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Abstract

We argue that bank holding companies (BHCs) extend shadow insurance to the prime institutional money market funds (PI-MMFs) they sponsor and that PI-MMFs price this shadow insurance by charging investors significantly higher expense ratios and paying lower net yields. We provide evidence that after September 2008, expense ratios at BHC-sponsored PI-MMFs increased more than at non-BHC-sponsored PI-MMFs. Despite higher expense ratios, BHC-sponsored PI-MMFs did not experience larger redemptions than non-BHC-sponsored PI-MMFs. In addition, we show that expense ratios increased with BHCs' financial strength and the likelihood of their support; however, this expense ratio differential disappeared after the 2016 MMF reform.

JEL Classification: G2, G21, G23, G28, H12, H81.

Keywords: bank, bank holding company, bank run, financial crisis, liquidity risk, money market fund, systemic risk, too big to fail.

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1. Introduction

Bank holding companies (BHCs) frequently own both insured bank subsidiaries and uninsured nonbanks, such as insurance or brokerage subsidiaries, or hold non-operational subsidiaries, such as special purpose vehicles (SPVs). The Gramm-Leach-Bliley Act of 1999 accelerated BHCs' shift into nonbank businesses by potentially giving them increased scope economies and by allowing them to diversify into nonbank services. However, evidence has accumulated that nonbank activities lead to regulatory arbitrage and have negative spillover effects on commercial banks and the economy in general. Acharya, Schnabl, and Suarez (2013) show that BHCs extend implicit guarantees to the SPVs they create. Chernenko and Sunderam (2014) demonstrate that the risk-taking by money market funds can disrupt their short-term lending to creditworthy borrowers. Ferreira, Matos, and Pires (2018) argue that equity fund managers support affiliated banks' lending operations. Pogach and Unal (2018) provide evidence that BHCs protect their nonbanks from the pressures of external dividends by using the bank segment's internal dividends.

We add to this growing literature by examining the BHC sponsorship of money market funds (BHC-sponsored MMFs). This industry goes back to the early 1980s and is among the earliest nonbank affiliations of BHCs. Other financial institutions that are not part of the usual financial safety-net can also establish and sponsor MMFs (non-BHC-sponsored MMF). Sponsoring institutions extend an implicit guarantee to MMF investors: that the sponsors will support the funds in times of crises. The guarantee is implicit because the sponsors do not have a legal obligation to support an ailing MMF under its sponsorship. However, as Kacperczyk and Schnabl (2013) point out, sponsors have the incentive to support an ailing MMF to minimize the spillover risk of a failed MMF to other businesses of the sponsor. Our objective is to understand how BHC-sponsored MMFs are different from non-

BHC-sponsored MMFs, and whether this affiliation creates regulatory arbitrage opportunities for the sponsoring BHC.

Sponsorship by a BHC rather than a non-BHC can matter for investors because the fund management can benefit from an affiliation with a BHC. The BHC has relatively quick access to cheap and information-insensitive funding sources through its bank subsidiaries, such as insured, brokered deposits or the discount window. Federal guidelines recognize the cross-subsidization within a BHC. For example, in its *Bank Holding Company Supervision Manual*, the Board of Governors of the Federal Reserve acknowledges that the failure of a nonbank subsidiary has financial ramifications for the BHC, and thus the subsidiary can use the BHC's resources to provide support to that subsidiary¹:

... Failure of a nonbank subsidiary may lead to a lack of confidence in the affiliated bank's ability to continue in business, which might precipitate a run on the bank's deposits. ... Because the bank is usually the largest subsidiary, the holding company may attempt to draw upon the resources of the bank to aid the nonbank subsidiary.

Hence, investors could expect the BHC to provide support to its sponsored MMF when the fund's assets lose value, or the redemption activity is high. This expected support from a BHC can be more credible, and therefore more valuable, than the expected support from an otherwise similar, non-BHC. The non-BHC sponsor lacks access to relatively cheap funds, thereby giving the BHC sponsor "deeper pockets." Pogach and Unal (2020) report that the credit spreads of new bond issues at BHCs were on average 20 basis points lower than other financial firms for the period from 1996 to 2002.

We test the implicit-guarantee hypothesis along four dimensions. In terms of pricing, BHC-sponsored MMFs can charge their institutional investors more than the non-BHC-sponsored MMFs

¹ Board of Governors of the Federal Reserve System, 2016, "Bank Holding Company Supervision Manual," Division of Banking Supervision and Regulation, Section 4030.0.

to compensate for the implicit guarantee from their sponsors. We measure this value by examining the fund-level expense ratios and the net yields on assets in two contrasting market conditions. One is the high-risk 2008 Lehman crisis that exposed MMFs to heightened redemption risk and increased the need for, and thus the value of, sponsor support. In this environment and to the extent that the value of the implicit insurance extended by the BHC sponsors is more valuable than other sponsors' support, we expect BHC-sponsored MMFs to charge higher fees after September 2008 to account for the higher value of the implicit insurance they provide. The other environment we examine is a 2016 regulatory change to the MMF industry that in practice, shifted risk away from MMFs (and sponsors) to investors. In response to the 2008 crisis, the Securities and Exchange Commission (SEC) put in place reforms to address the risk of investor runs on MMFs. One of the most important changes for prime institutional money market funds (PI-MMFs) was the imposition of floating net asset values (NAV) to reduce the risk of breaking the buck (NAV per share falling below \$1). If the difference in expense ratios between BHC-sponsored funds and non-BHC-sponsored funds were driven by the differences in investor risk exposure, we would expect that the premium on expense ratios charged by BHC-sponsored funds to disappear after these reforms.

The second dimension of our analysis focuses on the flow of funds into and out of MMFs. We examine the redemption behavior of investors in BHC-sponsored funds versus the non-BHC-sponsored funds during the Lehman crisis. This analysis elucidates the investors' perceptions about the safety of the fund. They may have perceived that the BHC that sponsored the fund was providing a valuable form of implicit insurance. If that is the case, we should observe that notwithstanding the higher expense ratio and lower yields, BHC-sponsored MMFs do not necessarily face more redemptions than non-BHC-sponsored MMFs after controlling for asset characteristics.

The third dimension of our analysis examines the actual support from the sponsors during the Lehman crisis. Despite the fact that only the Reserve Primary Fund broke the buck during the Lehman

crisis, many other MMFs kept their NAVs at \$1 with sponsor support. Brady, Anadu, and Cooper, 2012) provide a thorough analysis of the instances of sponsor support during the crisis. We use this dataset and investigate whether the BHC sponsors are more likely to support MMFs during the Lehman crisis and that whether the expense ratios are sensitive to the likelihood of support. We predict that BHC-sponsored MMFs are more likely to receive support from their sponsors.

Finally, we examine the sensitivity of the expense ratios to the financial strength of the sponsor. In order for the sponsor to extend a credible guarantee to a fund, it should itself have a sound financial standing. During the Lehman crisis, many BHCs themselves were experiencing liquidity issues, suffering declines in asset values, and even facing default. Therefore, to the extent that the implicit-guarantee hypothesis was valid, MMF investors should perceive sponsorship by financially strong BHCs to be more valuable. We therefore predict that the PI-MMFs that are sponsored by more liquid and lower default-risk BHCs charge higher expense ratios.

In our analysis, we focus primarily on PI-MMFs. There are two reasons for this emphasis. First, PI-MMFs are more vulnerable to industry-wide runs (Schmidt, Timmerman, and Wermers, 2016). Second, they are an important part of the shadow banking system and have a significant effect on the systemic risk of the aggregate financial system — as seen during the 2008 MMF Crisis. The size of BHC-sponsored PI-MMFs grew from a negligible percentage of the industry in 1986 to about 50%, \$227 billion, of total assets of the MMF industry by the turn of the century. These funds grew to \$612 billion and as much as 52% of all institutional MMF assets by the end of 2007. Hence, sponsorship of PI-MMFs created an enormous implicit liability for BHCs.

Our empirical results support the predictions. We use a difference-in-differences analysis and show that BHC-sponsored PI-MMFs earned 6.77 basis points fewer gross returns but charged 6.55 basis points higher expense ratios compared to non-BHC-sponsored PI-MMFs during the period

from September 2008 to March 2009 (post-Lehman crisis) relative to the period from March to August 2008 (pre-Lehman crisis). Given that the average expense ratio of non-BHC-sponsored PI-MMFs during the post-crisis period was 36 basis points, the 6.55 basis points difference is economically significant. Furthermore, it is within 0.1 basis points of the average premiums on deposit insurance that the Federal Deposit Insurance Corporation (FDIC) charged in 2008. Because of reduced gross yields and increased expense ratios during the same post-crisis period, investors' net yield was 13 basis points or 8.5% lower at BHC-sponsored PI-MMFs.

These results contrast with a placebo test of alternative funds – government institutional funds and prime retail funds. The identical institutions that sponsor PI-MMFs typically sponsor those funds. To the extent that there is a different clientele for BHC-sponsored funds versus non-BHC-sponsored funds, these clientele differences would carry over to other fund types under the same sponsor. However, the most conspicuous difference between government institutional funds and PI-MMFs is the risk of their underlying assets. While PI-MMF assets are exposed to risky assets such as asset-backed commercial paper (ABCP), government institutional funds have assets mostly free of default risk. In terms of prime retail funds, despite that these funds had similar risky assets as PI-MMFs, investors were less risk sensitive and did not exhibit run behavior during the Lehman crisis (Schmidt, Timmerman, and Wermers, 2016). Therefore, we predict that a sponsor's implicit guarantee would be relatively less valuable to investors in these funds and thus expense ratios would not significantly differ between BHC- and non-BHC-sponsored funds. We examine difference-in-differences in expense ratios between BHC-sponsored and non-BHC-sponsored funds and between the pre-Lehman and the post-Lehman periods. Consistent with our expectations, in contrast to PI-MMFs, the falsification tests find no relation between BHC sponsorship and expense ratios.

To assess the flow effect, we use a difference-in-differences to contrast the flows between pre- and post-Lehman crisis periods and for BHC- and non-BHC-sponsored funds. Our findings show

that there was no material difference between the changes in expense ratios for these two fund groups. In other words, no material withdrawal occurred at BHC-sponsored PI-MMFs despite the lower yields of these funds. This finding is in sharp contrast to the literature that analyzes the flow-performance relation during relatively calm periods. Kacperczyk and Schnabl (2013) and Cherenkov and Sunderam (2014) show that institutional investors are very sensitive to yield differences and that they move large sums of funds to gain additional returns of as little as 10 basis points. In addition, Christoffersen (2001) and Christoffersen and Musto (2002) provide evidence that there is a strong performance-flow relation, such that higher yielding funds attract more inflows. Given the findings of this literature, the mere fact that investors at BHC-sponsored funds did not redeem their funds despite a 13 basis points lower net return supports the argument that they see BHC sponsorships to be valuable.

