<br>(0.113)  | 0.058***<br>(0.010)  |
| Year-Month-Fixed Effects     | Yes                    | Yes                  |
| Sponsor-Fixed Effect         | Yes                    | Yes                  |
| Observations                 | 98,795                 | 98,795               |

**Table 9: Fund Risk and Fed Funds Rate: Conditioning on Sponsor Type**

The sample is all U.S. prime money market funds over the period January 2005-December 2013. The dependent variables are: the weekly annualized spread (*Spread*), the fraction of assets held in risky assets, net of the riskless assets (*Holdings Risk*), average portfolio maturity (*Maturity Risk*), and portfolio concentration, defined as a Herfindahl Index of asset classes (*Concentration*). *Low Rate* is an indicator variable equal to one if the Fed funds rate is less than or equal 1%, and zero otherwise. *Independent Sponsor* is an indicator variable equal one if the fund sponsor is an independent asset management company, and zero otherwise. Control variables include the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include week-fixed effects. Standard errors are clustered at the week level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

| VARIABLES                    | (1)<br>Spread         | (2)<br>Holdings Risk   | (3)<br>Maturity Risk   | (4)<br>Concentration |
|------------------------------|-----------------------|------------------------|------------------------|----------------------|
| Independent Sponsor          | -0.239<br>(0.893)     | -0.130<br>(2.535)      | -0.904<br>(1.042)      | -0.026<br>(0.020)    |
| Independent Sponsor*Low Rate | 2.449**<br>(1.224)    | 7.328**<br>(2.905)     | 4.519***<br>(1.170)    | 0.038**<br>(0.017)   |
| Log(Fund Size)               | 0.847***<br>(0.277)   | 3.029***<br>(0.634)    | 0.540*<br>(0.314)      | -0.009**<br>(0.005)  |
| Log(Family Size)             | 0.867**<br>(0.361)    | 2.776***<br>(0.746)    | 0.427**<br>(0.209)     | -0.013***<br>(0.005) |
| Expenses                     | 5.652**<br>(2.426)    | 10.423**<br>(4.892)    | 0.565<br>(1.978)       | 0.022<br>(0.036)     |
| Age                          | 2.624*<br>(1.548)     | 2.216<br>(2.943)       | 3.655***<br>(1.338)    | 0.055**<br>(0.026)   |
| Fund Flow                    | 0.522<br>(7.537)      | -40.494*<br>(21.799)   | 9.170<br>(8.570)       | -0.255**<br>(0.111)  |
| Fund Flow Volatility         | -31.457**<br>(13.800) | -85.261**<br>(36.820)  | -54.163***<br>(16.366) | -0.583***<br>(0.194) |
| Institutional                | 2.469*<br>(1.327)     | 4.215<br>(2.963)       | -0.298<br>(1.045)      | -0.024<br>(0.020)    |
| Constant                     | 16.236**<br>(8.237)   | -75.077***<br>(15.476) | 15.104*<br>(8.017)     | 0.232*<br>(0.128)    |
| Week-Fixed Effect            | Yes                   | Yes                    | Yes                    | Yes                  |
| Observations                 | 94,521                | 95,264                 | 95,253                 | 95,264               |

**Table 10: Fund Expenses and Fed Funds Rate: Conditioning on Sponsor Type**

The sample is all U.S. prime money market funds over the period January 2005-December 2013. The dependent variables are *Charged Expenses*, defined as percentage expense rate charged by a fund, *Incurred Expenses*, defined as percentage expense rate incurred by a fund, *Subsidy*, defined as the difference between incurred and charged expenses. *Low Rate* is an indicator variable equal to one if the Fed funds rate is less than or equal 1%, and zero otherwise. *Independent Sponsor* is an indicator variable equal one if the fund sponsor is an independent asset management company, and zero otherwise. Control variables include the annualized fund return, the natural logarithm of fund assets, the natural logarithm of family assets, the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include week-fixed effects. Standard errors are clustered at the sponsor level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

