The Unintended Consequences of the Zero Lower Bound Policy*

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Abstract

We study the impact of the zero lower bound interest rate policy on the U.S. money fund industry. We find that in response to policies that maintain zero interest rates, money funds: invest in riskier asset classes; hold less diversified portfolios; are more likely to exit the market; and reduce the fees they charge their investors. Further, 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—thus inducing a negative selection of risky funds in the market. Finally, fund families closing their money funds are more likely to open new funds, especially those invested in bonds.

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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 known as zero lower bound policy. This initial action was followed with a sequence of announcements providing guidance that the short-term rate would stay near zero for a longer period. Although the Fed's policy had a positive intention of stimulating a sluggish economic growth and boosting employment in the U.S., it has also created an adverse shock to competitiveness of an important part of the shadow banking system—money funds.[1] By regulation, money funds are obliged to invest in safe short-term assets with rates of return that are typically close to the Fed funds rate. The monetary policy shock has thus driven the funds' gross profit margins nearly to zero and many fund investors were facing investment opportunities with negative expected returns after paying their fund fees. In this paper, we examine implications of the zero interest rate policy for the behavior of money funds industry.

Traditionally, money funds used to 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 funds in September 2008 (e.g., Kacperczyk and Schnabl (2013); Chernenko and Sunderam (2014); Strahan and Tanyeri (2014)), until then, money funds provided investors positive returns, even after paying fund fees. The consequence of the unprecedented change in interest rates 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. Thus, any fund investing in these assets was likely to produce negative net-of-expense nominal returns to their investors. It has

[1] Notable examples of recent contributions on money funds include Christoffersen (2001), Christoffersen and Musto (2002), Baba, McCauley, and Ramaswamy (2009), McCabe (2010), Di Maggio (2013), Duygan-Bump et al. (2013), Kacperczyk and Schnabl (2013), Chernenko and Sunderam (2014), and Strahan and Tanyeri (2014).

thus become obvious that such business model cannot be sustained for too long as money would flow out of funds with negative returns.[2]

Such dire situation posed a dilemma for money funds. On the one hand, they could accept the situation and keep their risk profiles unchanged. This, however, would force them to first reduce or even waive their fees, and in the end, if the low rates persisted, 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. Increasing fund risk would then lead to an increase in fund returns and investor flows (e.g., Christoffersen (2001)). Moreover, boosting their net returns above zero would likely prevent funds from exiting 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 a significant loss of reputation for the fund organization and other related business of a fund sponsor.

A recent article in the Financial Times summarizes the situation in the money fund industry associated with zero interest rates as follows: "The risks are that as rates will plunge to zero or negative, money 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 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."[3]

In this paper, we assess empirically the equilibrium response of money funds to the low interest rate environment using weekly data on the universe of U.S. prime money funds. We exploit

[2]A standard portfolio theory suggests that investors should look at fund spread, returns net of Treasury bill, rather than fund returns as a way of assessing their decisions. But in times of zero interest rates both returns and spreads are virtually the same. In addition, our regression estimates account for any business-cycle variation in the data.
[3]Available at http://ftalphaville.ft.com/2012/07/20/1083261/ioer-negative-rates-and-ben/

both a time-series and cross-sectional variation in the data to identify the effect of the unconventional monetary policy on money funds' strategies. Our main empirical identification is an event study analysis of five FOMC announcements which signaled that interest rates would be kept near zero into the future. These decisions were plausibly exogenous with respect to money funds' behavior; hence, they constitute a useful shock. The benefit of having access to high-frequency data allows us to measure empirical effects within short event windows of up to six months. Specifically, we compare money funds' choices of risk, exit, and expense policy in the time series and in the cross section of fund data.

In the time series, we document an increase in the probability of exit from the money fund industry, higher risk taking, lower expenses charged by money funds, and higher fund subsidies in the period of three to six months after the announcements. All these results are economically and statistically significant. Notably, while we do not find any variation in expenses *incurred* by these funds over time, the fees *charged* are significantly reduced during a zero interest rate period, which suggests that money funds were actively maintaining their fees as a way of keeping their business alive and did not simply witness a period of lower operating costs.

In the cross section, we find that reaching for yield is particularly strong for independent funds, that is, funds whose sponsors are not affiliated with insurance company, commercial, or investment bank. In contrast, rather than taking more risk, affiliated funds take a path of exiting the market. Notably, we do not find significant differences across fund types in terms of their expense policy. We further enhance these findings by exploiting a variation in family-level percentage of assets managed by money funds within a group of independent sponsors. We find that funds whose families invest a greater percentage of their assets in money funds are less likely to exit and more likely to boost their risk taking. The cross-sectional results are consistent with a hypothesis that reputational concerns shape up strategic decisions of money funds. Overall, to the extent that any

macroeconomic (time-series) shock would likely affect all types of funds in a similar way, these results point towards ours as a leading mechanism explaining the data.

We conduct a number of tests to improve our identification and alleviate any empirical concerns. Our first concern is identification of the results on risk taking. To the extent that safer funds are more likely to exit our risk results could be driven by survival of the more risky funds. The question is whether strategic behavior of individual funds also contributes to risk changes over and above the negative selection channel. To address this concern we redo all our tests by removing funds that exit the sample after the shock. Our results remain qualitatively similar, which suggests that the negative selection and strategic fund behavior are both responsible for changes in risk.

Our second concern is that our results are not specifically about the role of zero-rate policy but rather are a generic response of money funds to changes in interest rates, independent of their levels. We assess this concern by splitting our sample into periods with rates higher than 1% (our control group) and periods when the rate is at most 1% (our treatment group) and estimating the effects of interest rate changes on our quantities of interest. We find a strong discontinuity in the way money funds respond to changes in Fed funds rate: While we observe no visible effect on exit, risk, and fees, when the rate is above 1%, we observe a similar quality of results to our main findings in periods when interest rates equal at most 1%.

Third, in our regressions, we include monetary policy surprises rather than the Fed funds rate changes and confirm our results on fund exit and risk-taking incentives, which further alleviates any concern that our results are driven by changes in economic conditions proxied by the Fed funds rate, rather than directly by changes in monetary policy. Finally, we use evidence from detailed money fund portfolio holdings over a shorter sample of 2010-2013 and show that as a result of a shock money funds tend to acquire positions whose yields are distinctly higher than the positions

that were acquired a month before. A similar analysis for placebo sample (periods with no policy changes) produces opposite results. Overall, all the results suggest that the zero-bound policy was a likely driver of changes in money funds' strategies.

In our final set of results, we show that the strategic adjustment in the money fund industry has broader industry organization implications for the entire mutual fund sector. To this end, we investigate whether the fund families that decide to close their money funds in response to monetary shock open new funds in a different asset class, possibly less stressed by low interest rates. Empirically, we compare fund closures and fund creations of fund families that have closed their money funds with those that did not. We find that the former ones are significantly more likely to open new bond funds, but not equity or balanced funds. This finding suggests that the prolonged period of low interest rates incentivize fund families to offset a stress on their money funds by relocating resources to other, similar asset classes.

Overall, our results highlight one important channel for transmission of monetary policy that has been completely overlooked by the academic literature, but one that is extremely relevant for practitioners and policy makers. This message resonates well with the August 2009 Fitch report about U.S. money funds that states: "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."[4]

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 funds. Empirical design the data, as well as empirical results are discussed in Section IV and Section V. Section VI presents evidence on industry organization of mutual funds, while Section VII concludes.

[4]"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.

II. Related Literature

Various papers have studied the role of money funds. To the best of our knowledge our paper is the first to examine the impact of monetary policy on risk-taking incentives of money fund managers. In this regard, the closest studies to ours are Di Maggio (2013), Kacperczyk and Schnabl (2013), and Strahan and Tanyeri (2014), which analyze risk taking of money funds before and after the collapse of Lehman Brothers, and during the European debt crisis, respectively. The key novelty of our paper is a new mechanism that explains risk taking: While in Kacperczyk and Schnabl (2013) the key friction is the increase in yields dispersion, after the Lehman collapse, of the different investable asset classes; the friction we emphasize here is the zero lower bound policy. Moreover, we focus on funds' strategic decisions to alter their expense policy and moderate their entry and exit; and quantify the value of subsidies provided by sponsors to their funds, which allows us to assess the costs of the monetary policy from the perspective of these intermediaries.