The results of our analysis of sponsor support during the financial crisis show that BHC sponsors with more ABCP exposure are indeed more likely to provide direct support to their affiliated PI-MMFs. ABCP is the class of assets that suffered the most as a result of the failure of Lehman's commercial paper. Those funds that had high holdings of ABCP experienced the greatest decline in asset values and therefore needed sponsor support. The results support this prediction. In addition, we find a higher probability of getting support is associated with higher charged expense ratios by BHC-sponsored PI-MMFs. We interpret these results as evidence that investors in PI-MMFs behave as if they find the BHC's implicit guarantee credible and treat their funds as being safer, and are therefore less likely to redeem.

Our final analysis pertains to the variations in default risk within BHC sponsors. We use a BHC's level of liquidity, equity, and uninsured deposits (all as a percentage of the BHC's assets) as proxies for the BHC's default risk. Higher liquidity and equity levels are signals of financial strength. We use the uninsured deposits ratio as a signal of the confidence of depositors that can mimic the institutional investors at MMFs. The higher levels of uninsured deposits can be construed as showing lower

expectations of default risk for the BHC. Our results support these conjectures. We find that PI-MMFs sponsored by BHCs with higher liquidity and uninsured deposits tend to charge a higher expense ratio in light of the more credible guarantee from their sponsors.

In sum, our findings show that BHC-sponsored PI-MMFs operated as if they were under a government safety net during the sample period. They were not “shadow banks” in the sense that they lacked access to the government safety net. Instead, BHCs were operating in the shadows and extending shadow insurance to institutional investors through their affiliated MMFs. In return, the affiliated MMFs charged higher expense ratios. However, the BHCs had no reserve or capital requirements and paid no fees to the federal insurer against the risks they assumed because of their sponsorship of the fund. Thus, the BHC sponsors benefited from potential government support without bearing any additional costs that led to regulatory arbitrage.

These results add to the findings of Acharya, Schnabl, and Suarez (2013). They provide evidence of regulatory arbitrage in which BHCs create SPV conduits and securitize loans. However, BHCs keep their sponsorship (guarantee) behind these securitized loans while getting relief from capital requirements. This sponsorship of SPVs and securitized loans is similar in spirit to the implicit guarantee extended by the BHC-sponsors of PI-MMFs that contributed to the growth of PI-MMFs. Hence, our findings nicely complement those in Acharya, Schnabl, and Suarez (2013). We also add to the findings in Kacperczyk and Schnabl (2013). They show that participation in MMFs places important financial obligations on the sponsoring firms. Our results support their insight and show that BHCs face increased exposure to liquidity risk because of their affiliation with MMFs.

We organize the paper as follows: Section 2 provides the institutional background. In Section 3, we discuss the conceptual framework and the empirical setting. Section 4 presents the data. Sections 5, 6, 7, and 8 provide the results of our empirical analyses. Section 9 concludes.

2. Institutional Background

MMFs, which were introduced in 1971, are structured as registered investment companies under the Investment Company Act of 1940. A management company (fund sponsor) can establish a new MMF as a separate legal entity. The management company can simultaneously operate many individual funds, and it can advertise them under a single brand name, such as *BlackRock* or *Fidelity*. The group of funds under a brand name are called a *fund complex*. A fund can issue share classes that can have different expense ratios or minimum investment requirements. They also often categorize share classes by investor type: *institutional* or *retail*. Institutional shares are for investors such as corporate treasuries, bank trust departments, corporations, and pension funds. These shares have higher minimum investment requirements and are associated with larger accounts. Retail shares are open to all investors — organizations and individuals (Morley, 2014 and Baklanova and Tanega, 2014).

Each institutional or retail MMF can have categories, such as *prime*, *government*, and *tax free*. Prime funds invest in short-term private debt instruments such as commercial paper, certificates of deposit, other bank obligations, repurchase agreements (repos), and corporate floating-rate notes. Government funds invest in US Treasury securities and in US government agency obligations such as government-funded enterprises. Tax-free funds invest in municipal securities.

Rule 2a-7 of the Investment Company Act of 1940 places restrictions on the liquidity, maturity, and credit risk of the assets held by an MMF, such that the fund assets have a relatively low risk exposure. Specifically, each asset held by an MMF must have a maximum maturity of one year, and the weighted average maturity of all assets held must be no longer than 60 days. A rating agency must rate 97% of all securities held by an MMF as being in their top two categories. Funds cannot invest more than 5% of their assets in the securities of one issuer. Ten percent of portfolio assets must be in liquid instruments with daily availability, and 30% of portfolio assets must be in instruments having

weekly availability. Also, MMFs cannot invest more than 5% of their assets in illiquid securities. Lastly, all MMF holdings must be denominated in US dollars.

Up until 2014, each share had a fixed price of \$1 that was pegged to a fixed portfolio net asset value (NAV) of \$1 per share. This fixed pricing was a pivotal fixture of the MMF industry from its start in 1971 through the crisis of 2008. Responding to the crisis of 2008, in 2014 the SEC abolished the stable per share NAV for the share prices of prime institutional funds and required floating share pricing to start in October 2016. (see Securities and Exchange Commission, 2014.a, 2014.b).

Under the fixed-share-price regime, healthy MMFs that met the requirements of Rule 2a-7 calculated the value of their assets by using the amortized cost accounting method. This method values each asset at its historical cost. The rule justifies the use of this method because it requires that MMF portfolio assets must be of high credit quality, high liquidity, and of short maturity. If an MMF's assets lose value so that the per-share market value (its shadow price) drops below its historical per-share cost of \$1 (below \$0.995), the fund “breaks the buck” — it has become distressed. When a fund breaks the buck, its board of directors can suspend redemptions to allow for an orderly liquidation.

The primary reasons for the deterioration of an MMF's assets include asset devaluation, asset default, an interest rate spike, or a liquidity event. Breaking the buck is a rare event. In the decades-long history of MMFs, only two have broken the buck. These were the Community Bankers US Government Fund in 1994 and the Reserve Primary Fund in 2008.

3. The Expense Ratio as a Fee for Implicit Insurance

The central argument of our paper is that institutional investors may price the value of a MMF sponsorship. We hypothesize that BHC sponsorships can be more valuable because of their “deep-pockets” relative to non-BHC sponsors (including other financial firms, such as insurance companies

and investment banks). This funding advantage provides a form of liquidity insurance for investors. Consequently, we argue that investors will accept higher expense ratios (and lower net yields) from BHC-sponsored MMFs when the environment gets riskier.

To investigate this hypothesis, we use the difference in expense ratios between BHC- and non-BHC-sponsored MMFs as a proxy for the value of this guarantee, while acknowledging and controlling for many other factors that can affect the expense ratio. This is a novel interpretation of the expense ratio. Expense ratios are the fees that investors pay to the fund company to manage the fund, and the fund expresses them as a percentage of its total assets. Fees for management and administrative services constitute the largest expense of funds followed by marketing and distribution. In addition, funds can charge investors for custodian and auditing fees as well as trustees' fees and expenses. If a BHC-sponsored MMF can provide a more credible liquidity backstop, then it could charge more for any of these components relative to a non-BHC-sponsored MMF to account for the implicit guarantee that it extends. Since from an investors' perspective, fees are fungible, for example, a custodial fee and an equal administrative fee are ultimately reflected identically in the investors' realized returns; we focus on the sum total of these fees.

Higher expense ratios can generate more profits for the MMF and its BHC sponsor. However, an implicit guarantee transfers risk from the MMF to the BHC. Hence, understanding the risks posed by the BHC-sponsored MMFs can help identify the channels through which these so-called "shadow banks" can extend shadow insurance and thereby extract subsidies from the safety net and potentially weaken financial stability.

However, other factors can influence the expense ratios. Of foremost importance is their use in determining the net yield to MMF investors. Because market conditions and portfolio holdings determine gross yield, fund managers can increase, lower, or waive expense ratios to give the investors

acceptable yields. When interest rates are high, fund gross returns are high; and MMFs can charge a higher expense ratio. In contrast, when interest rates are low, to compensate investors with reasonable net yields, MMFs can waive expense ratios. For example, there are MMFs that waived expense ratios during the 2009-2015 period when interest rates were at their record low levels. Conversely, waivers were at their lowest level during the period from 2006 to 2008 when rates were still relatively high (ICI Research Perspective, 2018). However, Christoffersen (2001) provides evidence that there is a relatively flat relation between MMF performance and waivers. In our empirical tests we use expense ratios net of waivers and reductions.

Expense ratios also depend on the minimum size of investment. Increasing the minimum size is associated with lower expense ratios. Schmidt, Timmerman, and Wermers (2016) argue that a fund with higher minimum size is a proxy for investor sophistication. Because a larger investment means more “skin in the game,” Schmidt, Timmerman, and Wermers (2016) claim that these investors will analyze the health of the fund more carefully than others will and hence could be considered sophisticated. They provide evidence that there is a strong relation between expense ratios and minimum investments for prime share classes.

To minimize the confounding effects of differences in minimum sizes on expenses, we compare the expense ratios of BHC- and non-BHC-sponsored funds at different minimum balance requirements. We control for the effects of market interest rates and investor sophistication when we compare the expense ratios of different sponsors. Our premise is that a fund that implicitly provides a higher guarantee because of its BHC affiliation will charge a higher expense ratio, regardless of the minimum investment size.

4. Data

4.1 Data Source

We use data from the *iMoneyNet* datasets that contain detailed historical information on individual US MMFs. Schmidt, Timmermann, and Wermers (2016) compare *iMoneyNet* data to statistics from the Investment Company Institute and find that *iMoneyNet* data cover about 93.5% of the total dollar value of US PI-MMFs.

The *iMoneyNet* dataset is structured such that group of funds are collected under a brand name, called the *fund complex*, for example, “Blackrock”. The *iMoneyNet* calls each fund that belongs to a fund complex as the *master class fund* and identifies it with an indicator. All share classes under the same master class fund name have identical portfolios and are managed by the same fund manager. Each share class has an associated master class fund name and a fund code. In the remainder of the paper, we use the terms fund and master class fund interchangeably.

We use three panel datasets: monthly, weekly, and daily observations. All three datasets record the total amount in each share class (share class assets). In addition, the datasets contain the expense ratio, gross yield, and net yield for each share class. The weekly dataset has the asset composition of the funds’ portfolios that comprises the weighted average maturity and the fraction of a fund’s portfolio that is held in commercial paper, floating-rate notes, repos, bank deposits, non-deposit bank obligations, and US government securities.

To complement our study, we also obtain the relevant BHC’s financial data from the Federal Reserve’s Y9-C report and its sponsoring between 2007 and 2011 from Brady, Anadu and Cooper (2012).

4.2 BHC Sponsorship Identification

The critical aspect of our analysis is the identification of the fund sponsors in terms of BHC or non-BHC affiliation. The *iMoneyNet* datasets contain a binary bank identifier. However, this variable does not vary over time and is fixed at a value that corresponds to the last date in each *iMoneyNet* dataset.

To identify the sponsorship status of each fund complex, we manually match the name of each fund complex in our data to a BHC or non-BHC sponsor.² Then, we search the SEC filings and the business press to identify all ownership and sponsorship relations between the MMF and other financial institutions over our sample period. We define a fund complex as being *BHC-sponsored* if it is affiliated with a BHC that is a financial holding company (FHC) with a subsidiary commercial bank, or a commercial bank that is not a member of the BHC.³ Thus, we correct the original identifier BHC sponsorship from *iMoneyNet* by adjusting it to be historically accurate.