| VARIABLES                    | (1)<br>Charged Expenses | (2)<br>Incurred Expenses | (3)<br>Subsidy       |
|------------------------------|-------------------------|--------------------------|----------------------|
| Independent Sponsor          | 0.012<br>(0.027)        | 0.062<br>(0.040)         | 0.049*<br>(0.027)    |
| Independent Sponsor*Low Rate | -0.013<br>(0.024)       | -0.031<br>(0.022)        | -0.018<br>(0.030)    |
| Log(Fund Size)               | -0.017***<br>(0.005)    | -0.048***<br>(0.010)     | -0.030***<br>(0.007) |
| Log(Family Size)             | 0.002<br>(0.005)        | 0.008<br>(0.010)         | 0.006<br>(0.007)     |
| Age                          | 0.023<br>(0.015)        | -0.005<br>(0.024)        | -0.027<br>(0.020)    |
| Fund Flow                    | 0.005<br>(0.018)        | -0.009<br>(0.035)        | 0.001<br>(0.033)     |
| Fund Flow Volatility         | -1.006***<br>(0.156)    | -0.640***<br>(0.240)     | 0.341*<br>(0.175)    |
| Institutional                | -0.190***<br>(0.020)    | -0.291***<br>(0.030)     | -0.099***<br>(0.019) |
| Constant                     | 0.505***<br>(0.097)     | 1.008***<br>(0.168)      | 0.496***<br>(0.135)  |
| Week-Fixed Effects           | Yes                     | Yes                      | Yes                  |
| Observations                 | 98,795                  | 98,484                   | 98,484               |

**Table 11: Fund Exit and ZIRP Shocks**

The sample is all U.S. prime money market funds. The dependent variables are *Number of Funds*, defined as the number of funds in a given period, and *Exit*, defined as an indicator variable equal to one if the fund exits the fund industry in week  $t$ . The estimation window includes one month before and three months (in columns (1) and (2)) and six months (in columns (3) and (4)) after the event dates defined in Table 1. *Event* is an indicator variable equal to one for the period after the event date and zero for the period before the event date. *Independent Sponsor* is an indicator variable equal one if the fund sponsor is an independent asset management company, and zero otherwise. Control variables include the annualized fund return, the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include year-fixed and sponsor-fixed effects. Standard errors are clustered at the week level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

Panel A: Fund Exit and Monetary Shocks

| VARIABLES             | (1)                               | (2)                  | (3)                               | (4)                  |
|-----------------------|-----------------------------------|----------------------|-----------------------------------|----------------------|
|                       | Number of Funds<br>3 Months Ahead | Exit                 | Number of Funds<br>6 Months Ahead | Exit                 |
| Event                 | -3.248***<br>(0.809)              | 0.002**<br>(0.001)   | -2.789***<br>(0.764)              | 0.002**<br>(0.001)   |
| Fund Return           | 3.899***<br>(0.690)               | -0.001<br>(0.002)    | 6.569***<br>(0.862)               | -0.002<br>(0.002)    |
| Log(Fund Size)        | -0.012*<br>(0.007)                | -0.001**<br>(0.000)  | -0.023***<br>(0.008)              | -0.001***<br>(0.000) |
| Log(Family Size)      | -0.171<br>(0.130)                 | -0.003<br>(0.002)    | -0.146<br>(0.103)                 | -0.003*<br>(0.002)   |
| Expenses              | -0.801***<br>(0.260)              | -0.014***<br>(0.005) | -0.298<br>(0.438)                 | -0.019***<br>(0.005) |
| Age                   | 0.298**<br>(0.129)                | 0.001*<br>(0.001)    | 0.280**<br>(0.134)                | 0.002**<br>(0.001)   |
| Fund Flow             | -1.515<br>(1.129)                 | -0.065**<br>(0.026)  | -1.110<br>(0.903)                 | -0.055**<br>(0.022)  |
| Fund Flow Volatility  | 3.734***<br>(0.607)               | 0.068**<br>(0.030)   | 4.881***<br>(0.611)               | 0.081***<br>(0.030)  |
| Institutional         | -0.070*<br>(0.040)                | -0.002**<br>(0.001)  | 0.047<br>(0.059)                  | -0.003***<br>(0.001) |
| Constant              | 237.789***<br>(2.280)             | 0.042<br>(0.028)     | 181.502***<br>(1.581)             | 0.039**<br>(0.019)   |
| Year-Fixed Effects    | Yes                               | Yes                  | Yes                               | Yes                  |
| Sponsor-Fixed Effects | Yes                               | Yes                  | Yes                               | Yes                  |
| Observations          | 18,568                            | 18,568               | 25,914                            | 25,914               |