Several papers studied the importance of conducting monetary policy at the zero bound. These papers primarily focus on aggregate macro quantities.[5] Our paper, in turn, is one of the first to provide micro-level evidence on the reaction of financial institutions to low interest rates. The benefit of using micro-level data is better identification of the underlying economic mechanisms. In this vein, Maddaloni and Peydró (2011) find that low short-term interest rates soften lending standards for retail and corporate loans. Jimenez et al. (2014) show that lowering overnight interest rate induces less-capitalized banks to lend to riskier firms. These studies, however, do not explicitly study the role of the zero bound policy. Also, their response variables and contexts are different than ours. Also related is a study by Chodorow-Reich (2014) who considers high-frequency event studies to analyze the effects of the unconventional monetary policy on banks and life insurance

[5] Related literature on conducting the zero interest rate monetary policy at the macro level includes Woodford (2003) and Bernanke, Reinhart, and Sack (2004).

companies. He shows that banks and life insurance companies benefit from low interest rates. Incidentally, though not his main focus, he also examines a time-series variation in risk taking of money funds. He documents evidence of a significant reaching-for-yield behavior, especially in the period of 2008-2012. However, while he analyzes annual trends in funds' risk taking, we consider narrow monetary policy event windows to isolate a specific effect of interest rate policy changes on risk taking. Further, a large and novel portion of our paper: (i) exploits a cross-sectional variation in fund strategies, (ii) discusses the tradeoff between risk taking and exit, (iii) provides evidence on sponsors' subsidies, and (iv) considers broader asset management implications. Finally, our study formally shows a distinct asymmetry in fund strategies conditional on the level of Fed funds rate.

More broadly, our paper sheds new light on the incentives of asset managers to reach for yield—one of the core factors contributing to the buildup of credit that preceded the financial crisis (Rajan (2010), Yellen (2011), and Stein (2013)). Popular explanations include competition among fund managers, different preferences for risk, or desire to offset constraints imposed by regulation. We provide a setting in which the incentives to reach for yield on one hand are limited by strict regulation, yet on the other hand are significantly affected by changes in interest rates and expectations about their future changes.

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.

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 fire-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 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 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 funds, the SEC voted to amend the 2a-7 rules to strengthen money 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 funds have to 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 of the sources of data for the present study.

IV. Research Design and Data

IV.A. Empirical Design

In our empirical tests we aim to identify the impact of interest rate policy on money funds' behavior. Our main focus is on the effects due the zero lower bound policy, introduced in December 2008. Since the policy set the short-term rate at zero, any identification due to interest rate changes would be difficult. To this end, we explore the importance of additional communication from the Federal Reserve regarding the duration of the zero-rate policy—forward guidance policy. In our context, the duration of zero-rate policy is crucial as it directly determines how long the money 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, in turn, would differ if the pressure were held for longer time.

In our analysis, we focus on the money funds' 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%, and the other four event dates capture the meetings at which the Fed outlined its forward guidance regarding the duration of the zero-rate regime. Specifically, on March 18, 2009, the Fed announced that it would keep rates at 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 would remain at zero until 2013, 2014, and 2015, respectively.

Notably, during our period of analysis there have been other policy-related events that might have affected financial markets, an important one being the quantitative easing (QE) interventions. We do not consider QE events for two reasons. First, the QE interventions mainly targeted the

long-term part of the yield curve, but the opportunity set of money funds only spans short-term assets. Second, QE primarily entails the purchase of mortgage-backed securities, and these securities cannot be held by money funds due to regulatory constraints.

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

In our empirical tests, we also exploit cross-sectional differences across money 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 so as 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

Our sample of funds includes the universe of U.S. taxable prime funds. We collect data for our tests from four sources. First, the data on money funds come from iMoneyNet and cover the period from January 2005 to December 2013 including 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. Finally, we gather detailed information about Fed funds rate changes and the forward guidance policy from the Federal Reserve Board website.

We run most of our analyses at the fund portfolio level. We aggregate all share classes by fund and investor type (retail, institutional). We compute fund characteristics (e.g., expense ratio) as weighted averages using share class assets 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 the 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 183 basis points while the average gross fund return equals 231 basis points. Hence, out of the abnormal profit of 47 basis points 38 basis points account for expenses, which leaves about 10 basis points accruing to fund investors. 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 in the high and low interest-rate regimes. This sample split is based on the interest rate level of 1% and reflects our view of what we consider a period of profit stress. A number of interesting patterns emerge. First, the spread during the low-rate period is 25% lower than that in the high-rate period; also, the nominal gross return is almost ten times larger in the high-rate period. This suggests that money funds face greater challenges in obtaining high returns in a low interest rate environment. Second, if we look at expenses charged they are significantly lower in the low-rate period, with a drop from 50 to 28 basis points, while 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 a fund to charge fees to 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 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 the 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 such as repos and Treasuries. They also charge slightly lower expenses and 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 our main results. First, we show the importance interest rates play in generating fund returns and establish the link between fund returns and subsequent fund flows. Next, we look at the effects of forward-guidance policy on risk taking, fund exit, and expenses in the time series and in the cross section. Finally, we provide a series of robustness tests that are meant to strengthen the identification of our mechanism.

V.A. Asset Returns and Fund Flows

The basic premise of our mechanism is that yields on assets in which money funds can invest, and consequently their portfolio returns, depend on the level of Fed funds rate. We begin our analysis by identifying such link in the data. To this end, we estimate the regression model of fund gross returns (*Fund Return*) on the Fed funds rate (*Fed Rate*) over our sample period.[6]

$$Fund\ Return_{it} = a_0 + a_1\ Fed\ Rate_t + \boldsymbol{b}\boldsymbol{X}_{it-1} + \varepsilon_{it} \qquad (1)$$

In the regression, we control for other determinants of fund returns possibly correlated with the level of interest rates (subsumed by vector *X*), such as the natural logarithm of fund size (*Log*(*Fund Size*)), the natural logarithm of fund family size (*Log*(*Family Size*)), the level of expenses charged by funds (*Expenses*), 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 marketed to institutional investors (*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 might proxy for general macro trends in the data we include year-fixed effects. We cluster standard errors at the year/week

[6] Alternatively, we could consider returns net of inflation, as in this period inflation is very low; moreover, this variation is captured by time-fixed effects.

dimension to account for any cross-sectional dependence of residuals due to the commonality of interest rates across fund observations. We report the results in Table 3.

Our results show that fund performance improves in periods of higher interest rates. The effect is statistically and economically highly significant. Consistent with our hypothesis that assets held by money funds are highly correlated with the level of short-term rates, we find that fund returns respond almost one to one with respect to changes in interest rates. This is evidenced in columns (1) and (2). Overall, the results underscore the importance of interest rates for generating fund performance. More importantly, these results highlight why the money market funds industry constitutes a great opportunity to study the consequences of the prolonged period of low interest rates. In fact, there is no other example of an industry whose performance depends so heavily on the Fed funds rate and this is one of the main reasons why we think our paper can provide novel insights regarding the consequences of the zero lower bound policy.

In the next test, we show that fund returns matter in that generating superior performance has important implications for fund flows and thus for managers' compensation. To show this formally, we first use aggregate evidence from prime fund industry. In Figure 1, we plot the value of assets under management for the universe of prime money funds for the period 2005-2013. The figure shows a significant decline in assets from more than $2 trillion in 2007 to less than $1.5 trillion in 2013. This sharp decline coincides with the period of declining interest rates and hence the aggregate fund performance. Moreover, it seems that at least the first two forward guidance announcements on March 18, 2009 and August 9, 2011 preceded a significant drop in assets invested in funds. This result is consistent with the hypothesis that given the expectation of an extended period of low interest rates, fund investors might have pulled out of these funds to find a more profitable investment opportunity and/or the fund companies decided to close down their operations. This suggests a strong effect of the Fed funds rate on the attractiveness of money funds.

Next, we provide micro-level evidence of this effect and estimate the flow-performance relationship at the individual fund level. The investors' portfolio choice problem is quite straightforward: They might respond to a significant decrease in money market funds' profitability by migrating from money funds accounts to bank deposits, if they look to park their money and save on fees, or by investing in other low-risk investment opportunities, such as blue chips or high-rated corporate bonds, which pay higher returns than money funds. In all of these cases, money funds should experience outflows as interest rates decrease. Formally, we estimate the following regression model.

$$Fund\ Flow_{it+1} = a_0 + a_1 Fund\ Return_{it} + \boldsymbol{bX}_{it} + \varepsilon_{it+1} \quad (2)$$

Table 4 reports the results, where our set of controls mimics that used in Table 3. In all regressions, we include sponsor-fixed effects and cluster standard errors at the fund sponsor level. In column (1), we report the results for the full sample of money funds without time-fixed effects. 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 2.08% per week, which is approximately 40% of the standard deviation of fund flows in the data. In terms of fund size, it means that, in one 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 additionally account for the fine week-level variation by introducing week-fixed effects and find that the effect remains statistically and economically strong.