Appendix A shows the fund complexes and the number of funds and share classes that are in our sample as of September 2008. The last two columns show that the *iMoneyNet* identifier and the corrected identifier, respectively. As the appendix shows, in the case of 18 complexes, the *iMoneyNet* identifier requires modification. These changes fall into three categories. The first pertains to instances where the sponsoring firms changed their filing status to a BHC over the sample period. This change accounts for differences in two fund complexes and the eight funds within those complexes. They are Goldman Sachs and Morgan Stanley that were investment banks before the crisis and became BHCs shortly after the Lehman collapse. The *iMoneyNet* files carry these two sponsors only as BHCs, whereas

² Philip Ostromogolsky contributed significantly to the matching work that spans the period of 1986-2016.

³ The definition of commercial bank excludes the following types of institutions: industrial loan company, federal savings bank, savings and loan institution, savings and loan holding company, and credit union.

they should be non-BHCs up until their switch.⁴ The second type is not an error, but a difference in usage. We consider a sponsor to have access to the domestic safety net if it has a domestic regulatory holder. For six complexes and nine funds, sponsors were recorded correctly as “BHCs” by *iMoneyNet*, but those BHCs lacked a domestic regulatory holder. We treat a fund complex of a foreign bank as a non-BHC fund because the foreign banks do not have the same safety net advantages as US banks. In one case, we correctly identified a parent to be a domestic institution and changed its identification from a non-BHC to a BHC. The third and final type of difference is due to other data discrepancies. These apply to nine fund complexes and 21 funds within these complexes. In some cases, *iMoneyNet* codes private uninsured banks as a BHC, which does not match our usage.

5. Do Institutional Investors Value BHC Sponsorship of MMFs?

5.1 The Lehman Crisis and Expense Ratios

The \$350 billion contraction in the ABCP market in late 2007 casts doubt on the credit quality of many such short-term, AAA-rated asset categories (Covitz, Liang, and Suarez, 2009). PI-MMFs, which held such assets, experienced a significant credit event that reduced the value of their assets and brought them perilously close to breaking the buck. One of those funds, the Reserve Primary Money Market Fund, was not able to weather the storm because of its exposure to Lehman’s commercial paper. On September 15, 2008, Lehman declared bankruptcy that inflicted a severe credit event on the Reserve Fund’s assets. A day after Lehman’s crisis, the Reserve Fund broke the buck on September 16, 2008, that then triggered the largest crisis in the history of the US MMF industry.⁵ The collapse of

⁴ In the case of Goldman Sachs, *iMoneyNet* shows some funds to be BHC-sponsored and some to be non-BHC-sponsored within the same complex. We consider all funds under Goldman Sachs to be non-BHC-sponsored while Goldman Sachs was not officially a BHC.

⁵ See Strahan and Tanyeri (2013), McCabe (2010), Investment Company Institute (2009), Securities and Exchange Commission (2009).

the Reserve Fund sparked unprecedented mass withdrawals from PI-MMFs. From September 12 to October 1, 2008, PI-MMFs lost a total of \$460 billion, which was 29% of industry assets.⁶

The main hypothesis of this paper is that because BHC-sponsored funds provide a more credible guarantee, institutional investors are willing to accept lower net yields from their PI-MMFs. To test this hypothesis, we compare the gross yields, expense ratios, and net yields of funds with BHC and non-BHC sponsors of the PI-MMFs before and after this shock to the industry. Ultimately, net yield – the return after accounting for expenses, is what matters to investors. For instance, whether they realize less net yield caused by higher expense ratios or lower gross yields will not affect investor decision making. Empirically, we find that gross yields are not statistically different across sponsors.. Therefore, definitionally and empirically, an increase (decrease) in the expense ratio of one basis point is equivalent to a decrease (increase) in the net yield received by investors of one basis point. Thus, comparing differences in net yields is identical to comparing the negative differences in expense ratios.

Figure 1 displays the average gross yields for both types of funds from 2006 through 2009. The vertical lines represent August 2007 and September 2008, respectively. August 2007 is when the French bank BNP Paribas announced that they were freezing \$2.2 billion of subprime funds and were barring investors from redeeming cash from the funds. As we indicated earlier, Kacperczyk and Schnabl (2013) argue that August 2007 marks the time when the underlying asset risk of the MMF industry fundamentally changed.

We observe that the average gross yields for BHC-sponsored and non-BHC-sponsored funds experienced a slight uptick immediately after August 2007, but the increase was not significant and there was no statistical difference between their average yields. Figure 1 also shows that shortly after

⁶ We calculate this percentage from data provided by *iMoneyNet*. See Strahan and Tanyeri (2013) and McCabe (2010).

August 2007, the gross yield offered by both types of funds declined dramatically until August 2008. This result is a direct consequence of the decline in short-term rates. The three-month yield on Treasury bills was 4.55% on September 4, 2007 and declined to 1.72% on September 2, 2008. However, shortly after September 2008, non-BHC-sponsored funds on average had gross yields slightly higher than the average gross yield offered by BHC-sponsored funds. This observation means that the non-BHC-sponsored funds further increased the asset risk and thus the corresponding gross yield, possibly to prevent redemptions. The difference disappeared in 2009 and thereafter. This convergence can be explained by the rapid decline in the interest rates of the economy.

Figure 2 displays the average expense ratios during the same period. We should note that the expense ratios for the 2006-2008 period are not particularly confounded with fee waivers because, as indicated above, fee waivers were at their lowest level during this period. We observe an interesting pattern in Figure 2. The BHC-sponsored PI-MMFs increased their expense ratios relative to non-BHC-sponsored PI-MMFs right around August 2007. However, the difference is not statistically significant. As September 2008 approached, we observe that BHC-sponsored funds further increased their expense ratios while non-BHC-sponsored PI-MMFs slightly decreased their expense ratios. Following September 2008, the expense ratios diverged sharply; the difference between the two types of funds reached its maximum as the BHC-sponsored funds charged higher rates on average by roughly 8 basis points by January 2009.

Next, we examine the variation in expense ratios across different minimum required investments. We segregate funds into three buckets: “small” for funds with minimum balances of less than \$25,000; “medium” for funds with between \$25,000 and \$1,000,000; and “large” for funds with minimum balances of more than \$1,000,000. Figure 3 displays the average expense ratios for each of these three buckets of minimum balances. Expense ratios are inversely related to the size of the minimum investment requirement for both types of funds. This observation is consistent with Schmidt,

Timmerman, and Wermers (2016) who argue that minimum investments capture investor sophistication. Funds with higher minimum investments attract more sophisticated investors who pay lower expense ratios. However, we observe that on average, BHC-sponsored PI-MMFs increased the expense ratios at every minimum size bucket in the post-Lehman period. These observations cannot be consistent with investors becoming less sophisticated (justifying charging a higher expense ratio) in a falling interest rate environment. In contrast, the results give support to the argument that expense ratios reflect risk, at least to some extent. We argue that BHC-sponsored funds charge higher expense ratios in an environment where the implicit insurance the sponsoring BHC provides becomes more valuable.

5.2. Portfolio Characteristics of PI-MMFs in 2008

In Table 1, we provide the average portfolio makeup of PI-MMFs overall and by sponsor type (BHC or non-BHC) for the months of June 2008 and December 2008. We take June and December as representative months for the pre- and post-crisis periods. There are 345 (317) distinct prime institutional share classes with 230 (167) non-BHC-sponsored share classes and 115 (150) BHC-sponsored share classes as of June 2008 (December 2008).

The first three columns of Table 1 pertain to June 2008. In terms of our focal variables, gross yield, expense ratio, and net yield, there is no difference on average between the BHC-sponsored and non-BHC-sponsored MMFs. In terms of measures of asset risk, including weighted asset maturity (WAM), age, complex size, government debt (US Treasury and agency debt), repos, and bank obligations, non-BHC- and BHC-sponsored funds are statistically indistinguishable. However, the compositions do vary in a few categories. First, BHC-sponsored funds hold significantly more time deposits, which stands to reason, although these holdings represent a relatively small component of total assets. The BHC-sponsored funds also hold less in floating rate notes (FRNs) than non-BHC-

sponsored funds, although this difference is only marginally significant. The last difference is in the composition of their commercial paper holdings and ABCP. *iMoneyNet* reports first-tier and second-tier commercial paper categories, which include ABCP.⁷ However, it reports the ABCP amount separately. Hence, we create a commercial paper variable that is the sum of the first tier and the second tier net of ABCP and enter the ABCP as a separate variable in our analysis. We observe in Table 1 that non-BHC-sponsored funds hold significantly more ABCP than BHC-sponsored funds, 20% to 10%, while BHC-sponsored funds hold more non-ABCP commercial paper than non-BHC-sponsored funds, 29% to 22%. However, in aggregate, risky asset holdings do not statistically differ between BHC- and non-BHC-sponsored MMFs.

The last three columns of Table 1 provide the same information about portfolio composition for December 2008. The picture changed substantially after the fall of Lehman and the ensuing run on PI-MMFs. Markedly, funds sponsored by BHCs charged a significantly higher expense ratio of 44 basis points versus the 36 basis points charged by funds with non-BHC sponsors as of December 2008. This change is reflected as well in the significant difference in the net yield. Investors in BHC-sponsored funds received 136 basis points on average, while investors in funds that were not sponsored by BHCs received 153 basis points on average. In other words, while non-BHC sponsors kept their expense ratios unchanged relative to the pre-crisis level, BHC sponsors showed a significant departure from the industry average and charged higher expense ratios and paid lower net yields to their institutional customers after the Lehman crisis. This observation provides the initial support for our hypothesis that these investors were willing to pay for BHC sponsorship when it was needed most

⁷ “First tier” securities, as defined by Rule 2a-7 of the Investment Company Act of 1940, are securities rated in the highest short-term rating category by two or more rating agencies. “Second tier” indicates that the securities have received the highest rating from one rating agency and the second highest rating from another or has received the second highest rating from two rating agencies.

immediately following the crisis. In terms of asset composition, both types of MMFs have similar portfolios, and there is no statistical difference in the holdings of risky assets in aggregate.

5.3 Difference-in-Differences Analysis of BHC- and Non-BHC-Sponsored MMFs

To provide further support for these observations, we estimate a difference-in-differences between BHC- and non-BHC-sponsored funds before and after the Lehman crisis for gross yield, expense ratio, and net yields, while controlling for other fund characteristics. The specification is as follows:

$$Focal\ Variable_{j,t} = \gamma_0 + \gamma_1 BHC_j + \gamma_2 After\ Lehman_t + \gamma_3 After\ Lehman_t * BHC_j + \omega Controls_{j,t} + \varepsilon_{jt}, \quad (1)$$

where j and t denote the share class and the month, respectively. The focal variables are 30-day gross and net compound yields, the expense ratio, and the outflow that are all calculated as the percentage changes in total net assets. The variable BHC equals one for the BHC-sponsored funds and zero otherwise. $After\ Lehman$ is equal to one for September 2008–February 2009 and zero for February–August 2008. The difference-in-differences estimator, γ_3 , is the coefficient for the product of the BHC and $After\ Lehman$ variables. This is the main coefficient of interest and measures the difference between the BHC-sponsored fund’s response and that of the non-BHC-sponsored fund to the Lehman collapse.