Panel B: Conditioning on Sponsor Type and Monetary Shocks

| VARIABLES                 | (1)                               | (2)                  | (3)                               | (4)                  |
|---------------------------|-----------------------------------|----------------------|-----------------------------------|----------------------|
|                           | Number of Funds<br>3 Months Ahead | Exit                 | Number of Funds<br>6 Months Ahead | Exit                 |
| Event                     | -3.280***<br>(0.803)              | 0.002***<br>(0.001)  | -2.862***<br>(0.767)              | 0.002***<br>(0.001)  |
| Event*Independent Sponsor | 0.077<br>(0.067)                  | -0.002<br>(0.002)    | 0.178**<br>(0.081)                | -0.003**<br>(0.001)  |
| Fund Return               | 3.900***<br>(0.689)               | -0.001<br>(0.002)    | 6.574***<br>(0.861)               | -0.002<br>(0.002)    |
| Log(Fund Size)            | -0.012*<br>(0.007)                | -0.001**<br>(0.000)  | -0.023***<br>(0.008)              | -0.001***<br>(0.000) |
| Log(Family Size)          | -0.172<br>(0.130)                 | -0.003<br>(0.002)    | -0.150<br>(0.103)                 | -0.003*<br>(0.002)   |
| Expenses                  | -0.802***<br>(0.260)              | -0.013***<br>(0.005) | -0.309<br>(0.436)                 | -0.019***<br>(0.005) |
| Age                       | 0.298**<br>(0.129)                | 0.001*<br>(0.001)    | 0.281**<br>(0.134)                | 0.002**<br>(0.001)   |
| Fund Flow                 | -1.515<br>(1.130)                 | -0.065**<br>(0.026)  | -1.106<br>(0.905)                 | -0.055**<br>(0.022)  |
| Fund Flow Volatility      | 3.727***<br>(0.605)               | 0.068**<br>(0.030)   | 4.888***<br>(0.611)               | 0.081***<br>(0.030)  |
| Institutional             | -0.070*<br>(0.040)                | -0.002**<br>(0.001)  | 0.045<br>(0.059)                  | -0.003***<br>(0.001) |
| Constant                  | 237.790***<br>(2.283)             | 0.042<br>(0.027)     | 181.543***<br>(1.587)             | 0.038*<br>(0.019)    |
| Year-Fixed Effects        | Yes                               | Yes                  | Yes                               | Yes                  |
| Sponsor-Fixed Effects     | Yes                               | Yes                  | Yes                               | Yes                  |
| Observations              | 18,568                            | 18,568               | 25,914                            | 25,914               |

**Table 12: Fund Risk and ZIRP Shocks**

The sample is all U.S. prime money market funds. The dependent variables are: the weekly annualized spread (*Spread*), the fraction of assets held in risky assets, net of the riskless assets (*Holdings Risk*), average portfolio maturity (*Maturity Risk*), and portfolio concentration, defined as a Herfindahl Index of asset classes (*Concentration*). The estimation window includes one month before and three months (in columns (1)-(4)) and six months (in columns (5)-(8)) after the event dates defined in Table 1. *Event* is an indicator variable equal to one for the period after the event date and zero for the period before the event date. *Independent Sponsor* is an indicator variable equal one if the fund sponsor is an independent asset management company, and zero otherwise. Control variables include the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include year/month-fixed and sponsor-fixed effects (in Panel A) and year/month-fixed effects (in Panel B). Standard errors are clustered at the week level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