In the next set of results, we aim to understand if there is any non-linearity in the flow-performance relationship as the Fed fund rate approaches the zero lower bound. In particular, we define an indicator variable *Low Rate* that is equal to one in times when Fed funds rate is at most 1%,

and zero otherwise. Subsequently, we estimate the regression model in (2) with an additional interaction effect *Fund Return*Low Rate*. The results are presented in columns (3) and (4) for the models without and with week-fixed effects.

The flow-performance relationship is stronger in periods of lower interest rates as the coefficient of the interaction term is positive and highly significant. We conclude that the changes in interest rates towards zero bound alter considerably the payoff per unit of extra performance: Investors are about twice as sensitive to changes in fund performance as they are in normal times. This further underscores the need for funds to adjust their operating strategies along various dimensions, such as exit, risk taking, and cost policy. We turn to these results in the next section.

V.B. Fund Strategies around the Zero Interest Rate Policy Events

In this section, we evaluate money funds' behavior around the forward-guidance policy announcements using an event-study methodology. We first analyze the changes in fund behavior in the time series—before and after FOMC events. Subsequently, we explore the cross-section of money funds with respect to their sponsor types.

V.B.1 Time-Series Evidence

In our analysis, we consider two post-event windows: a short one of three months and a long one of six months. We analyze these two types of windows because there are strategies that funds can immediately alter, such as the riskiness of their portfolios 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. In both cases, the pre-event window is a short one month to avoid any contamination with other potential events. Formally, we estimate the following regression model.

$$Fund\ Strategy_{it} = a_0 + a_1 Event_t + \boldsymbol{b}\boldsymbol{X}_{it-1} + \varepsilon_{it} \qquad (3)$$

We use a generic dependent variable, *Fund Strategy*, to measure three dimensions of fund adjustments: exit, risk taking, and expense policy. Our independent variable of interest in all tests is *Event*, an indicator variable equal to one for the period after the event date (short or long), and zero beforehand. We also include a set of control variables that we used in models (1) and (2). These are measured as of beginning of 2007 to account for any endogenous movement in observables due to monetary shocks.[7]

We begin with the analysis of the exit strategy. We provide evidence on both the industry's evolution, investigating the changes in the number of active funds, and more micro evidence on the fund's probability of exiting from the market. Our dependent variables are # *Funds*, defined as the number of money funds available in week *t*, and *Exit*, defined as an indicator variable equal to one if the fund sponsor closes its money fund in week *t*, and zero otherwise. For the first specification, we aggregate all controls at time *t* by taking the value-weighted average across all funds, where the value is defined by each fund's assets under management. Panel A of Table 5 reports the results. In columns (1) and (2), we present the results for the 3-month window, and in columns (3) and (4) for the 6-month window.

We find that, on average, five and nine funds drop after the policy event within the shorter and longer horizons, respectively. This is an economically large effect that, if cumulated over five events, brings the total to more than 25 and 45 funds of lost funds. The funds leaving the market are often large funds which corroborates the observed decline in aggregated assets under management, in Figure 1. Similarly, we find that the probability of exiting the fund industry increases significantly in both horizons following the event. Though we report our results jointly for all the events, we also find consistent results when looking at each event separately. We also find

[7] We also entertained the models with simple one-week or one-month lags and the results are very similar.

that later events are more important than early ones, perhaps because extending the forward guidance policy into a longer future imposed more stress on the fund industry.

In our next test we turn to measuring funds' incentives to take risk. We use four different risk measures. *Spread* is the difference between *Fund Return* and the T-bill rate; *Holdings Risk* is a difference in fund weights in the riskiest asset class (bank obligations) and 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 Herfindahl 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. The results are reported in Panel B of Table 5.

We find that as a result of the policy announcements, three out of four measures of fund riskiness increase for both investment horizons. The only risk level that goes down is *Maturity Risk*. This difference 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. Comparing the results in columns (1)-(4) to those in (5)-(8), it seems that the risk profile of money fund industry depends on the policy announcements, and much of the risk adjustment happens quickly.

The last dimension of adjustment we consider is the expense policy. It is apparent that in the wake of low interest rates and low fund returns fund companies would want to maintain their client relationship by reducing the fees they charge, thus effectively increasing these investors' net of fees returns. At the same time, there is no reason to believe that expenses truly incurred by funds would not stay at a similar level. Consequently, by lowering their fees to investors, fund companies would offer subsidies to their investors. In the paper, we measure the degree of such subsidies by taking the difference between incurred and charged expenses.

We evaluate this strategic behavior by estimating the regression model in (3) with *Charged Expenses*, *Incurred Expenses*, and *Subsidy* (defined as the difference between incurred and charged expenses) as our dependent variables and *Event* as our main independent variable. All other controls are the same as before. In contrast to previous regressions, we cluster standard errors at the sponsor level since fund expenses are persistent over time and thus this dimension of dependence produces more conservative standard errors. Panel C of Table 5 reports the results from the estimation, separately for the 3-month and 6-month post-event window.

We find a significant reduction (increase) in expenses charged (fund subsidies) in response to FOMC announcements. These effects are particularly strong for the longer, six-month window, which might reflect some sluggishness with which fund companies respond in terms of their pricing policies. We find no differences in fund incurred expenses in response to the announced policies.

V.B.2 Cross-Sectional Evidence

Our results so far rely on the time-series identification: We compare changes in average fund behavior in response to forward-guidance announcements. In this section, we shed more light on our economic mechanism by exploiting sponsor-level variation in incentives to respond to profit margin squeeze. As we have shown, fund sponsors might want to respond to margin deterioration by changing their exit, risk, or pricing strategies. However, these responses might vary across funds. We hypothesize that fund sponsors with greater reputation concerns might want to internalize these negative spillovers by either taking less risk or leaving the fund industry altogether. They might also entertain different pricing strategies. We argue that one way to measure reputation concerns is whether a fund is sponsored by a financial institution (large reputation concerns) or is sponsored by an independent asset management company (less reputation concerns). Formally, we estimate the following regression model:

$$Fund\ Strategy_{it} = a_0 + a_1 Event_t + a_2 Independent\ Sponsor_i + a_3 Event_t * Independent\ Sponsor_i + \boldsymbol{b}\boldsymbol{X}_{it-1} + \varepsilon_{it} \quad (4)$$

In this model, *Independent Sponsor* is an indicator variable equal to one if the sponsor is an independent management company and zero if it is an affiliated company. *Fund Strategy* and *X* are defined as in model (3). The incremental effect of change with respect to sponsor type is measured by the coefficient of the interaction term *Event*Independent Sponsor*. We present the results in Table 6.

In Panel A, we report the results for # *Funds* and *Exit* for 3-month (columns (1) and (2)) and 6-month event window. We find that funds sponsored by independent companies are more likely to stay following the policy announcement. This result is particularly strong for the longer six-month window, which could be due to the fact that adjustments, such as exit take longer to materialize.

In Panel B, we consider various measures of risk. The results 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 holds for three out of four measures or risk. The risk adjustment already takes place within the shorter 3-month period.

The results on exit and risk are consistent with our hypothesis that reputation concerns might be driving strategic adjustments of money funds. Moreover, a combination of the two results implies an additional industry effect. Given that safer, affiliated, funds are more likely to leave and the more risky independent funds are more likely to stay, this mechanism leads to a negative selection of funds that stay after the policy events. This, in turn, makes the entire money fund industry more unstable.

Finally, we investigate changes in the expense policy. The results are reported in Panel C of Table 6. We find no differences across fund types in terms of the policies, perhaps because this simple way of adjustment could be used by all funds independent of their reputation concerns.

In our cross-sectional tests, we assume that reputational concerns can be measured by whether or not a fund's sponsor is affiliated with the financial conglomerate. However, it is possible that this cross-sectional variation might capture features other than reputational concerns. For example, affiliated funds might have different financial capacity to bail out their funds. To assess the robustness of our tests, we turn to an alternative specification in which we solely focus on funds unaffiliated with a financial conglomerate. The cross-sectional dimension we consider is purely based on the asset management business. We argue that fund families that manage lots of non-money fund money might be more concerned about their reputation loss in the event of the run on money fund, due to potential spillovers to a much larger business. We measure the degree of such concern using variable *Business Risk*, the fraction of family assets that is held in non-money fund business. Formally, we estimate the following regression model.

$$Fund\ Strategy_{it} = a_0 + a_1 Event_t + a_2 Business\ Risk_i + a_3 Event_t * Business\ Risk_i + \boldsymbol{bX}_{it-1} + \varepsilon_{it} \quad (5)$$

Our empirical design follows that in model (4). Our coefficient of interest is a_3. We present the results in Table 7. In Panel A, we show the results for all adjustments for a 3-month event window, while in Panel B we focus on a 6-month window. Our results are qualitatively similar to our earlier findings: Funds with greater reputation concerns, indicated by higher *Business Risk*, are less likely to take more risk, in two event horizons. In turn, they are more likely to subsidize their money funds. We find no strong evidence for the decision to exit the market.