The vector of controls contains other variables that are potentially correlated with the focal variables. One important control is the riskiness of the asset holdings. For this, we use two measures. The first is the WAM, since assets with shorter maturities are easier to liquidate (McCabe, 2010). The second is the fund’s investment holdings that the investor perceives to have a lower liquidation value. Kacperczyk and Schnabl (2013) argue that investors perceive bank obligations, FRNs, and commercial paper to have lower liquidation values. They classify US Treasury securities, repos, and BHC-time

deposits as assets with high liquidation values. We also follow Kacperczyk and Schnabl (2013) and create a risky holdings variable as another proxy for portfolio riskiness. Further, we use the log of minimum investment as a proxy for investor sophistication (Schmidt, Timmerman, and Wermers, 2016). Additional variables control for the Treasury yield and the size of the fund complex. We should note that complex size and fund size are correlated. For our BHC-sponsored sample, the correlation between complex and fund sizes is 51% with significance at the 1% level.

In addition to our lead specification in equation (1), we also include a robust difference-in-differences specification, following Bertrand, Duflo and Mullainathan (2004) who propose collapsing the pre- and post-time series as a way to overcome the problem of serial correlation in difference-in-differences that produces consistent standard errors. Unless otherwise stated, we estimate the specifications at the share-class level and cluster all standard errors at the fund-sponsor level. We cluster at this level because we expect that the error term across share classes under the same sponsor to be correlated. Clustering at the sponsor level accounts for the arbitrary correlation within fund complexes.

We report the results in Table 2. Column (1) shows that BHC-sponsored funds earned lower gross yields, though not statistically significant, relative to non-BHC-sponsored funds post-Lehman. However, the difference in yields is salient when we examine the net yields; as shown in Column (2), investors in BHC-sponsored PI-MMFs received a net yield that was 13 basis points lower than that of investors in non-BHC-sponsored funds after the Lehman failure. Given that the non-BHC-sponsored PI-MMFs' average net yield was 153 basis points in December 2008, the 13 basis points difference means that investors accepted an 8.5% lower net yield from BHC-sponsored PI-MMFs relative to non-BHC-sponsored funds. The major factor underlying this result was the higher expense ratios charged by the BHC-sponsored funds. Column (3) shows that the expense ratios are 6.55 basis

points higher for BHC-sponsored PI-MMFs, or approximately 18% higher than the expense ratios that non-BHC-sponsored funds charged post-Lehman.

The control variables have the expected signs. The gross and net yields have positive correlations with Treasury yields. However, funds charge more on average when Treasury yields are low. This seemingly counterintuitive result is plausible given that the BHC-sponsored funds charged higher expense ratios in the declining interest rate environment. We also observe that funds with riskier holdings realized higher gross yields and, consequently, net yields. The riskiness of a fund's holdings, measured by WAM, also affects the expense ratio, but none of the portfolio components, such as time deposits, bank obligations, FRNs, commercial paper, and ABCP, are important predictors of the expense ratio. Finally, the results show that higher minimum investment, a proxy for investor sophistication, is associated with higher net yields and a lower expense ratio. We also use risky holdings as a percentage of total assets as an alternative measure of the risk of portfolio holdings. We find that our result does not change when we control for the aggregate risky holdings instead of separate portfolio holdings, and a higher risky-holding percentage generates higher yields.

To further demonstrate the robustness of our findings, we report in Columns (4) – (6) of Table 2 the results from a robust difference-in-differences specification, which was proposed by Bertrand, Duflo and Mullainathan (2004). Similar to the results in Columns (1) – (3), Columns (4) – (6) show that investors in BHC-sponsored PI-MMFs received around 13 basis points lower net yields while being charged 5 basis points higher expense ratios than the investors in non-BHC-sponsored PI-MMFs.

iMoneyNet reports the simple and compound investor returns over multiple time intervals. In a robustness check, we use alternative measures of investor returns including the 30-day net simple

yield, the 7-day net compound yield, the 1-month net simple return⁸, and the 1-month net simple yield. We observe that in all cases, irrespective of the specific yield measure, the net return on investment is 11 to 17 basis points lower for the MMFs that were sponsored by BHCs after the collapse of Lehman.

In Table 2, we show that the expense ratios at BHC-sponsored funds were 6.55 basis points higher than the expense ratios at non-BHC-sponsored funds (4.97 basis points with robust estimates). Our argument is that this finding reflects a form of insurance against losses on funds placed by the sponsoring BHCs in their sponsored MMFs. While the BHC sponsor's guarantee is implicit, there are analogous guarantees that are easily observed that provide protection to investors against loss; while that protection, itself, is derived from the same ultimate source: the federal government. This relation can provide an idea of the economic magnitude of the observed difference in charged expense ratios and therefore a reasonable benchmark.

In the US, funds placed directly in a bank, for instance in a money market deposit account, are explicitly insured by the FDIC (under the applicable statutory conditions). In 2008, matching the bulk of our sample period, the FDIC guaranteed an average of \$4.6 trillion in insured deposits. That same year, it collected \$3 billion in insurance assessments (i.e., insurance premiums) that equals 6.52 basis points of insurance premium per insured dollar. Our point estimate of 6.55 basis points (or 4.97 with robust estimates) for a qualitatively similar “insurance” guarantee aligns remarkably well with this point of reference.

5.4 Difference-in-Differences Analysis of Government and Retail MMFs

We have thus far shown a significant difference in the response to the Lehman failure of PI-MMFs that are sponsored by BHCs and those that are not. However, there conceivably are other,

⁸ We use *iMoneyNet's* definitions that calculate the “yield” by using the dividend factor and the “return” by using the dividend factor plus capital gains and losses.

non-risk-based explanations for this observation. For instance, potentially, there could be a clientele difference between BHC- and non-BHC-sponsored PI-MMFs. Perhaps investors in BHC-sponsored PI-MMFs are less financially sophisticated, and therefore more willing to accept a larger expense ratio and lower net yields. Along the same lines, differences in expense ratios might have nothing to do with the underlying risk but instead with the unobserved differences between BHC- versus non-BHC-sponsored PI-MMFs. Alternatively, perhaps due to the structure of the tests or because of coincidental events surrounding the Lehman failure, the tests can be biased in favor of finding a result. If unobserved characteristics of sponsors or of their clientele are driving our main results, we can predict that those same results will carry over to other funds sponsored by the same BHCs and non-BHCs that serve the same respective clientele. If the differences in expense ratios are unrelated to risk, then the expense ratios should change across all funds they manage.

To mitigate these concerns, we construct two “placebo” tests. First, we examine the Government Institutional MMFs (GI-MMFs) that were also exposed to the Lehman failure, but were less affected by the changes in risk because the asset holdings of these funds were much more restricted than PI-MMFs and predominantly contained bonds of government and government-sponsored entities. In addition, we explore the family of Prime Retail MMFs (PR-MMFs), where a BHC sponsor’s guarantee may be less attractive to their relatively less risk sensitive target clientele. Schmidt, Timmerman, and Wermers (2015) argue that retail depositors are relatively unsophisticated and had a much more muted response to the crisis. If our tests are biased towards finding a result, we are more likely to see a significant change in expense ratios in government and prime-retail funds, as well as the changes we have already observed in PI-MMFs.

To facilitate these falsification tests, we apply the identical analysis as in Columns (4) – (6) of Table 2 to the GI-MMFs and PR-MMFs; the results are shown in Table 3. We observe that contrary to the results for PI-MMFs, we find no significant difference in the charged expense ratios between

GI-MMFs sponsored by BHCs and those that are not. In addition, the BHC-sponsored PR-MMFs have lower yields than non-BHC-sponsored PR-MMFs, but the BHC-sponsored PR-MMFs do not charge a higher expense ratio. The fact that we do not see any significance adds confidence to the interpretation that the observed significant differences in the charged expense ratios of PI-MMFs are associated with BHC sponsor's implicit guarantee against increased risk.

5.5 Difference-in-Differences Analysis of Redemptions

We next analyze the changes in the redemption decisions of investors during the post-Lehman period. If BHC-sponsored funds charge significantly higher expense ratios and if BHC and non-BHC sponsors provide equal guarantees, then we should see these return-seeking, prime institutional investors move their funds away from the relatively expensive BHC-sponsored funds toward the relatively inexpensive non-BHC-sponsored funds. This behavior would be consistent with the predictions of Christoffersen (2001), Christoffersen and Musto (2002), Kacperczyk and Schnabl (2013), and Cherenkov and Sunderam (2014).

To assess the difference in redemptions between BHC-sponsored and non-BHC-sponsored funds before and after the Lehman crisis, we use the data on monthly assets under management from *iMoneyNet* and compute the 1-month, 2-month, and 3-month redemptions in percentages for every share class in our sample. To mitigate the effect of outliers and extreme values, we winsorize the redemption data at the 1st and 99th percentiles of their empirical distributions. In Table 4, we present the estimation results of equation (1) and the robust difference-in-differences model proposed by Bertrand, Duflo and Mullainathan (2004). This analysis parallels that in Table 2 in which the institutional investors earned less and were charged more during the post-Lehman period at BHC-sponsored PI-MMFs. Table 4 shows that investors at BHC-sponsored funds behave differently than what would be predicted by the research. After the Lehman collapse, even while the BHC-sponsored

funds charged significantly higher expense ratios and, therefore, paid significantly lower net yields, these funds faced no greater associated net outflows of funds in the 1-month, 2-month, and 3-month horizons.

In all, the evidence of the flow analysis shows that institutional investors in BHC-sponsored funds behave differently. Despite being charged higher expense ratios and earning lower net yields than investors in non-BHC-sponsored funds, they do not respond by redeeming more that indicates the BHC sponsorship provides a safety net for institutional investors that they are willing to pay for.

6. Are BHC Sponsors More Likely to Provide Support?

MMF sponsors play a critical role in preventing a fund from breaking the buck. In times of distress, these sponsors can and do provide liquidity support. Sponsors can purchase assets that have declined in value at par so that the MMF can meet any mass redemption requests by its investors. Other forms of sponsor support include capital contributions, capital support agreements, letters of credit, and performance guarantees. This support is not merely theoretical. Moody's (2010) provides examples of major sponsorship interventions and demonstrates that sponsors extended extensive instances of support in 1994 and 2008. Indeed, sponsor support played a pivotal role during the crisis of September 2008. The SEC estimates that from August 2007 to December 2008 almost 20% of all PI-MMFs received sponsor support (Securities and Exchange Commission (2009), p. 20). Brady, Anadu and Cooper (2012) also conservatively estimate that at least 21 prime MMFs that received sponsors' support would have broken the buck in absence of the support during the financial crisis.