Panel A: Fund Risk and Monetary Shocks

| VARIABLES                | (1)                   | (2)                             | (3)                   | (4)                  | (5)                   | (6)                             | (7)                   | (8)                  |
|--------------------------|-----------------------|---------------------------------|-----------------------|----------------------|-----------------------|---------------------------------|-----------------------|----------------------|
|                          | Spread                | Holdings Risk<br>3 Months Ahead | Maturity Risk         | Concentration        | Spread                | Holdings Risk<br>6 Months Ahead | Maturity Risk         | Concentration        |
| Event                    | 34.329***<br>(12.113) | 0.954***<br>(0.323)             | -1.216**<br>(0.503)   | 0.005***<br>(0.002)  | 21.341**<br>(10.471)  | 0.879***<br>(0.271)             | -1.347***<br>(0.386)  | 0.005***<br>(0.001)  |
| Log(Fund Size)           | 0.311***<br>(0.087)   | 1.672***<br>(0.051)             | 0.244***<br>(0.043)   | 0.002***<br>(0.000)  | 0.251***<br>(0.073)   | 1.645***<br>(0.048)             | 0.248***<br>(0.034)   | 0.002***<br>(0.000)  |
| Log(Family Size)         | -7.141***<br>(1.528)  | 0.632<br>(0.524)                | -0.065<br>(0.516)     | 0.013***<br>(0.004)  | -4.828***<br>(1.177)  | 0.435<br>(0.395)                | 0.472<br>(0.423)      | 0.011***<br>(0.003)  |
| Expenses                 | 3.950***<br>(0.914)   | 2.043***<br>(0.335)             | 1.898***<br>(0.289)   | 0.015***<br>(0.002)  | 3.140***<br>(0.697)   | 1.296***<br>(0.313)             | 1.659***<br>(0.246)   | 0.012***<br>(0.002)  |
| Age                      | -63.297***<br>(5.856) | -5.511<br>(3.417)               | -14.730***<br>(2.111) | 0.173***<br>(0.021)  | -52.901***<br>(4.554) | -2.220<br>(3.474)               | -10.630***<br>(2.152) | 0.197***<br>(0.018)  |
| Fund Flow                | 2.211*<br>(1.286)     | 0.002<br>(1.955)                | 10.502***<br>(0.854)  | -0.041***<br>(0.012) | 1.566<br>(1.043)      | -0.739<br>(1.641)               | 9.684***<br>(0.681)   | -0.037***<br>(0.010) |
| Institutional            | -23.283***<br>(3.680) | -13.671***<br>(2.358)           | -22.086***<br>(1.544) | 0.002<br>(0.008)     | -21.940***<br>(2.649) | -19.000***<br>(2.182)           | -21.336***<br>(1.330) | -0.011<br>(0.007)    |
| Constant                 | -0.208<br>(0.235)     | 3.497***<br>(0.250)             | -0.732***<br>(0.152)  | 0.010***<br>(0.001)  | -0.459**<br>(0.193)   | 3.350***<br>(0.268)             | -0.738***<br>(0.189)  | 0.008***<br>(0.001)  |
| Year/Month-Fixed Effects | Yes                   | Yes                             | Yes                   | Yes                  | Yes                   | Yes                             | Yes                   | Yes                  |
| Sponsor-Fixed Effects    | Yes                   | Yes                             | Yes                   | Yes                  | Yes                   | Yes                             | Yes                   | Yes                  |
| Observations             | 16,830                | 16,882                          | 16,879                | 16,882               | 23,462                | 23,527                          | 23,524                | 23,527               |