V.C Robustness Checks

In this section, we provide additional evidence on the validity of our identification strategy. First, we examine the robustness of our results for a sample of funds that survives the effect of monetary policy. Second, we compare the results of interest rate changes conditional on the level of short-

term rates. Third, we estimate our models using monetary policy surprises rather than directly the Fed funds rate. Finally, we provide empirical evidence from the security-level data.

V.C.1 Survivorship

Our results in Panel B of Table 5 suggest that fund risk goes up as a result of policy announcements. To understand these findings, it is important to isolate their driving forces. In particular, the average yields in the money fund sample can increase for two reasons: (1) Average fund yields go up because of negative selection that retains more risky funds in the data; (2) Money funds strategically adjust their risk profiles in response to policies. Our results so far, suggest the first channel is partially operating given that riskier funds are more likely to stay. In this section, we check to what extent the second channel also contributes to our average results.

We address this concern using a subset of funds which are present in both periods of the event study. Conditioning on surviving funds makes the selection issue absent in the estimation. Formally, we estimate the regression models in (3) and (4). Table 8 presents the results. In Panel A, we report results for the time-series effect and in Panel B for the cross-sectional effect. Our results from these two models are qualitatively similar to those reported in Tables 5 and 6. Hence, we conclude that both economic mechanisms might be jointly responsible for the *average* risk effects in the data.

V.C.2 Interest Rate Regimes

So far, we have interpreted our empirical results as being solely explained by unconventional monetary policy. A possible alternative could be that *any* decrease in interest rates might produce similar effects in the data. While we have no reason to believe that unconditional result exists, simply because the argument about negative investors' returns only applies to very low interest rates,

we check whether the data show such asymmetry. In other words, one can think of this test as yet another identification strategy.

In our first test, we examine general consequences of changes in the Fed funds rate over the longer period of 2005-2013. The period of January 2005–December 2013 is an attractive testing ground because it 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 2 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 (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-lower 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 all our specifications, we measure variables at the weekly level and then include year-by-month or year fixed effects, thereby isolating within-month or within-year variation, which helps us control for any other macroeconomic shocks concurrent with the monetary policy changes that might affect the money funds' behavior. Formally, we estimate the following model.

$$Fund\ Strategy_{it} = a_0 + a_1 Fed\ Rate_{it} + a_2 Low\ Rate_i + a_3 Fed\ Rate_{it} * Low\ Rate_{it} + \boldsymbol{b}\boldsymbol{X}_{it-1} + \varepsilon_{it} \quad (6)$$

where *Fund Strategy*, *Fed Rate*, and *X* are defined as before. *Low Rate* is an indicator variable equal one for periods with *Fed Rate* of maximum 1% and zero in periods with *Fed Rate* higher than 1%.

We begin by analyzing the effect of Fed funds rate on the number of active funds and on the probability of their exit. To this end, we estimate the regression model for the two dependent variables on the level of Fed Rate using a full sample of funds and conditional on the level of interest rates. Apart from the standard controls we used in Table 5, the regressions for exit, in columns (3)-(4), additionally include year/month-fixed effects and sponsor-fixed effects. We cluster standard errors at the week level. Panel A of Table 9 reports the results.

Column (1) investigates the relation between Fed Rate the number of active funds and shows that there is usually a negative relationship between the two. The effect though statistically significant, is economically quite small. However, when we differentiate between the high and the low interest rate period in Column (2), we find that a lower interest rate during a low-interest rate environment significantly reduces the number of active funds, with a total loss of about 17 funds. In a similar spirit, we analyze the probability of exiting from the market, controlling for funds' characteristics, sponsor fixed effects as well as month fixed effects. While we again find little effect of interest rate changes on exit strategies in the high-rate regime (Column 3), we find that the changes in interest rates from 1% towards zero have important implications for the number of funds and fund exit, as demonstrated in columns (4). In particular, following the reduction in Fed funds rate from 1% to 0%, the probability of an exit from the industry increases by 7.2 percentage points. These effects are highly significant both statistically and economically.

We next turn to results on risk taking. We estimate the regression model in which the dependent variables are various risk measures and the main independent variable is *Fed Rate*. All regressions include year/month-fixed effects and sponsor-fixed effects, and standard errors are clustered at the week level. We report the results in Panel B of Table 9.

We find a statistically significant positive effect of reducing *Fed Rate* on the level of risk for all risk measures during period of low rates. In terms of economic values, a reduction in the *Fed Rate* from 1% to 0% increases *Spread* by almost 57 basis points *Holdings Risk* by 5.9%, *Maturity Risk* by 1.7; and *Concentration* by 2.8%. These are sizable effects, especially for the money funds with returns close to zero. Similar effects are absent in periods of high interest rates.

Finally, we evaluate the conditional effect of interest rates on fund expense policy. *Charged Expenses*, *Incurred Expenses*, and *Subsidy* are our dependent variables. All other controls are the same as before. In contrast to previous regressions, we cluster standard errors at the sponsor level since fund expenses are persistent over time and thus this dimension of dependence produces more conservative standard errors. Panel C of Table 9 reports the results.

The results, in columns (1), (3), and (5) indicate an overall negative effect of interest rates on fund expenses, both charged and incurred, and a positive effect on fund subsidies. The opposite is true when interest rates approach zero bound: Lower rates coincide with a reduction of expenses charged by funds. As *Fed Rate* goes down from 1% to 0% funds charge 8 basis points less for their service, as presented in column (2). This reduction occurs despite the fact that incurred expenses are generally unaffected by the interest rate change, as demonstrated in column (4). The implication of these two facts is an increase in fund subsidies. As presented in column (6), a decrease in *Fed Rate* from 1% to 0% increases fund subsidy by an economically large 7.9 basis points. This effect is statistically and economically highly significant. Overall, the asymmetric response of expenses suggests a strategic fund behavior in terms of their pricing policy.

We also analyze the asymmetric behavior in the cross-section of funds. In particular, we compare exit, risk-taking, and pricing strategies for funds with different sponsor type across

different interest rate regimes. The differential effect of the change in the interest regime across two fund types can be measured by the coefficient of the interaction term *Independent Sponsor* Low Rate*.

In Panel A of Table 10, 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 about 8.8 more funds sponsored by independent companies left when interest rates change their regime. The change in interest rates does not lead to significantly different responses across fund types in terms of their exit strategies.

Panel B of Table 10 reports the results for 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 relatively 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: Relative to affiliated funds, on average, the spread of independent funds increases by 2.4 basis points, holdings risk increases by 7.3 basis points, fund portfolio maturity increases by 4.5 days, and concentration increases by 3.8 percentage points. In turn, the coefficient of *Independent Sponsor* is not statistically significant, which suggests the two groups of funds are similar to each other in the high-rate regime.

We entertain similar tests for our expense measures and report the results in Panel C of 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 their pricing strategies. Even though, in general, funds lower their expenses in the low-rate regime we find that they do not execute this strategy in economically distinct ways.

V.C.3 Monetary Policy Surprises

In the previous sections, we utilized changes in short-term interest rates near the zero-lower bound and the "forward guidance" announcements as proxies for monetary policy shocks. The concern might be that the changes in monetary policy might be anticipated by financial markets as they reflect a systematic response to macro-economic environment. Our tests so far address this issue by including time-fixed effects at high frequencies; here, we consider an alternative approach of using the unanticipated component of policy announcements to predict money funds' behavior. The use of announcements is potentially valuable because it allows us to identify shocks to the information set of agents and understand the transmission mechanism of the monetary policy. A classic study that disentangles the expected and unexpected components of monetary policy from Fed funds futures and studies if the latter can account for the daily variation of bond yields around FOMC announcements is Kuttner (2001).[8]

There are two difficulties with this approach. First, the data constructed by Kuttner (2001) show that in the last few years the unanticipated component is extremely small, in the order of two basis points. This means that most of the information about changes in interest rates is anticipated by financial markets. Second, data on short-term target changes are likely to underestimate the extent of exogenous variation in monetary policy, because even when market participants fully foresee target rate changes, statements of the members of the policy committee can still provide valuable information about the path of future policy.

In our study, we employ the methodology recently proposed by Buraschi et al. (2014). They employ individual agents forecasts of Fed funds rate, GDP, and inflation to construct an empirical proxy for policy shocks from the residuals of Taylor rule regressions, and show that path shocks

[8] Other papers that construct a factor proxing for news about the future path of policy are Gurkaynak, Sack, and Swanson (2005) for the U.S. and Andersson (2010) for the Euro-zone area.

account for a significant fraction of the variance of one-year expected excess returns on 2-5 years bonds and are also priced in the cross-section of equity returns. Following a similar approach, we construct the monetary shocks by collecting data on all FOMC meetings. For each FOMC meeting, we compute the change in yield for Treasury bonds with maturities 1, 3, 5, 7, and 10 years from the closing price the day before the meeting until the morning after the meeting. If there is a two-day meeting, we use the difference over two days. From such shocks, we extract the first principal component and observe that the loadings on eigenvectors are similar across all maturities, which suggests that the first principal component explains the maximum amount of variance of the series.