Our hypothesis is that BHC sponsorship matters for investors because the sponsoring BHC has relatively quick and easy access to cheap and information-insensitive funding sources through its insured subsidiaries, such as insured brokered deposits or the discount window. In addition,

regulations recognize the failure of a nonbank subsidiary, such as a sponsored MMF, can have serious financial ramifications for the BHC, and thus the parent may use its resources to provide support to that subsidiary. In this section, we examine whether BHCs provide support to their sponsored MMFs when the fund's assets lose value, or the redemption activity is high. Given that non-BHC sponsors lack access to relatively cheap funds, thereby giving the BHC sponsor deeper pockets, we predict the likelihood of BHC support will be high.

Brady, Anadu and Cooper (2012) list instances of non-contractual support in the form of cash contributions or purchases of distressed securities at above-market price provided to MMFs by their sponsors that are based on a review of the annual SEC financial statement filings of public MMF with fiscal year-end dates falling between 2007 and 2011. They identify the fund name and the corresponding SEC Series ID of the fund that receives support from the sponsor. Each fund name is the master class fund name in *iMoneyNet*. We designate our analysis period from the fiscal year ending February 2008 to January 2010 to capture support instances for a wider period around September 2008. We search the Series ID in *iMoneyNet* and extract the master class funds that received the sponsors' support.

To evaluate the likelihood of getting support, we collapse the time series in the sample and conduct a cross-sectional analysis using a logit model at the master class fund-level. If a fund receives support during the analysis period, we designate the variable Get Support as 1, otherwise zero. To estimate the logit model, we keep only funds that experienced greater than 20% asset losses in at least one month during the analysis period. We apply this filtering criteria because we want to restrict our sample to only those funds that needed their sponsor's support at some point.

The run on MMFs was triggered by the announcement by the Reserve Primary Fund that it had suffered significant losses to its holding of Lehman Brothers' commercial paper and had broken the

buck. This announcement had profoundly deleterious effect on the perception of commercial paper as a safe asset, despite its short maturity and high credit rating (Kacperczyk and Schnabl, 2010). Therefore, sponsor support because of redemptions would be more likely when the holding of commercial paper is greater. To allow for this possibility, we create a variable $BHC*ABCP$ and test whether BHC-sponsored funds are more likely to receive a sponsor's support if they have larger holdings of ABCP. In addition, we use commercial paper (both including and excluding ABCP), ABCP by itself, risky portfolio holdings, and maximum monthly loss as proxies for portfolio risk. We define risky portfolio holdings as the sum of time deposits, bank obligations, Floating Rate Notes, Commercial Paper, ABCP. We define the maximum monthly loss as the negative of the largest monthly percentage change in net assets during the analysis period experienced by a fund. This transformation makes the interpretation easier, such that a higher value implies higher loss.

We present the results in Table 5. We observe that the coefficient on BHC is positive but insignificant when the specification does not allow for an interaction term with portfolio riskiness. Only in Column (2), when we use the interaction with commercial paper (excluding ABCP), is BHC significant and positive, indicating that the likelihood of bank support is higher relative to nonbanks. However, in this specification, commercial paper becomes insignificant. We observe that ABCP is marginally significant and positive for the greater than 20 percent asset loss case. No other risk variable is significant, with the one exception for of the case when where Maximum Monthly Asset loss is used as a risk proxy. In this case, the larger the maximum loss the more likely is the sponsor support

In unreported regressions, we analyzed the support instances reported in annual SEC filings with fiscal year-end dates between February 2008 and February 2009. This narrower sample period mirrors the ABCP crisis period documented in Acharya and Schnabl (2010). The major difference using this sample is that the interaction term $BHC*ABCP$ is highly significant, indicating that support varies with

the amount of ABCP in a fund. Additionally, while the commercial paper definition excluding ABCP is insignificant, it becomes significant when the definition includes commercial paper and ABCP.

In all, we can conclude that the likelihood of a bank sponsor's support was higher, and further that we have some evidence that ABCP was a driver of the likelihood of sponsor support.

We also cross-sectionally examine the relation between the charged expense ratio and the likelihood of sponsors' support. A higher likelihood of sponsor support could sustain a higher expense ratio. We obtain the estimated probability of getting support from the logit model described above and present the results in Table 6. We observe that BHC-sponsored funds with a higher probability of receiving support charge a significantly higher expense ratio. On average, 0.1 rise in the estimated probability of getting support is associated with 2.1 to 3.9 bps higher expense ratio in the BHC-sponsored funds.

7. BHC's Financial Strength and Expense Ratios

In this section, we allow for variations in the liquidity holdings, capitalization levels, and the default risks of BHC sponsors. We can view these variations as proxies for the ability of the BHC to provide support and the strength of their guarantee. To the extent that BHC-sponsored MMFs enjoy an implicit protection derived from their affiliation with their BHCs, MMFs sponsored by BHCs with lower default risks and more liquidity can provide more valuable guarantees. Hence, the MMF can charge higher expense ratios to exploit such an advantage.

We obtain BHC quarterly financial data from Y-9C reports and compute the liquidity holdings, uninsured deposits, and equity ratios as a percentage of BHC total assets. As a measure of equity, we use the ratio of the total equity capital, as reported on Schedule HC of the Y-9C forms, to the bank's reported total assets. This measure includes, perpetual preferred stock, common stock, non-preferred

stock surplus, retained earnings, other accumulated income, noncontrolling interests in consolidated subsidiaries, and other equity capital components. We count federal funds sold, federal funds for resale, noninterest bearing balances (currency), and interest-bearing balances (domestic and foreign) as liquid assets.

To ensure that the BHCs' financial data are known before the expense ratio is determined, we link the expense ratio and other PI-MMF data to the lagged BHCs' financial data. For example, we match BHCs' financial data in the first quarter of 2008 to PI-MMF data in the second quarter of 2008. We use three specifications to test our hypothesis. First, we use the lagged BHCs' financial data as explanatory variables and test whether the sponsors with lower default risk charge higher expense ratios. The second specification sorts the lagged BHCs' financial data into four quartile groups and tests whether sponsors in lower risk groups charge higher expense ratios. Finally, we collapse the monthly PI-MMFs data into quarterly data and use lagged BHC financial data as regressors to show robustness.

We present the results in Table 7. We observe a significantly positive relation between BHCs' liquid assets ratio and PI-MMFs' charged expense ratio in Columns (1) and (3) that is consistent with our hypothesis that BHC sponsors with lower default risks can offer stronger guarantees and thus the funds sponsored by these BHCs can charge a higher expense ratio. Given that the sample standard deviation in the liquid assets ratio is 16%, a one standard deviation increase in the liquid assets ratio is associated with a 5.8 to 6.9 basis points higher expense ratio. The positive relation between the liquid assets ratio and the charged expense ratio is robust to the alternative specification in Column (2) in which the explanatory variables are indicators of the BHCs financial variables quartile groups. We observe that compared with the PI-MMFs sponsored by BHCs with liquid asset ratios in the lowest quartile, the PI-MMFs sponsored by BHCs with liquid asset ratios in the highest quartile charge 13 basis points higher expense ratios on average. In all of these specifications, the equity ratio is

insignificant. This finding shows that MMF investors care about the liquidity strength of the sponsor, rather than its capitalization.

The other variable we use is uninsured deposits. This variable can signal uninsured depositors' perception of the strength of a BHC. The higher the level, the more confidence uninsured depositors have about the financial strength of the BHC, *ceteris paribus*. Indeed, Jacewitz and Pogach (2018) show that between 2007 and 2008, the risk premium paid by the largest BHCs was 35 basis points lower than the risk premium at other BHCs. These uninsured depositors are closest to the MMF institutional investors, whose funds are explicitly uninsured but can benefit from implicit insurance provided by the BHC sponsor. Hence, we argue that the amount of uninsured deposits in a BHC can be a proxy for the collective confidence in this BHC's financial strength.

We augment our analysis with the uninsured deposit ratio and present the results in Columns (4) – (6) of Table 7. We observe that the relation between the uninsured deposits ratio and the charged expense ratio is significant in the quarterly data regression in Column (6), although this relation is less significant in the monthly data regression and insignificant in the quartiles of the uninsured deposits ratio. However, in all cases the sign is positive that indicates higher levels of uninsured deposits are correlated with higher expense ratios. A one standard deviation increase (5%) in the uninsured deposits ratio is correlated with a 2.35 basis points higher expense ratio in the subsequent quarter. In addition, in Columns (4) – (6), we find that the significance and magnitude of the liquid asset ratio remain unchanged when the uninsured deposits ratio is taken into account.

The positive and significant relation between uninsured deposits and expense ratios can have an alternate explanation. It is possible that uninsured depositors of the sponsoring BHC can move their

funds into the MMFs to exploit the US Treasury's guarantee on MMFs.⁹ Therefore, MMFs could have raised expense ratios to meet the increased demand. On September 29, following the collapse of the Reserve Fund and the unprecedented fund outflows that followed, the US Treasury announced the Temporary Guarantee Program for Money Market Funds (commonly known as TGP).¹⁰ This program retroactively guaranteed money held by MMF investors as of the close of business on September 19, 2008 – 10 days earlier. TGP was designed to address “temporary dislocations in the credit market,” specifically to buttress the MMF industry by stabilizing fund values. Indeed, TGP likely reduced the liquidity risk of the industry, overall, as existing funds no longer had a reason to flee. Moreover, other government responses to the crisis created new risk-free money management options for institutional investors. Starting on October 14, 2008, the FDIC implemented the Temporary Liquidity Guarantee Program (TLGP). In part, the TLGP offered to guarantee *without limit* non-interest-bearing transaction accounts. By the end of December 2008, the Program guaranteed nearly \$684 billion or 84% of deposits in eligible accounts (see Quarterly Banking Profile, FDIC; Fourth Quarter 2008 and authors calculations). Moreover, there was a large and protracted increase in deposit accounts that were protected by the TLGP. Funds covered by the TLGP increased by more than 13% (\$112 billion), over the course of 2009. These accounts are typically deposits by businesses used to make payroll and facilitate other business transactions. As a point of comparison, the cumulative outflows from PI-MMFs in September and October 2008 was approximately \$400 billion¹¹ The guarantee of noninterest-bearing transaction accounts ultimately expired on December 31, 2010.¹²

⁹ See US Treasury Press Release, September 29, 2008 (<https://www.treasury.gov/press-center/press-releases/Pages/hp1161.aspx>)

¹⁰ Ibid.

¹¹ See Schmidt, Timmermann, and Wermers (2016).

¹² See Federal Deposit Insurance Corporation (2017).

However, the specifics of the program’s design were such that it had less of an impact on our empirical results. Namely, its retroactive nature meant that it did not directly affect the marginal investor. Unlike most insurance guarantees, the TGP was a “sunk guarantee,” in the sense that it applied only to funds that existed at some time in the past. The US Treasury’s announcement noted that the coverage applied “to shareholders for amounts that they held in participating money market funds as of the close of business on September 19, 2008.” From the perspective of a marginal investor, looking to invest a dollar or move a dollar in the present, that dollar would not be and could not be guaranteed under the Treasury program. Thus, throughout the full post-Lehman period, the maximum value of the guarantee for each individual fund and each individual investor was immutably based on an ex ante unknowable date in the past.