Panel B: Conditioning on Sponsor Type and Monetary Shocks

| VARIABLES                 | (1)                   | (2)                             | (3)                             | (4)                 | (5)                   | (6)                             | (7)                             | (8)                 |
|---------------------------|-----------------------|---------------------------------|---------------------------------|---------------------|-----------------------|---------------------------------|---------------------------------|---------------------|
|                           | Spread                | Holdings Risk<br>3 Months Ahead | Maturity Risk<br>3 Months Ahead | Concentration       | Spread                | Holdings Risk<br>6 Months Ahead | Maturity Risk<br>6 Months Ahead | Concentration       |
| Independent Sponsor       | -3.837<br>(2.878)     | 6.642**<br>(3.309)              | 4.768***<br>(1.366)             | -0.000<br>(0.020)   | -0.776<br>(2.940)     | 5.681<br>(3.492)                | 5.107***<br>(1.484)             | -0.011<br>(0.021)   |
| Independent Sponsor*Event | 9.215***<br>(1.239)   | 1.821***<br>(0.634)             | -1.010**<br>(0.460)             | 0.008**<br>(0.004)  | 4.646***<br>(1.668)   | 3.405**<br>(1.533)              | -1.897***<br>(0.709)            | 0.026***<br>(0.007) |
| Log(Fund Size)            | 1.358**<br>(0.601)    | 3.102***<br>(0.889)             | 0.559<br>(0.444)                | -0.009*<br>(0.005)  | 1.121**<br>(0.514)    | 3.168***<br>(0.871)             | 0.503<br>(0.440)                | -0.008<br>(0.005)   |
| Log(Family Size)          | 1.132*<br>(0.663)     | 3.542***<br>(0.939)             | 0.347<br>(0.304)                | -0.012**<br>(0.005) | 0.936*<br>(0.559)     | 3.336***<br>(0.904)             | 0.427<br>(0.293)                | -0.013**<br>(0.005) |
| Expenses                  | 15.013**<br>(5.818)   | 15.387**<br>(6.780)             | -2.012<br>(3.046)               | 0.046<br>(0.041)    | 13.661***<br>(4.966)  | 15.591**<br>(6.588)             | -2.208<br>(2.981)               | 0.052<br>(0.040)    |
| Age                       | 11.336***<br>(3.351)  | 4.921<br>(4.337)                | 7.683***<br>(2.137)             | 0.085***<br>(0.032) | 9.207***<br>(2.932)   | 3.969<br>(4.171)                | 7.367***<br>(2.164)             | 0.087***<br>(0.032) |
| Fund Flow                 | 3.399<br>(15.427)     | -42.839<br>(26.417)             | 15.279<br>(9.695)               | -0.248*<br>(0.129)  | 3.629<br>(12.685)     | -45.113*<br>(25.876)            | 16.330<br>(10.039)              | -0.247*<br>(0.127)  |
| Fund Flow Volatility      | -61.994**<br>(25.558) | -53.305<br>(43.026)             | -60.787***<br>(18.732)          | -0.397*<br>(0.209)  | -52.152**<br>(21.349) | -57.933<br>(42.253)             | -60.876***<br>(18.776)          | -0.403**<br>(0.204) |
| Institutional             | 6.432**<br>(2.908)    | 8.657**<br>(3.824)              | -0.656<br>(1.505)               | -0.006<br>(0.021)   | 5.285**<br>(2.481)    | 8.297**<br>(3.668)              | -0.567<br>(1.472)               | -0.006<br>(0.021)   |
| Constant                  | -34.986*<br>(18.869)  | -111.568***<br>(23.029)         | -3.997<br>(12.725)              | -0.012<br>(0.160)   | -25.810<br>(16.505)   | -104.344***<br>(22.463)         | -2.431<br>(12.892)              | -0.027<br>(0.159)   |
| Year/Month-Fixed Effects  | Yes                   | Yes                             | Yes                             | Yes                 | Yes                   | Yes                             | Yes                             | Yes                 |
| Observations              | 16,830                | 16,882                          | 16,879                          | 16,882              | 23,462                | 23,527                          | 23,524                          | 23,527              |

**Table 13: Fund Expenses and ZIRP Shocks**

The sample is all U.S. prime money market funds. The dependent variables are *Charged Expenses*, defined as percentage expense rate charged by a fund, *Incurred Expenses*, defined as percentage expense rate incurred by a fund, *Subsidy*, defined as the difference between incurred and charged expenses. The estimation window includes one month before and three months (in columns (1)-(3)) and six months (in columns (4)-(6)) after the event dates defined in Table 1. *Event* is an indicator variable equal to one for the period after the event date and zero for the period before the event date. *Independent Sponsor* is an indicator variable equal one if the fund sponsor is an independent asset management company, and zero otherwise. Control variables include the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include year-fixed and sponsor-fixed effects (in Panel A) and week-fixed effects (in Panel B). Standard errors are clustered at the sponsor level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