Table 11 reports the relationship between this measure of monetary policy shocks and the money market funds' exit, risk-taking, and price-setting behavior. Panel A shows that an unexpected decrease in interest rates increases the likelihood for these funds to exit the market. This result is significant only in the low interest rate regime. Panel B provides evidence corroborating our previous findings about the higher risk-taking incentives for the funds during periods of low interest rates. Both the weekly annualized spread and the fraction of assets held in risky assets significantly increase when the funds witness an unexpected decrease in interest rates. These results mirror the ones presented in Table 9. Finally, Panel C analyzes the effect on expenses for the universe of money funds and the relationship with changes in monetary policy. In this case, the unexpected component of these changes has no significant effect on their expenses, both charged and incurred, and on the subsidy paid by the sponsors.

For all the previous results, the magnitude is lower than previously shown, but this is expected as these monetary policy shocks only capture the unforeseen portion of the rate change.

V.C.4 Evidence from Portfolio Holdings

In this section, we provide additional evidence on risk taking using information from individual security holdings. We provide further evidence on the "reaching-for-yield" behavior by money funds using detailed information on their holdings. We collect the data from the N-MFP form on the yields of the individual securities held by the funds. These data became available in November 2010 as a consequence of the Dodd-Frank Act and contains all the information related to the portfolio holdings of U.S. money funds, such as the issuer name, the security yields, the transaction date as well as a description of the security type at a monthly frequency. Given the sample period, we can analyze only three of the events in Table 1. These data allow us to investigate if the new securities added to their portfolio after the ZIRP shocks feature a higher yield than the ones before the shocks. Figure 3 presents the results, with each panel considering two empirical distributions: one the month before, and another one three months after each policy event.

The results indicate a right-ward shift in the distribution of yields after the monetary policy announcements, that is, fund portfolios on average hold assets with higher yields. The results from the Kolmogorov-Smirnov tests confirm that the differences between the respective two distributions are statistically significant.

In an additional test, we examine whether the increase in yields is a function of new additions made by funds to their portfolios after the policy announcement or is a legacy effect of the portfolios formed before the announcement. To this end, we compare the average yields of the securities added to the portfolio right before with those added right after the events. Formally, we estimate the following regression model.

$$Mean\ Yield_{it} = a_0 + a_1 Event_{it} + \boldsymbol{b}\boldsymbol{X}_{it-1} + \varepsilon_{it} \qquad (7)$$

where *Mean Yield* is the average yield of all securities of a given fund at time *t*, and *Event* is an indicator variable equal to one for the period after the ZIRP shocks and zero for the period before the ZIRP shocks. All other controls mimic those in model (3). The coefficient of our main interest is a_1. Table 12 presents the results.

Columns (1)-(3) report estimates for the three different events, controlling for year-month and fund-fixed effects. The coefficient of *Event* is positive and statistically significant for all three events, which means that the new securities feature significantly higher yields in the post period relative to the pre period. We further assess whether these results are due to monetary policy effects or are rather a general reflection of macro trends in the data. To this end, we design a placebo test in which we estimate a similar regression model for two random event windows, one (January 2011) picked for the period before the first event and one (March 2013) picked for the period after the last event. The results, in columns (4) and (5), indicate that the average yields on the new securities, if anything, decrease over time when considering these different dates. Hence, it is unlikely that our results are a reflection of a general macro trend.

In sum, the evidence from the portfolio data corroborates our earlier findings that the expectation of a long period of low interest rates induced money funds to search for higher-yield securities.

VI. Industry Spillovers

Our results so far indicate three different margins of adjustment for money funds: risk taking, exit, and fee waivers. In this section, we examine whether the exit from the money fund industry leads to resource reallocation in the entire mutual fund industry. To the extent that exiting money fund business frees up management resources and possible investor clientele fund families might want to accommodate such space by opening new funds specializing in different asset classes.

To this end, we collect detailed information from CRSP on mutual fund families' closures and creations of new funds. We expect the fund families that decided to close their money funds to be more likely to open a new fund, in order to relocate their unused resources. We further sharpen our hypothesis by differentiating across fund strategies. For example, money fund managers might be easier to employ in fixed income rather than equity funds. Similarly, investors in money funds might find bond funds to be a closer investment substitute. Formally, we estimate the following specification:

$$Number\ of\ Funds_{it} = a_0 + a_1 After_t + a_2 Treated_{it} + a_3 After_t \times Treated_{it} + \boldsymbol{b}\boldsymbol{X}_{it-1} + \varepsilon_{it}, \qquad (8)$$

where the dependent variable *Number of Funds* is the number of funds of a given style (money, bond, balance, and equity) at month *t* within a fund family *i*. *After* is an indicator variable equal to one for the month following the closure of the money fund, and zero for the month before the closure. *Treated* is an indicator variable equal to one for the families experiencing money fund closures in month *t* (treated group), and zero for the families that do not close their money funds in month *t* (control group). Our coefficient of interest is a_3. To capture any other variation that might drive both the closure and the opening of funds, we include several family controls (*X*), such as the log(Family TNA) and the Fund Family Return, as well as, family-fixed effects. We further distinguish between the periods of low interest rate regime (odd columns) and high interest rate regime (even columns) to see if the response to shocks is symmetric or not. Table 13 presents the results.

Columns (1) and (2) report the results for money funds. We observe a negative and statistically significant coefficient a_3. The effect is particularly strong for the low interest rate regime. Specifically, in that period, we find that treated families experience a reduction of more than 3 funds compared to the control group. This result is not purely mechanical, because fund families might

decide to close one money fund to substitute it with another one. Finding the negative effect validates the use of this empirical setting.

The subsequent six columns report the results for three different asset classes. In columns (3) and (4), we show that fund families that close their money funds, tend to open more than 6 bond funds. This effect is only present in the low-interest rate period underscoring the importance of the monetary shock. One identification concern is that the creation of bond funds might be driven by movement in the interest rates, or by a general trend in the industry, and not merely by the closure of money funds in the same fund family. However, we can reject this possibility for two reasons. First, we find a significant effect only in the low-interest regime, and there is no general trend in the creation of bond funds, as captured by the insignificant coefficient of the *After* variable. Second, using the difference-in-difference specification ensures that the general effects of changes in interest rate or market conditions on the profitability of bond funds should not differentially impact the fund families that closed a money fund and the ones that did not. In columns (5)-(8), we report results of similar specifications for equity and balanced funds. We find no significant differences between treatment and control group in the creation of these types of funds.

In sum, our results provide suggestive evidence that bond funds are the closest substitute to money funds in terms of resource allocation, either because the managerial skills can be easiest deployed in bond funds, or because investors in money funds are most likely to migrate to bond funds because they match most closely the risk profile of money funds. A suggestive evidence of this fact is Figure 4, in which we report a time-series evolution of assets under management for the two asset classes. It is clear from the graph that the correlation between the two series is negative.

VII. Concluding Remarks

The financial crisis of 2007-2008 created an immense public pressure to restore global economic order. With the rapid decline in economic output and a surge in unemployment rates, monetary authorities worldwide launched an unprecedented policy of keeping short-term interest rates at record low levels with an additional promise of maintaining such status quo into a distant future. While the ultimate scorecard of the policy is still being debated some critics have voiced concerns that the policy might have led to undesired dislocations in various parts of financial markets.

This paper empirically investigates such adverse consequences in the context of money funds. There is no doubt that money funds serve an important role in the functioning of financial and corporate world by being the primary provider of short-term capital to liquidity-driven financial sector and a place in which cash excesses from large corporations and individuals could be parked earning a safe interest rate. Given that money funds primarily invest in assets classes whose returns are linked to the Fed funds rate, monetary policy plays an important role in their operations. Thus this industry offers a great setting in which to study unintended consequences monetary policy may have on financial markets. An additional strength of the fund setting is access to detailed high-frequency micro-level data, which allows us to handle identification issues in a more effective way.

Our novel empirical evidence shows that in the times of unusually low interest rates fund managers increased, on average, their portfolios' risk in order to offer positive returns. As an attempt to deliver non-negative net returns to their investors almost all funds significantly reduced their expenses *charged* to investors, even though the *incurred* expenses did not vary much over time. The observed 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 funds that were not successful in retaining their investors' base, or were worried about negative reputation spillovers, were more likely to exit.