To conclude, our analysis exploits the variations within BHC sponsors and indicates that PI-MMFs that have BHC sponsors with lower default risks represented by a higher liquid assets ratio charged a higher expense ratio. This result complements the main argument in this paper.

8. Changes in the Expense Ratios Around the 2016 MMF Reform

The analysis thus far has concentrated on the 2008 financial crisis that heightened risk for MMF investors. Therefore, the sponsor guarantee became more important and valuable for MMF investors. In this section, we identify an exogenous shock to MMFs. In 2016, the government put regulations in place that potentially affected the value of a sponsor’s guarantee. Therefore, we look for changes in the expense ratios around the time of these substantial regulatory developments.

On July 23, 2014, the SEC adopted a reform to address the risk of investor runs in MMFs.¹³ One of the major changes that affected PI-MMFs was the imposition of floating net asset values (NAV) to be fully in effect by October 14, 2016. This change required the PI-MMFs to value their portfolio instruments by using present market value rather than the amortized cost. Funds were no longer required to maintain a fixed share price of \$1.00. In this way, “breaking the buck” is no longer possible. Regulators explicitly intended to reduce the risk of breaking the buck by introducing the floating NAV.¹⁴ In that case, the value of the implicit guarantee from the sponsors, or at least the perceived value, would have been reduced after the 2016 Money Market Fund reform. Hence, if the difference in expense ratios between BHC-sponsored funds and non-BHC-sponsored funds was driven by a difference in risk exposure for investors and if the reforms reduced or eliminated the value of the implicit guarantee, then the premium in expense ratios charged by BHC-sponsored funds would shrink or disappear after the reform.

Figure 4 displays the difference in the average expense ratios for BHC-sponsored and non-BHC-sponsored funds from 2014 through 2018. The vertical lines represent the month when the reform went into effect. As a reference for the overarching interest rate environment, the figure also provides the Federal Funds Rate. We observe that before the reform, BHC-sponsored PI-MMFs charged higher expense ratio mostly. Shortly after the Reform, however, in response to the change in interest rate environment, non-BHC-sponsored PI-MMFs rose their expense ratio more than the BHC-sponsored PI-MMFs and as a consequence the relation flipped that non-BHC-sponsored funds consistently charged higher expense ratio. We should also note that changes in the number of BHC-

¹³ See Securities and Exchange Commission press release, July 23, 2014. (<https://www.sec.gov/news/press-release/2014-143>)

¹⁴ See SEC Commissioner Aguilar’s public statement “Strengthening Money Market Funds to Reduce Systemic Risk”, July 23, 2014. (<https://www.sec.gov/news/public-statement/2014-07-23-open-meeting-statment-laa>)

sponsored funds in the market after the reform were larger. From January 2016 to August 2017, the number of BHC-sponsored funds declined by 50%, whereas the number of non-BHC-sponsored funds decreased by 23%.

To further examine this regulatory change, we conduct an analysis parallel to that in Table 2 with a robust difference-in-differences method as proposed by Bertrand, Duflo and Mullainathan (2004). The results are shown in Table 8. To better assess the change in expense ratios, we restrict our sample to the same set of fund complexes as in our analysis of the Lehman collapse conditional on the fund complexes still existing during our sample period of July 2014 to July 2018. We start in July 2014 because this is the date the new reform was first proposed.

Table 2 shows that the funds sponsored by BHCs had lower net yields while charging higher expense ratios after Lehman failed compared to funds sponsored by non-BHCs. In contrast, as shown in Columns (2) and (3) of Table 8, the analysis on the same sample of fund complexes indicates that after the reform, BHC-sponsored PI-MMFs delivered higher net yields and charged lower expense ratios than non-BHC-sponsored PI-MMFs. In a robustness check, we perform another analysis that uses the full sample of all the available fund complexes in *iMoneyNet* during the sample period and find that the results remain significant and have similar magnitude. Our findings are consistent with a reduction in the value of an implicit subsidy following the 2016 reforms and thus provide ancillary evidence that before the reform, the implicit guarantee from the BHC sponsors was valuable and funds sponsored by BHCs were able to charge higher expense ratios.

9. Conclusion

PI-MMFs are an important part of the shadow banking system. In this paper, we show that an important distinguishing feature of these funds is that PI-MMF investors perceive BHC-sponsored

funds to be less risky than non-BHC-sponsored PI-MMFs and price this BHC affiliation accordingly. We provide evidence that they accept lower net yields and redeem less, in contrast to the explanations in the literature. In other words, institutional investors behaved as if they were paying insurance premiums to BHC-sponsored MMFs to protect their investment against losses during the 2008 MMF crisis. In support of this shadow insurance hypothesis, we further show that the charged expense ratio is associated with the sponsoring BHC's financial strength and the likelihood of its support. Moreover, consistent with our hypothesis, the premium charged in the expense ratio of BHC-sponsored MMFs disappeared after the 2016 MMF reform that shifted the risk from MMFs to investors.

These observations are important in light of the definition of shadow banks first proposed by McCulley (2009) and followed by many others (Acharya, Schnabl, and Suarez, 2013; Kane, 2014; Financial Stability Board, 2015). These definitions highlight two quintessential characteristics of shadow banks. One, they operate in the shadows without access to FDIC insurance. The other is that because shadow banks do not have explicit access to the government safety net, they do not operate under the same regulatory constraints.

However, our findings add a third characteristic. We show that shadow banks can extend shadow insurance. We show that during the 2008 crisis BHC-sponsored MMFs extended shadow insurance by charging “premiums” in the form of higher expense ratios. This guarantee was more pronounced at BHC-sponsored MMFs because the sponsor had access to the government safety net. Therefore, we argue that it is better to characterize some of these nontraditional intermediation activities as “banks in the shadows extending shadow insurance” rather than “shadow banks.”

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Figure 1: This figure shows the average gross yields for prime institutional money market funds from January 2006 through November 2009. The vertical lines show the two important dates that affect the risk of the funds. August 2007 is when the French bank BNP Paribas announced that they had frozen \$2.2 billion of subprime funds. September 2008 is when the Lehman crisis occurred.

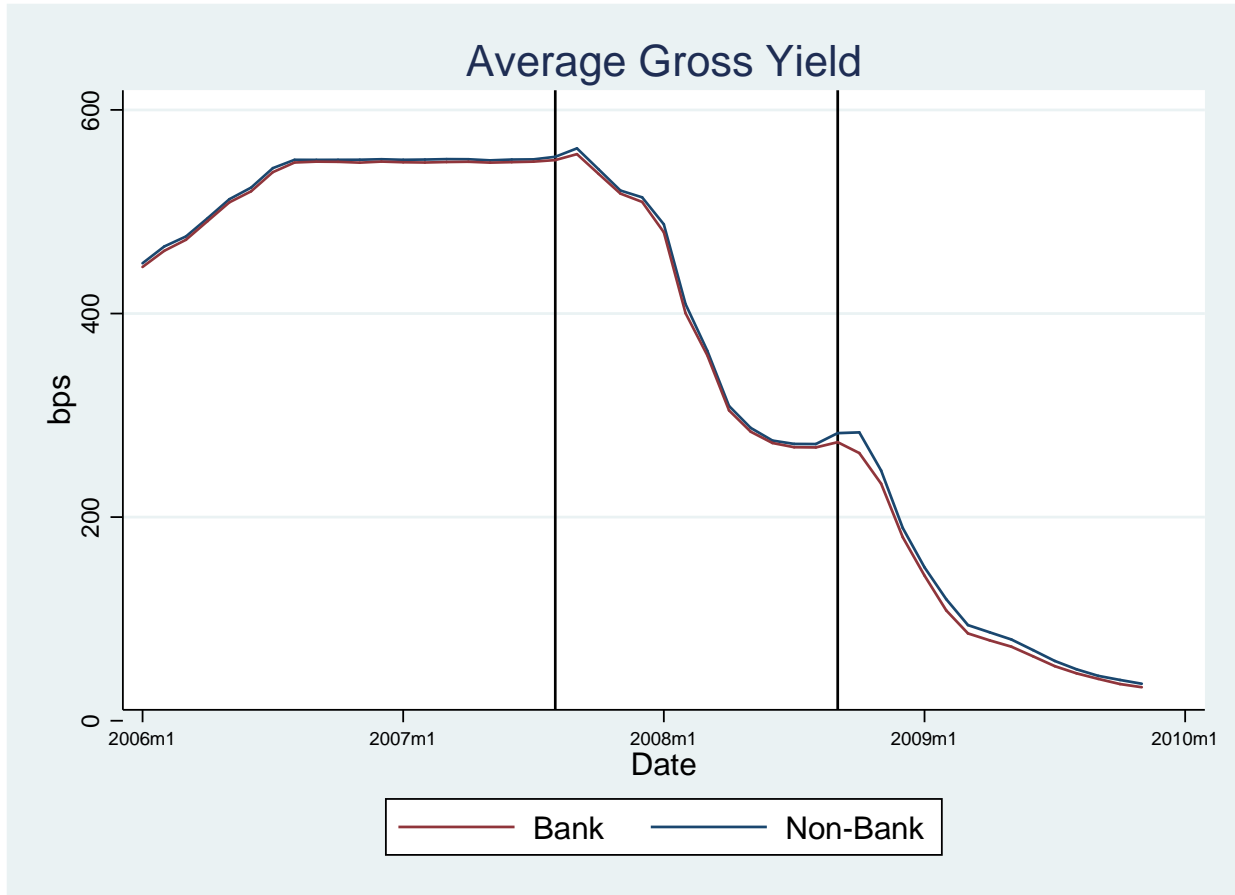


Figure 2: This figure shows the average expense ratios for prime institutional money market funds from January 2006 through November 2009. The vertical lines show the two important dates that affect the risk of the funds. August 2007 is when the French bank BNP Paribas announced that they had frozen \$2.2 billion of subprime funds. September 2008 is when the Lehman crisis occurred.