Panel A: Fund Expenses and Monetary Shocks

| VARIABLES             | (1)                  | (2)                  | (3)                  | (4)                  | (5)                  | (6)                  |
|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|                       | Charged              | Incurred             | Subsidy              | Charged              | Incurred             | Subsidy              |
|                       | 3 months ahead       |                      |                      | 6 months ahead       |                      |                      |
| Event                 | -0.001<br>(0.002)    | -0.002**<br>(0.001)  | -0.002<br>(0.002)    | -0.014**<br>(0.006)  | -0.003***<br>(0.001) | 0.010**<br>(0.005)   |
| Log(Fund Size)        | -0.006***<br>(0.001) | -0.045***<br>(0.001) | -0.039***<br>(0.001) | -0.005***<br>(0.001) | -0.044***<br>(0.001) | -0.038***<br>(0.001) |
| Log(Family Size)      | 0.014***<br>(0.003)  | 0.031***<br>(0.003)  | 0.020***<br>(0.003)  | 0.006**<br>(0.002)   | 0.028***<br>(0.002)  | 0.025***<br>(0.003)  |
| Age                   | 0.010***<br>(0.003)  | 0.026***<br>(0.005)  | 0.016***<br>(0.004)  | 0.012***<br>(0.003)  | 0.031***<br>(0.004)  | 0.019***<br>(0.004)  |
| Fund Flow             | -0.028<br>(0.028)    | -0.006<br>(0.032)    | 0.029<br>(0.037)     | -0.024<br>(0.023)    | -0.005<br>(0.026)    | 0.028<br>(0.029)     |
| Fund Flow Volatility  | -0.699***<br>(0.057) | -0.804***<br>(0.044) | -0.127*<br>(0.074)   | -0.641***<br>(0.044) | -0.833***<br>(0.035) | -0.218***<br>(0.061) |
| Institutional         | -0.133***<br>(0.012) | -0.318***<br>(0.002) | -0.184***<br>(0.011) | -0.120***<br>(0.009) | -0.317***<br>(0.002) | -0.196***<br>(0.009) |
| Constant              | 0.445***<br>(0.034)  | 0.648***<br>(0.038)  | 0.167***<br>(0.042)  | 0.197***<br>(0.034)  | 0.566***<br>(0.032)  | 0.337***<br>(0.039)  |
| Sponsor-Fixed Effects | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Year-Fixed Effects    | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  |
| Observations          | 18,568               | 18,506               | 18,506               | 25,914               | 25,829               | 25,829               |

Panel B: Conditioning on Sponsor Type and Monetary Shocks

| VARIABLES                 | (1)                  | (2)                         | (3)                  | (4)                  | (5)                         | (6)                  |
|---------------------------|----------------------|-----------------------------|----------------------|----------------------|-----------------------------|----------------------|
|                           | Charged              | Incurring<br>3 months ahead | Subsidy              | Charged              | Incurring<br>6 months ahead | Subsidy              |
| Independent Sponsor       | -0.003<br>(0.020)    | 0.030<br>(0.039)            | 0.032<br>(0.027)     | -0.006<br>(0.022)    | 0.029<br>(0.039)            | 0.034<br>(0.027)     |
| Independent Sponsor*Event | 0.005<br>(0.006)     | 0.008<br>(0.005)            | 0.003<br>(0.007)     | 0.011<br>(0.012)     | 0.011<br>(0.010)            | 0.000<br>(0.013)     |
| Log(Fund Size)            | -0.006<br>(0.004)    | -0.047***<br>(0.011)        | -0.041***<br>(0.008) | -0.006<br>(0.004)    | -0.047***<br>(0.011)        | -0.040***<br>(0.008) |
| Log(Family Size)          | 0.003<br>(0.005)     | 0.004<br>(0.012)            | 0.001<br>(0.010)     | 0.004<br>(0.005)     | 0.005<br>(0.012)            | 0.000<br>(0.010)     |
| Age                       | 0.015<br>(0.013)     | -0.002<br>(0.026)           | -0.016<br>(0.022)    | 0.016<br>(0.012)     | 0.002<br>(0.026)            | -0.014<br>(0.023)    |
| Fund Flow                 | -0.022<br>(0.033)    | 0.003<br>(0.046)            | 0.035<br>(0.047)     | -0.012<br>(0.029)    | 0.004<br>(0.038)            | 0.032<br>(0.039)     |
| Fund Flow Volatility      | -0.789***<br>(0.149) | -0.592*<br>(0.299)          | 0.166<br>(0.240)     | -0.751***<br>(0.134) | -0.599**<br>(0.287)         | 0.115<br>(0.242)     |
| Institutional             | -0.115***<br>(0.016) | -0.290***<br>(0.033)        | -0.175***<br>(0.024) | -0.102***<br>(0.015) | -0.291***<br>(0.033)        | -0.188***<br>(0.025) |
| Constant                  | 0.327***<br>(0.081)  | 1.020***<br>(0.188)         | 0.687***<br>(0.152)  | 0.287***<br>(0.074)  | 0.996***<br>(0.194)         | 0.701***<br>(0.162)  |
| Week-Fixed Effects        | Yes                  | Yes                         | Yes                  | Yes                  | Yes                         | Yes                  |
| Observations              | 18,568               | 18,506                      | 18,506               | 25,914               | 25,829                      | 25,829               |