Overall, it seems that the zero lower bound policy might have triggered a reduction in capital supply to financial and large corporate sector and increased the financial markets' exposure to costly runs and defaults. While theoretically one could imagine each party affected to substitute to other sources of financing/investing, practically speaking, such adjustment might be difficult because the borrowing/lending relationships tend to be driven by reputation and the nature of contracts is very short term (mostly overnight), thereby creating a significant degree of rollover risk.

More broadly, although our empirical results speak mostly to one part of financial markets, we want to emphasize that the effects we document are not necessarily limited to money market funds industry only. For example, the reaching-for yield phenomenon has been observed in other markets. For example, an average insurance company has shifted its assets towards riskier equity holdings, reaching the level of equity exposure of almost 20% in 2014, putting at risk their ability to meet unexpected redemption claims. Similarly, pension funds, traditionally mandated to protect net worth of their risk-averse investors, expanded their holdings into more than 60% in equity, away from typically held bonds. However, more work remains to be done to better understand the transmission mechanisms underlying the effects of the zero lower bound monetary policy on the stability of financial markets.

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Figure 1: Assets Under Management of Prime Money Funds: 2005-2014

Note: The figure presents the evolution of weekly total net assets under management for the universe of prime money market funds over the period 2005-2014.

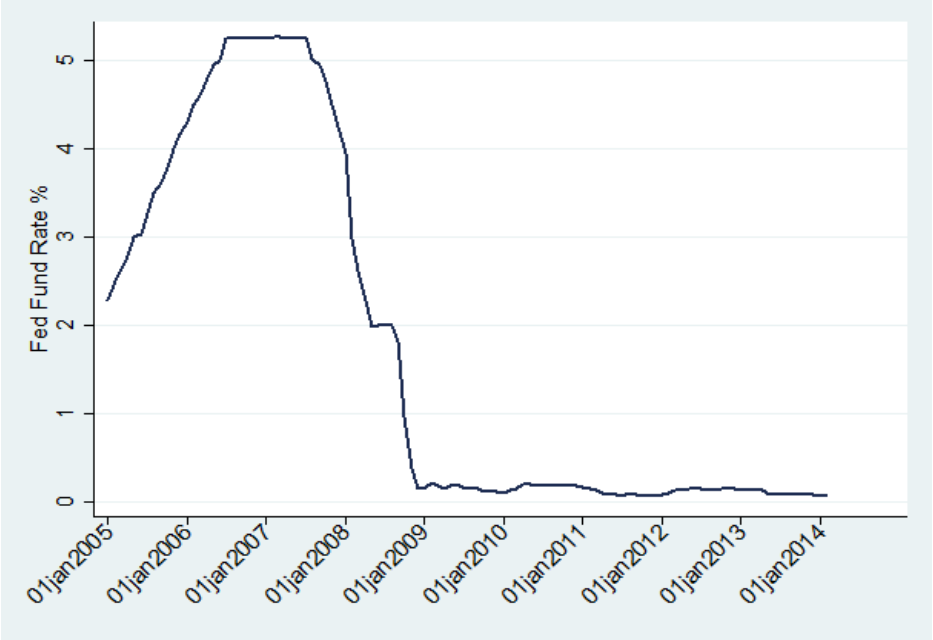

Figure 2: Fed Funds Rate: 2005-2014

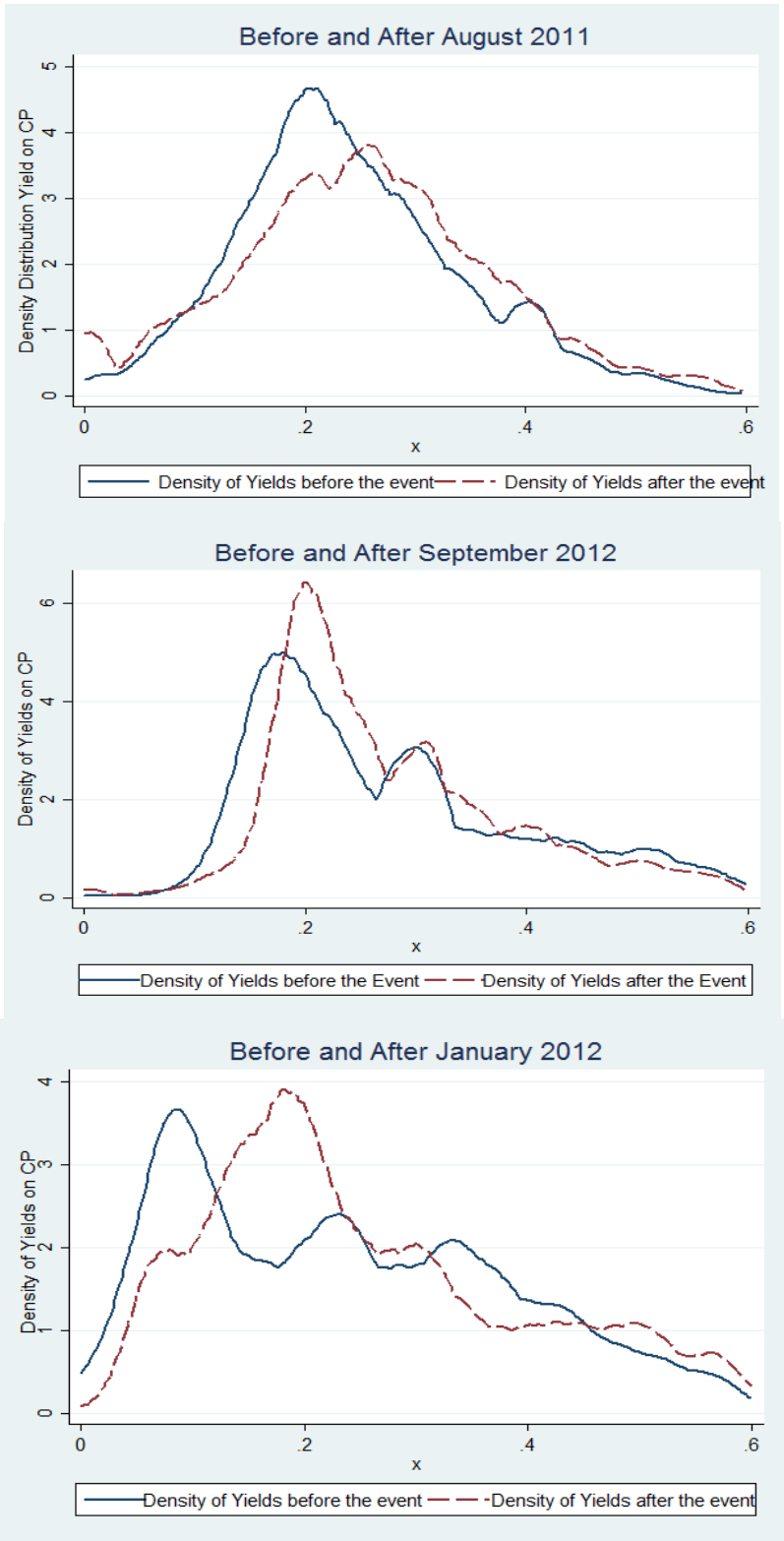

Figure 3: Yields Distribution and ZIRP Shocks

Note: Empirical distributions of the fund portfolio yields before and after the three ZIRP shocks.