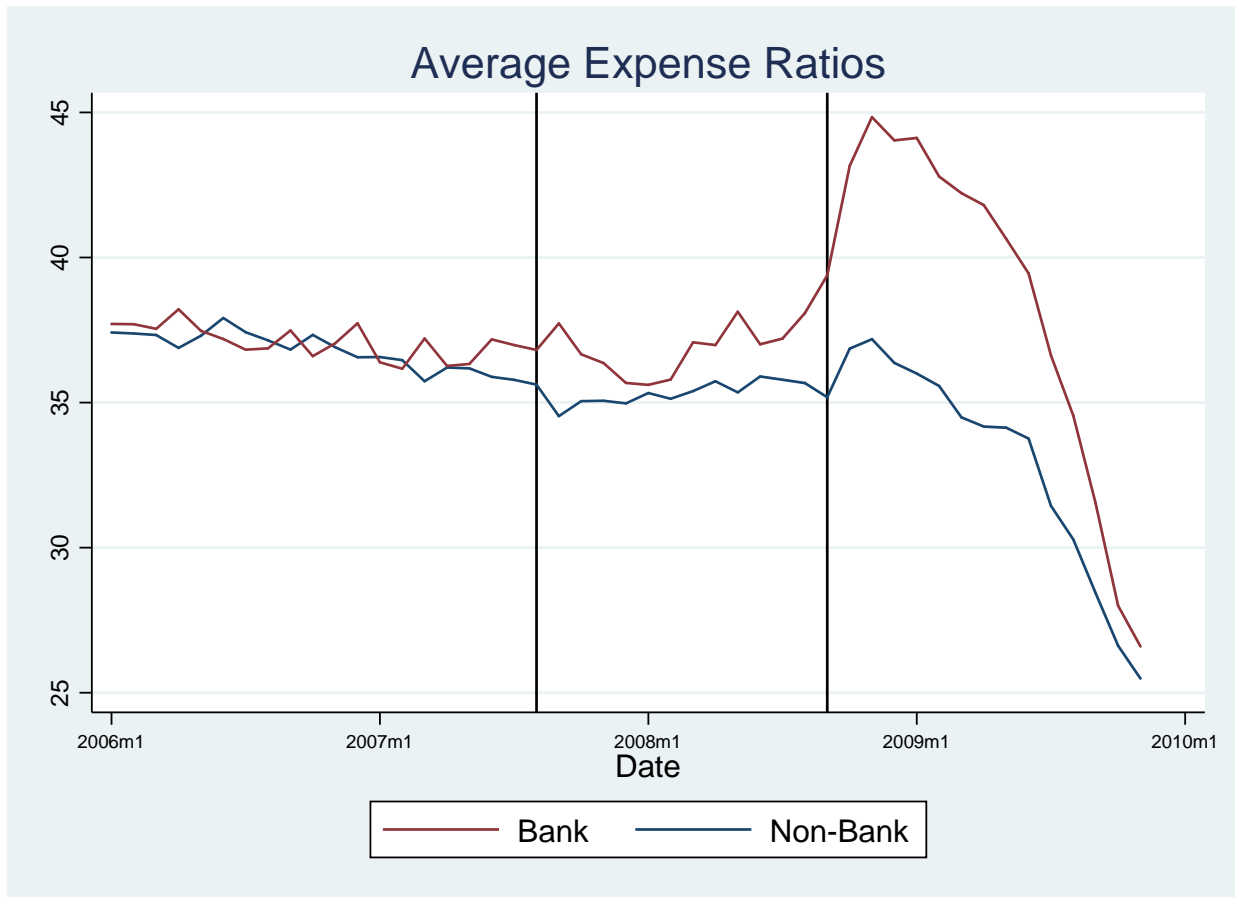


Figure 3: This figure shows the average expense ratios by required minimum investment before and after the Lehman failure (September 2008). Funds are separated into three sizes: “small” for funds with minimum balances of less than \$25,000, “medium” for funds with between \$25,000 and \$1,000,000, and “large” for funds with minimum balances of more than \$1,000,000.

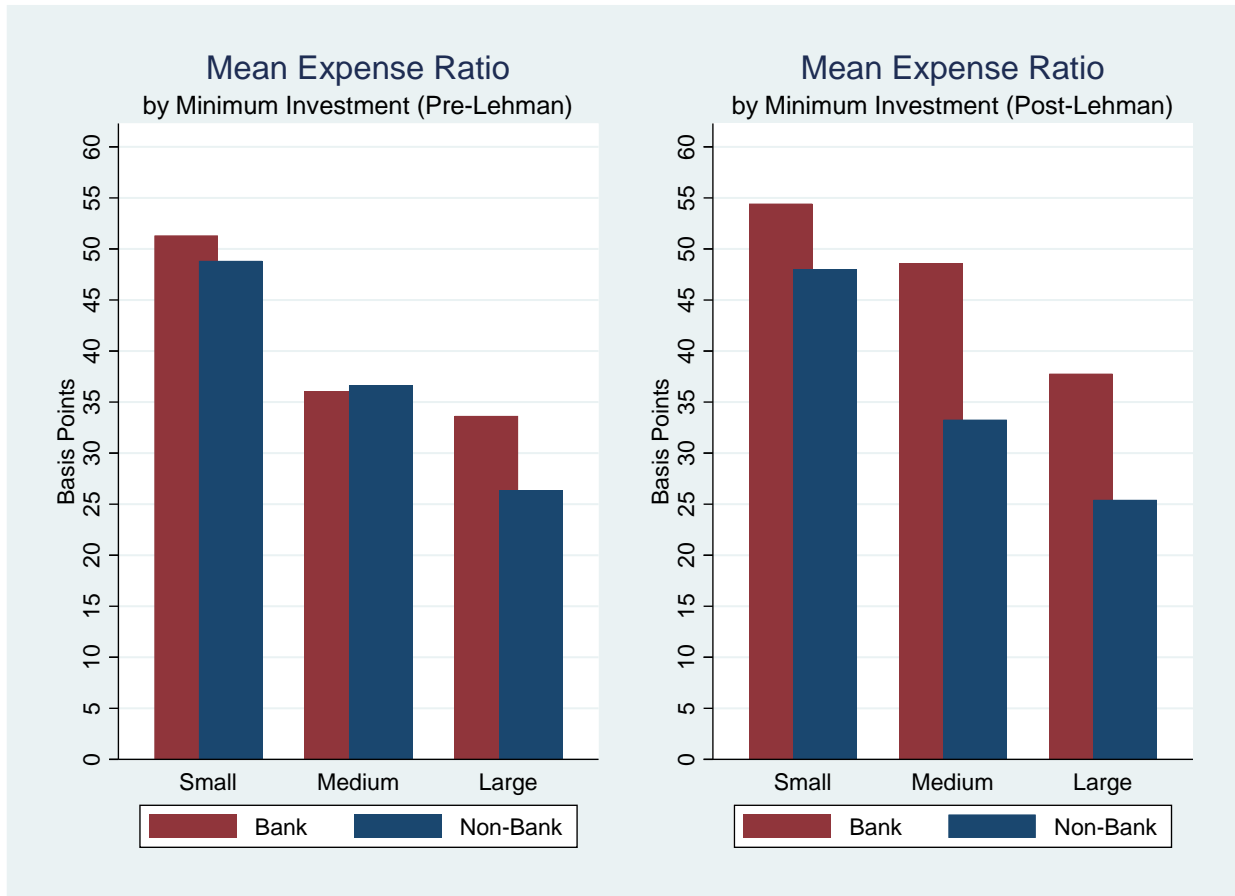


Figure 4: This figure shows the difference in the average expense ratios for prime institutional money market funds for bank and non-bank sponsors (left axis, positive indicates bank sponsored funds are higher) and the Federal Funds Rate (right axis), from July 2014 to June. The vertical line shows the month when the Money Market Fund Reform went into effect.

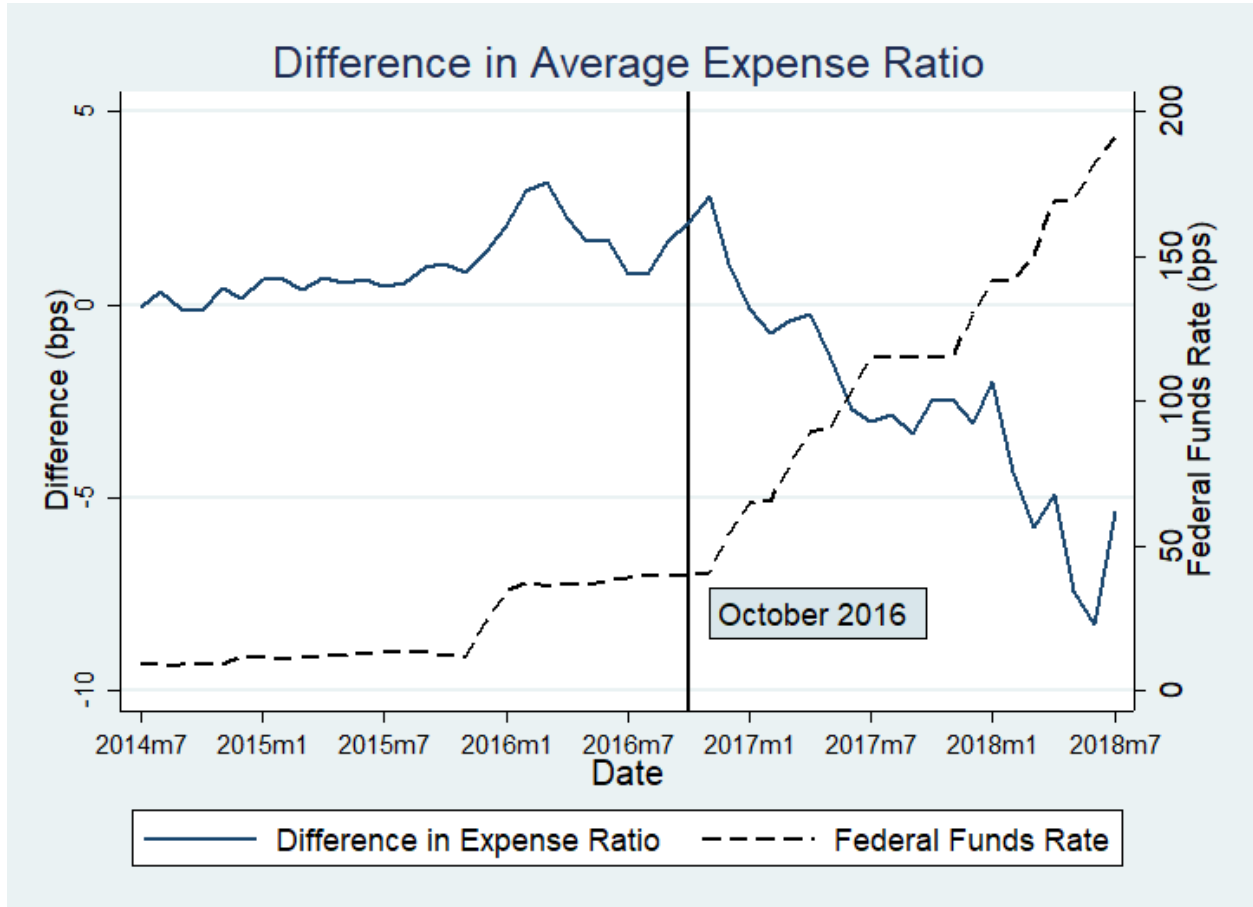


Table 1: This table presents the portfolio characteristics of prime institutional money market funds (PI-MMFs) as of June and December 2008. The means for each variable are given for the universe of PI-MMFs as well as for each group of sponsors – non-BHCs and BHCs. The standard deviations are in the parentheses below the mean. Holdings are as a fraction of total net assets. Stars on the mean represent the significance of the difference between non-BHC and BHC-sponsors, with *** for 1%, ** for 5%, and * for 10%.