**Table 14: Fund Risk and ZIRP Shocks—Conditioning on Survival**

The sample is all U.S. prime money market funds. The dependent variables are: the weekly annualized spread (*Spread*), the fraction of assets held in risky assets, net of the riskless assets (*Holdings Risk*), average portfolio maturity (*Maturity Risk*), and portfolio concentration, defined as a Herfindahl Index of asset classes (*Concentration*). The estimation window includes one month before and three months (in columns (1)-(4)) and six months (in columns (5)-(8)) after the event dates defined in Table 1. *Event* is an indicator variable equal to one for the period after the event date and zero for the period before the event date. We restrict our estimation to the sample of funds that are present in both periods before and after the event. *Independent Sponsor* is an indicator variable equal one if the fund sponsor is an independent asset management company, and zero otherwise. Control variables include the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), the natural logarithm of fund age, fund flow computed as a percentage change in total net assets from time  $t$  to time  $t+1$  adjusted for market appreciation, standard deviation of fund flow, and an indicator variable equal to one if the fund is offered to institutional investors and zero otherwise. All regressions are at the weekly level and include year/month-fixed and sponsor-fixed effects (in Panel A) and year/month-fixed effects (in Panel B). Standard errors are clustered at the week level. \*\*\*, \*\*, \* represent 1%, 5%, and 10% significance, respectively.

## Panel A: Fund Risk and Monetary Shocks

| VARIABLES                | (1)                   | (2)                   | (3)                   | (4)                  | (5)                   | (6)                   | (7)                   | (8)                  |
|--------------------------|-----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|-----------------------|----------------------|
|                          | Spread                | Holdings Risk         | Maturity Risk         | Concentration        | Spread                | Holdings Risk         | Maturity Risk         | Concentration        |
|                          | 3 Months Ahead        |                       |                       |                      | 6 Months Ahead        |                       |                       |                      |
| Event                    | 34.329***<br>(12.113) | 0.954***<br>(0.323)   | -1.216**<br>(0.503)   | 0.005***<br>(0.002)  | 21.341**<br>(10.471)  | 0.879***<br>(0.271)   | -1.347***<br>(0.386)  | 0.005***<br>(0.001)  |
| Log(Fund Size)           | 0.311***<br>(0.087)   | 1.672***<br>(0.051)   | 0.244***<br>(0.043)   | 0.002***<br>(0.000)  | 0.251***<br>(0.073)   | 1.645***<br>(0.048)   | 0.248***<br>(0.034)   | 0.002***<br>(0.000)  |
| Log(Family Size)         | -7.141***<br>(1.528)  | 0.632<br>(0.524)      | -0.065<br>(0.516)     | 0.013***<br>(0.004)  | -4.828***<br>(1.177)  | 0.435<br>(0.395)      | 0.472<br>(0.423)      | 0.011***<br>(0.003)  |
| Expenses                 | 3.950***<br>(0.914)   | 2.043***<br>(0.335)   | 1.898***<br>(0.289)   | 0.015***<br>(0.002)  | 3.140***<br>(0.697)   | 1.296***<br>(0.313)   | 1.659***<br>(0.246)   | 0.012***<br>(0.002)  |
| Age                      | -63.297***<br>(5.856) | -5.511<br>(3.417)     | -14.730***<br>(2.111) | 0.173***<br>(0.021)  | -52.901***<br>(4.554) | -2.220<br>(3.474)     | -10.630***<br>(2.152) | 0.197***<br>(0.018)  |
| Fund Flow                | 2.211*<br>(1.286)     | 0.002<br>(1.955)      | 10.502***<br>(0.854)  | -0.041***<br>(0.012) | 1.566<br>(1.043)      | -0.739<br>(1.641)     | 9.684***<br>(0.681)   | -0.037***<br>(0.010) |
| Institutional            | -23.283***<br>(3.680) | -13.671***<br>(2.358) | -22.086***<br>(1.544) | 0.002<br>(0.008)     | -21.940***<br>(2.649) | -19.000***<br>(2.182) | -21.336***<br>(1.330) | -0.011<br>(0.007)    |
| Constant                 | -0.208<br>(0.235)     | 3.497***<br>(0.250)   | -0.732***<br>(0.152)  | 0.010***<br>(0.001)  | -0.459**<br>(0.193)   | 3.350***<br>(0.268)   | -0.738***<br>(0.189)  | 0.008***<br>(0.001)  |
| Year/Month-Fixed Effects | Yes                   | Yes                   | Yes                   | Yes                  | Yes                   | Yes                   | Yes                   | Yes                  |
| Sponsor-Fixed Effects    | Yes                   | Yes                   | Yes                   | Yes                  | Yes                   | Yes                   | Yes                   | Yes                  |
| Observations             | 16,830                | 16,882                | 16,879                | 16,882               | 23,462                | 23,527                | 23,524                | 23,527               |