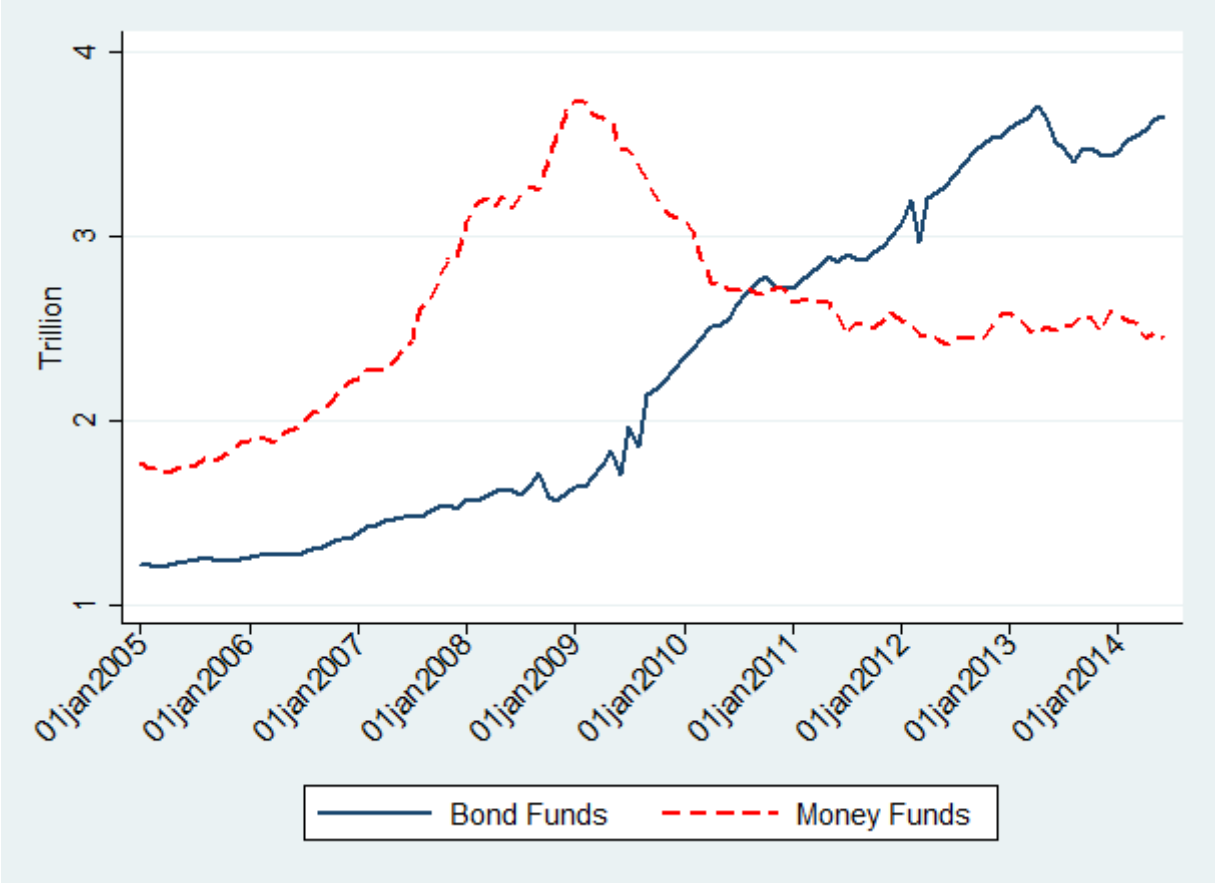

Figure 4: Money Funds vs. Bond Funds AUM: 2005-2014

The figure presents the evolution of weekly total net assets for the universe of prime money market funds and bond funds over the period 2005-2014.

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 "an extended period of time"
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
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 Gross 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, the expense ratio (charged), 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.

	(1)	(2)	(3)	(4)
Fed Rate	93.025***	94.370***	62.291***	62.086***
	(1.012)	(0.963)	(5.087)	(5.083)
Controls	Yes	Yes	Yes	Yes
Year-Fixed Effects	No	No	Yes	Yes
Fund-Fixed Effects	Yes	No	No	No
Sponsor-Fixed Effects	No	Yes	No	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), 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.

	(1)	(2)	(3)	(4)
VARIABLES\MODEL	Flow		Flow	
Fund Return	0.001***	0.009***	0.002***	0.006***
	(0.000)	(0.001)	(0.000)	(0.002)
Fund Return*Low Rate			0.002**	0.006***
			(0.001)	(0.002)
Controls	Yes	Yes	Yes	Yes
Sponsor-Fixed Effects	Yes	Yes	Yes	Yes
Week-Fixed Effects	No	Yes	No	Yes
Observations	98,948	98,948	98,948	98,948

Table 5: Fund Strategies and ZIRP Shocks

The sample is all U.S. prime money market funds. The estimation window includes one month before and three months or six months 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. **In Panel A**, 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*. **In Panel B**, 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*). **In Panel C**, 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. Control variables include the annualized fund return, the natural logarithm of fund assets, the natural logarithm of family assets, expense ratio (charged), 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

	(1)	(2)	(3)	(4)
VARIABLES	# Funds	Exit	# Funds	Exit
	3 Months Ahead		6 Months Ahead	
Event	-5.400***	0.002**	-9.000***	0.002**
	(0.543)	(0.001)	(1.152)	(0.001)
Controls	No	Yes	No	Yes
Year-Fixed Effects	No	Yes	No	Yes
Sponsor-Fixed Effects	No	Yes	No	Yes
Observations	10	18,568	10	25,914

Panel B: Fund Risk

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARBLES	Spread	Holding Risk	Maturity	Concentration	Spread	Holding Risk	Maturity	Concentration
	3 Months Ahead				6 Months Ahead			
Event	34.329***	0.954***	-1.216**	0.005***	21.341**	0.879***	-1.347***	0.005***
	(12.113)	(0.323)	(0.503)	(0.002)	(10.471)	(0.271)	(0.386)	(0.001)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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 C: Fund Expenses

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Charged	Incurred	Subsidy	Charged	Incurred	Subsidy
		3 months ahead			6 months ahead	
Event	-0.001	-0.002**	-0.002	-0.014**	-0.003***	0.010**
	(0.002)	(0.001)	(0.002)	(0.006)	(0.001)	(0.005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
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

Table 6: Fund Strategies and ZIRP Shocks: Conditioning on Sponsor Type

The design follows Table 5. *Independent Sponsor* is an indicator variable equal one if the fund sponsor is an independent asset management company, and zero otherwise.

Panel A: Fund Exit

	(1)	(2)	(3)	(4)
VARIABLES	# Funds	Exit	# Funds	Exit
	3 Months Ahead		6 Months Ahead	
Event	-3.280***	0.002***	-2.862***	0.002***
	(0.803)	(0.001)	(0.767)	(0.001)
Event*Independent Sponsor	0.077	-0.002	0.178**	-0.003**
	(0.067)	(0.002)	(0.081)	(0.001)
Controls	Yes	Yes	Yes	Yes
Year-Fixed Effects	No	Yes	No	Yes
Sponsor-Fixed Effects	No	Yes	No	Yes
Observations	20	18,568	20	25,914

Panel B: Fund Risk

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Spread	Holding Risk	Maturity	Concentration	Spread	Holding Risk	Maturity	Concentration
	3 Months Ahead				6 Months Ahead			
Independent Sponsor	-3.837	6.642**	4.768***	0	-0.776	5.681	5.107***	-0.011
	(2.878)	(3.309)	(1.366)	(0.020)	(2.940)	(3.492)	(1.484)	(0.021)
Independent	9.215***	1.821***	-1.010**	0.008**	4.646***	3.405**	-1.897***	0.026***
Sponsor*Event	(1.239)	(0.634)	(0.460)	(0.004)	(1.668)	(1.533)	(0.709)	(0.007)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Y/M-F.E.	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 C: Fund Expenses

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Charged	Incurred	Subsidy	Charged	Incurred	Subsidy
		3 months ahead			6 months ahead	
Independent Sponsor	-0.003	0.030	0.032	-0.006	0.029	0.034
	(0.020)	(0.039)	(0.027)	(0.022)	(0.039)	(0.027)
Independent	0.005	0.008	0.003	0.011	0.011	0
Sponsor*Event	(0.006)	(0.005)	(0.007)	(0.012)	(0.010)	(0.013)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Week-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,568	18,506	18,506	25,914	25,829	25,829

Table 7: Variation in Reputation within Independent Fund Sponsors

Panel A: 3-Month Horizon

Variable	Exit	Spread	Holdings Risk	Maturity	Concentration	Subsidy
Event	0.001	25.207**	4.368*	-0.120	0.018*	-0.050***
	(0.002)	(12.275)	(2.439)	(0.936)	(0.010)	(0.015)
Event*	-0.001	-11.003*	-3.661*	-1.774*	-0.016	0.062***
Business Risk	(0.003)	(6.241)	(2.349)	(1.002)	(0.012)	(0.019)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sponsor F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7635	7030	7036	7036	7036	7619

Panel B: 6-Month Horizon

Variable	Exit	Spread	Holdings Risk	Maturity	Concentration	Subsidy
Event	-0.001	22.596**	7.848***	2.395**	0.036***	-0.052***
	(0.004)	(10.835)	(2.016)	(0.958)	(0.008)	(0.011)
Event*	-0.001	-11.003**	-8.226***	-4.705***	-0.039***	0.079***
Business Risk	(0.005)	(4.826)	(2.367)	(1.113)	(0.009)	(0.015)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sponsor F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,659	9789	9802	9802	9802	10,633

Table 8: Fund Risk and ZIRP Shocks: Conditioning on Survival

The design follows that in Table 5 (Panel A) and Table 6 (Panel B). We restrict our estimation to the sample of funds that are present in both periods before and after the event.