Panel B: Conditioning on Sponsor Type and Monetary Shocks

| VARIABLES                 | (1)                   | (2)                             | (3)                    | (4)                 | (5)                   | (6)                             | (7)                    | (8)                 |
|---------------------------|-----------------------|---------------------------------|------------------------|---------------------|-----------------------|---------------------------------|------------------------|---------------------|
|                           | Spread                | Holdings Risk<br>3 Months Ahead | Maturity Risk          | Concentration       | Spread                | Holdings Risk<br>6 Months Ahead | Maturity Risk          | Concentration       |
| Independent Sponsor       | -3.748<br>(2.837)     | 6.178*<br>(3.305)               | 4.633***<br>(1.355)    | -0.008<br>(0.023)   | -0.979<br>(2.893)     | 5.382<br>(3.476)                | 5.016***<br>(1.469)    | -0.016<br>(0.022)   |
| Independent Sponsor*Event | 9.167***<br>(1.212)   | 2.507***<br>(0.801)             | -0.823*<br>(0.473)     | 0.020*<br>(0.011)   | 4.972***<br>(1.631)   | 3.865**<br>(1.556)              | -1.776**<br>(0.702)    | 0.034***<br>(0.010) |
| Log(Fund Size)            | 1.367**<br>(0.601)    | 3.104***<br>(0.889)             | 0.558<br>(0.444)       | -0.009*<br>(0.005)  | 1.124**<br>(0.514)    | 3.171***<br>(0.871)             | 0.501<br>(0.440)       | -0.008<br>(0.005)   |
| Log(Family Size)          | 1.132*<br>(0.664)     | 3.541***<br>(0.939)             | 0.346<br>(0.304)       | -0.012**<br>(0.005) | 0.935*<br>(0.560)     | 3.336***<br>(0.904)             | 0.427<br>(0.293)       | -0.013**<br>(0.005) |
| Expenses                  | 15.085**<br>(5.819)   | 15.406**<br>(6.778)             | -2.019<br>(3.047)      | 0.046<br>(0.041)    | 13.689***<br>(4.965)  | 15.613**<br>(6.586)             | -2.217<br>(2.982)      | 0.052<br>(0.040)    |
| Age                       | 11.204***<br>(3.367)  | 4.882<br>(4.339)                | 7.694***<br>(2.138)    | 0.085***<br>(0.032) | 9.156***<br>(2.936)   | 3.929<br>(4.172)                | 7.385***<br>(2.165)    | 0.087***<br>(0.032) |
| Fund Flow                 | 3.334<br>(15.402)     | -42.871<br>(26.403)             | 15.281<br>(9.696)      | -0.248*<br>(0.129)  | 3.592<br>(12.675)     | -45.149*<br>(25.859)            | 16.336<br>(10.040)     | -0.248*<br>(0.127)  |
| Fund Flow Volatility      | -61.740**<br>(25.537) | -53.231<br>(43.025)             | -60.808***<br>(18.733) | -0.396*<br>(0.209)  | -52.045**<br>(21.338) | -57.844<br>(42.252)             | -60.907***<br>(18.777) | -0.402*<br>(0.204)  |
| Institutional             | 6.473**<br>(2.908)    | 8.666**<br>(3.823)              | -0.660<br>(1.505)      | -0.006<br>(0.021)   | 5.298**<br>(2.480)    | 8.305**<br>(3.667)              | -0.573<br>(1.472)      | -0.006<br>(0.021)   |
| Constant                  | -34.490*<br>(18.921)  | -111.411***<br>(23.038)         | -4.036<br>(12.728)     | -0.011<br>(0.160)   | -25.613<br>(16.520)   | -104.192***<br>(22.468)         | -2.501<br>(12.896)     | -0.026<br>(0.159)   |
| Year/Month-Fixed Effects  | Yes                   | Yes                             | Yes                    | Yes                 | Yes                   | Yes                             | Yes                    | Yes                 |
| Observations              | 16,830                | 16,882                          | 16,879                 | 16,882              | 23,462                | 23,527                          | 23,524                 | 23,527              |