Panel A: Time-Series Evidence

VARIABLES	(1) Spread	(2) Holdings Risk	(3) Maturity Risk	(4) Concentration	(5) Spread	(6) Holdings Risk	(7) Maturity Risk	(8) Concentration
	3 Months Ahead				6 Months Ahead			
Event	34.329***	0.954***	-1.216**	0.005***	21.341**	0.879***	-1.347***	0.005***
	(12.113)	(0.323)	(0.503)	(0.002)	(10.471)	(0.271)	(0.386)	(0.001)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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: Cross-Sectional Evidence

VARIABLES	(1) Spread	(2) Holdings Risk	(3) Maturity Risk	(4) Concentration	(5) Spread	(6) Holdings Risk	(7) Maturity Risk	(8) Concentration
	3 Months Ahead				6 Months Ahead			
Independent Sponsor	-3.748	6.178*	4.633***	-0.008	-0.979	5.382	5.016***	-0.016
	(2.837)	(3.305)	(1.355)	(0.023)	(2.893)	(3.476)	(1.469)	(0.022)
Independent Sponsor*Event	9.167***	2.507***	-0.823*	0.020*	4.972***	3.865**	-1.776**	0.034***
	(1.212)	(0.801)	(0.473)	(0.011)	(1.631)	(1.556)	(0.702)	(0.010)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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 9: Comparisons across Interest Rate Regimes

The sample is all U.S. prime money market funds over the period January 2005-December 2013. The definitions of all dependent and control variables follow those in Table 5. All regressions are at the weekly level and include year/month-fixed and sponsor-fixed effects. *Low Rate* is an indicator variable equal to one if Fed funds rate is below 1%, and zero otherwise. Standard errors are clustered at the week level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

Panel A: Fund Exit

	(1)	(2)	(3)	(4)
VARIABLES	# Funds		Exit	
			RF>1	RF<=1
Fed Rate	-1.555***	-2.348***	0.003	-0.072***
	(0.475)	(0.258)	(0.002)	(0.016)
Low Rate		-132.783***		
		(12.459)		
Fed Rate*Low Rate		16.861***		
		(3.171)		
Controls	Yes	Yes	Yes	Yes
Year/Month-F. E.	No	No	Yes	Yes
Sponsor F. E.	No	No	Yes	Yes
Observations	442	442	50,334	48,458

Panel B: Fund Risk

	(1)	(2)	(3)	(4)
VARIABLES	Spread	Holdings Risk	Maturity Risk	Concentration
Fed Rate	2.713	-0.048	-0.893	0.001
	(26.732)	(0.28)	(0.649)	(0.001)
Fed Rate*Low Rate	-56.611***	-5.941***	-1.673*	-0.028***
	(13.628)	(0.723)	(1.032)	(0.006)
Controls	Yes	Yes	Yes	Yes
Sponsor-Fixed Effects	Yes	Yes	Yes	Yes
Year/Month-Fixed Effects	Yes	Yes	Yes	Yes
Observations	94,521	95,264	95,253	94,264

Panel C: Fund Expenses

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES\MODEL	Charged Expenses		Incurred Expenses		Subsidy	
Fed Rate	-0.006***	-0.005***	-0.002	0.004***	0.004***	0.008***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Fed Rate*Low Rate		0.080***		-0.001		-0.079***
		(0.027)		(0.011)		(0.022)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sponsor-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	98,484	98,484	98,484	98,484	98,484	98,484

Table 10: Comparisons across Interest Rate Regimes: Conditioning on Sponsor Type

The design follows that in Table 8. All control variables are defined in Table 5 and Table 6.

Panel A: Fund Exit

VARIABLES	(1) Number of Funds	(2) Exit
Low Rate	-20.098***	-0.009
	(2.135)	(0.008)
Independent Sponsor	34.970***	--
	(3.888)	
Independent Sponsor*Low Rate	8.796***	0.000
	(1.587)	(0.001)
Controls	Yes	Yes
Year-Month-Fixed Effects	No	Yes
Sponsor-Fixed Effect	No	Yes
Observations	920	98,795

Panel B: Fund Risk

VARIABLES	(1) Spread	(2) Holdings Risk	(3) Maturity Risk	(4) Concentration
Independent Sponsor	-0.239	-0.130	-0.904	-0.026
	(0.893)	(2.535)	(1.042)	(0.020)
Independent Sponsor*Low Rate	2.449**	7.328**	4.519***	0.038**
	(1.224)	(2.905)	(1.170)	(0.017)
Controls	Yes	Yes	Yes	Yes
Week-Fixed Effect	Yes	Yes	Yes	Yes
Observations	94,521	95,264	95,253	95,264

Panel C: Fund Expenses

VARIABLES	(1) Charged Expenses	(2) Incurred Expenses	(3) Subsidy
Independent Sponsor	0.012	0.062	0.049*
	(0.027)	(0.040)	(0.027)
Independent Sponsor*Low Rate	-0.013	-0.031	-0.018
	(0.024)	(0.022)	(0.030)
Controls	Yes	Yes	Yes
Week-Fixed Effects	Yes	Yes	Yes
Observations	98,795	98,484	98,484

Table 11: The Effects of Unexpected Monetary Shock

The design follows Table 5. *Monetary Shock* is the first principal component of the unexpected shock to changes in Treasury yields around FOMC announcements. Control variables mimic the corresponding definitions from Tables 5-7. All regressions are at the weekly level. *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.

Panel A: Fund Exit

VARIABLES	(1)	(2)	(3)
	Exit		
	Full Sample	High Rate	Low Rate
Monetary Shock	-0.012	0.009	-0.048**
	(0.018)	(0.021)	(0.022)
Controls	Yes	Yes	Yes
Year/Month-Fixed Effects	Yes	Yes	Yes
Sponsor-Fixed Effects	Yes	Yes	Yes
Observations	98,795	50,337	48,458

Panel B: Fund Risk (Low-Rate Regime)

VARIABLES	(1)	(2)	(3)	(4)
	Spread	Holdings Risk	Maturity Risk	Concentration
Monetary Shock	-0.919*	-0.001**	0.031	-0.000
	(0.633)	(0.000)	(0.072)	(0.000)
Controls	Yes	Yes	Yes	Yes
Sponsor-Fixed Effects	Yes	Yes	Yes	Yes
Year/Month-Fixed Effects	Yes	Yes	Yes	Yes
Observations	45,322	46,286	46,054	46,065

Panel C: Fund Expenses

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Charged Expenses			Incurred Expenses			Subsidy		
	Full Sample	High Rate	Low Rate	Full Sample	High Rate	Low Rate	Full Sample	High Rate	Low Rate
Monetary Shock	0.001	0.000	0.002	-0.000	-0.002	0.000	-0.002	-0.002	-0.002
	(0.004)	(0.001)	(0.006)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.005)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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	98,795	50,337	48,458	98,484	50,186	48,298	98,484	50,186	48,298

Table 12: Evidence from Portfolio Holdings

The sample is all U.S. prime money market funds. The dependent variable is the mean of the yields of the new securities added to the fund portfolio. The estimation window includes one month before and three months after the last three 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. Columns (4) and (5) repeat the analysis by considering a randomly drawn date that does not coincide with any of the ZIRP shocks dates. All regressions are at the monthly level and include year/month-fixed and fund-fixed effects. Standard errors are clustered at the monthly level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	(1)	(2)	(3)	(4)	(5)
	Mean Yield				
	Event: August 2011	*Event: January 2012*	*Event: September 2012*	*Placebos* *March 2011*	*January 2013*
Event	0.0388***	0.0439***	0.0420***	-0.0302***	-0.0107***
	(0.000701)	(0.000971)	(0.000371)	(0.000438)	(0.000287)
Controls	Yes	Yes	Yes	Yes	Yes
Year/Month-Fixed Effects	Yes	Yes	Yes	Yes	Yes
Fund-Fixed Effects	Yes	Yes	Yes	Yes	Yes
Observations	49,242	39,690	59,716	31,988	24,129

Table 13: Industry Response

The sample includes all mutual funds families in U.S. over the period January 2005-December 2013. The dependent variables are *Number of Funds*, defined as the number of funds in a given period for a given type of fund. *Treated* is an indicator variable equal to one if the fund family closed one of its money market fund. *After* is an indicator variable equal to one after the closure of the money market fund. All regressions include fund family fixed effects. Standard errors are clustered at the week level. ***, **, * represent 1%, 5%, and 10% significance, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Money Funds		Bond Funds		Equity Funds		Balanced Funds	
	LR	HR	LR	HR	LR	HR	LR	HR
After	-0.410*	0.226	0.406	0.005	2.358	-1.015	0.804	0.058
	(0.241)	(0.355)	(1.442)	(0.290)	(2.695)	(1.266)	(0.940)	(0.178)
After*Treated	-3.018**	-1.049	6.735**	-1.055	14.98	1.774	3.318	0.928
	(1.458)	(3.149)	(3.387)	(2.496)	(13.438)	(6.527)	(2.484)	(1.907)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Family-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1920	2130	1920	2130	1920	2130	1920	2130