	June 2008			December 2008		
	All	Non-BHC	BHC	All	Non-BHC	BHC
30-Day Gross Yield (bps)	274.3 (17.14)	275.1 (16.89)	272.9 (17.61)	185.2 (50.68)	189.6 (59.45)	180.3* (38.27)
Expense Ratio (bps)	36.3 (23.98)	36.04 (25.45)	36.83 (20.83)	39.83 (24.22)	36.16 (23.39)	43.92*** (24.54)
30-Day Net Yield (bps)	238 (28.55)	239 (30.03)	236 (25.34)	145.3 (52.51)	153.4 (58.88)	136.4*** (42.80)
Share Class Assets (\$B)	3.5 (7.6)	3.3 (7.6)	3.9 (7.8)	3.2 (7.1)	3.0 (6.4)	3.4 (7.8)
WAM (days)	42.24 (11.82)	42.31 (12.34)	42.1 (10.73)	37.85 (13.54)	39.14 (16.28)	36.42* (9.467)
Age (years)	9.948 (6.999)	9.942 (7.142)	9.959 (6.734)	10.87 (7.147)	11.17 (7.638)	10.55 (6.568)
Complex Assets (\$B)	103.6 (108.9)	108.4 (119.8)	94.0 (82.4)	137.5 (138.9)	131.7 (160.6)	143.8 (109.9)
Low-Risk Holdings						
U.S. Govt.	0.0489 (0.0951)	0.048 (0.0891)	0.0507 (0.107)	0.0861 (0.129)	0.0859 (0.121)	0.0863 (0.137)
Repos	0.135 (0.118)	0.136 (0.125)	0.133 (0.104)	0.148 (0.165)	0.147 (0.203)	0.150 (0.109)
Risky Holdings						
<i>All Risky Holdings</i>	0.816 (0.159)	0.816 (0.158)	0.816 (0.161)	0.766 (0.201)	0.767 (0.218)	0.764 (0.181)
Time Deposits	0.0297 (0.0412)	0.0208 (0.032)	0.0473*** (0.0508)	0.0357 (0.0613)	0.0231 (0.0405)	0.0499*** (0.0759)
Bank Obligations	0.189 (0.15)	0.18 (0.143)	0.207 (0.162)	0.176 (0.151)	0.208 (0.167)	0.140*** (0.122)
Floating Rate Notes	0.185 (0.137)	0.194 (0.144)	0.168* (0.12)	0.149 (0.138)	0.149 (0.157)	0.148 (0.113)
Commercial Paper	0.242 (0.189)	0.218 (0.196)	0.290*** (0.163)	0.222 (0.159)	0.226 (0.181)	0.218 (0.129)
ABCP	0.17 (0.164)	0.203 (0.173)	0.103*** (0.118)	0.184 (0.183)	0.162 (0.176)	0.208** (0.188)
Observations	345	230	115	317	167	150

Table 2: This table shows the relation between the yield and expense ratios with fund sponsorship. Columns (1) – (3) present results from equation (1). Columns (4) – (6) present results from regressions on the months before and after Lehman bankruptcy. Bertrand, Duflo and Mullainathan (2004) propose this technique as a robust difference-in-differences regression that produces consistent standard errors. BHC is a dummy variable that equals one for BHC-sponsored funds and zero otherwise. After Lehman equals one for observations in September 2008 – February 2009 and zero for observations in February 2008 – August 2008. The sample period is from February 2008 to February 2009. Standard errors are clustered at the sponsor level. Robust t-statistics are in parentheses. The *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

VARIABLES	Difference-in-Differences			Robust Difference-in-Differences		
	(1) 30-Day Gross Yield (bps)	(2) 30-Day Net Yield (bps)	(3) Charged Expense Ratio (bps)	(4) 30-Day Gross Yield (bps)	(5) 30-Day Net Yield (bps)	(6) Charged Expense Ratio (bps)
BHC	-7.15** (-2.13)	-10.78** (-2.49)	3.62 (1.10)	-3.06 (-1.08)	-6.63 (-1.50)	3.19 (0.99)
After Lehman	-23.00*** (-4.82)	-20.32*** (-4.21)	-2.63 (-1.47)	118.43*** (3.76)	137.92*** (4.34)	-6.85 (-0.54)
BHC * After Lehman	-6.77 (-1.16)	-13.24** (-2.10)	6.55** (2.59)	-8.99* (-1.70)	-12.83** (-2.26)	4.97** (2.08)
log(Complex Assets)	-0.54 (-0.53)	-1.48 (-1.45)	0.93 (0.99)	-1.52 (-1.46)	-2.65** (-2.34)	0.96 (1.00)
Treasury Yield (bps)	0.51*** (18.54)	0.52*** (19.33)	-0.01** (-2.07)	1.55*** (6.76)	1.70*** (7.29)	-0.05 (-0.55)
log(WAM)	16.58*** (2.83)	11.87* (1.91)	4.81** (2.47)	23.37*** (4.91)	17.85*** (3.66)	6.16** (2.44)
Time Deposits (%)	1.15*** (3.50)	1.07*** (2.72)	0.08 (0.35)	0.39 (0.89)	0.30 (0.56)	0.10 (0.30)
Bank Obligations (%)	1.01*** (7.74)	1.07*** (6.03)	-0.06 (-0.44)	1.04*** (8.71)	1.16*** (6.79)	-0.10 (-0.70)
Floating Rate Notes (%)	1.38*** (5.85)	1.50*** (6.89)	-0.12 (-1.33)	1.17*** (7.35)	1.37*** (9.55)	-0.17* (-1.80)
Commercial Paper (%)	0.72*** (4.21)	0.79*** (4.32)	-0.07 (-0.97)	0.54*** (4.57)	0.65*** (4.38)	-0.10 (-1.12)
ABCP (%)	0.55*** (3.19)	0.56*** (2.74)	-0.01 (-0.09)	0.69*** (3.61)	0.73*** (3.68)	-0.03 (-0.34)
log(Minimum Investment)	0.01 (0.02)	1.47*** (4.36)	-1.46*** (-5.39)	0.08 (0.31)	1.38*** (3.86)	-1.31*** (-4.51)
Constant	101.23*** (5.38)	68.29*** (3.35)	32.51*** (3.63)	-75.26 (-1.62)	127.31*** (-2.71)	34.51* (1.95)
Observations	4,355	4,354	4,359	708	707	709
R-squared	0.513	0.503	0.121	0.875	0.804	0.115

Table 3: This table shows the results from a robust difference-in-differences method as proposed by Bertrand, Duflo and Mullainathan (2004) for yields and expense ratios of Government Institutional MMFs and Prime Retail MMFs. The sample MMFs here are chosen such that these MMFs have the same sponsors as the PI-MMFs in Table 2. BHC is a dummy variable that equals one for BHC-sponsored funds and zero otherwise. After Lehman equals one for observations in September 2008 – February 2009 and zero for observations in February 2008 – August 2008. The sample period is from February 2008 to February 2009. Standard errors are clustered at the sponsor level. Robust t-statistics are in parentheses. The *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

VARIABLES	Government Institutional MMFs			Prime Retail MMFs		
	(1)	(2)	(3)	(4)	(5)	(6)
	30-Day Gross Yield (bps)	30-Day Net Yield (bps)	Charged Expense Ratio (bps)	30-Day Gross Yield (bps)	30-Day Net Yield (bps)	Charged Expense Ratio (bps)
BHC	-5.60 (-0.98)	-8.96 (-1.19)	3.32 (0.89)	-3.55 (-0.75)	-10.73 (-1.64)	7.18 (1.03)
After Lehman	-14.72 (-0.50)	-35.06 (-1.09)	22.25 (1.36)	161.19*** (2.96)	33.32 (0.48)	127.86 (1.20)
BHC * After Lehman	1.05 (0.15)	0.09 (0.01)	1.20 (0.37)	-13.05** (-2.15)	-11.82** (-2.00)	-1.22 (-0.41)
log(Complex Assets)	-3.02** (-2.36)	-4.17** (-2.55)	1.13 (1.46)	-0.32 (-0.28)	2.61 (1.45)	-2.92 (-1.38)
Treasury Yield (bps)	0.87*** (3.65)	0.69*** (2.76)	0.20 (1.60)	2.15*** (4.47)	1.05 (1.65)	1.10 (1.14)
log(WAM)	7.94*** (3.66)	4.88* (1.97)	3.23** (2.19)	30.63*** (4.39)	27.90*** (2.82)	2.72 (0.37)
Time Deposits (%)				0.84** (2.20)	0.55 (0.63)	0.30 (0.37)
Bank Obligations (%)				1.02*** (5.81)	0.74*** (4.10)	0.27 (1.08)
Floating Rate Notes (%)	1.53*** (7.98)	1.60*** (8.62)	-0.07* (-1.80)	1.32*** (7.43)	0.71*** (2.94)	0.62*** (2.98)
Commercial Paper (%)	-5.62 (-1.11)	-2.52 (-0.48)	-3.07*** (-4.35)	0.53*** (4.00)	0.08 (0.54)	0.45** (2.59)
ABCP (%)				0.71*** (4.71)	0.41 (1.57)	0.29 (1.11)
log(Minimum Investment)	-0.19 (-0.53)	1.34*** (3.05)	-1.51*** (-3.92)	0.26 (1.24)	1.75*** (3.19)	-1.49*** (-2.91)
Constant	94.47** (2.25)	87.80* (1.89)	3.36 (0.15)	-204.75** (-2.65)	-101.58 (-1.02)	-103.17 (-0.68)
Observations	748	748	750	527	527	527
R-squared	0.865	0.824	0.154	0.875	0.688	0.118

Table 4: This table shows the investor redemptions in response to the Lehman crisis. Columns (1) – (3) present results from equation (1), and Columns (4) – (6) present results from a robust difference-in-differences method as proposed by Bertrand, Duflo and Mullainathan (2004). BHC is a dummy variable that equals one for BHC-sponsored funds and zero otherwise. After Lehman equals one for observations in September 2008 – February 2009 and zero for observations in February 2008 – August 2008. The sample period is from February 2008 to February 2009. Standard errors are clustered at the sponsor level. Robust t-statistics are in parentheses. The *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

VARIABLES	Difference-in-Differences			Robust Difference-in-Differences		
	(1) 1-Month Redemptions (%)	(2) 2-Month Redemptions (%)	(3) 3-Month Redemptions (%)	(4) 1-Month Redemptions (%)	(5) 2-Month Redemptions (%)	(6) 3-Month Redemptions (%)
BHC	2.64 (1.56)	5.70 (1.34)	6.68 (0.95)	2.23 (1.37)	5.40 (1.28)	6.30 (0.91)
After Lehman	14.26*** (4.50)	13.92*** (2.84)	13.76* (1.92)	78.71*** (5.56)	199.36*** (6.50)	248.40*** (5.17)
BHC * After Lehman	-1.03 (-0.38)	-0.65 (-0.10)	2.17 (0.23)	-1.20 (-0.44)	-0.27 (-0.04)	1.36 (0.13)
Treasury Yield (bps)	0.09*** (5.16)	0.05** (2.41)	0.03 (0.95)	0.56*** (4.84)	1.46*** (5.83)	1.87*** (4.89)
log(Complex Assets)	-0.41 (-1.59)	-0.63 (-1.13)	-0.75 (-0.89)	-0.21 (-0.83)	-0.48 (-0.83)	-0.72 (-0.81)
30-Day Gross Yield (bps)	0.02** (2.24)	0.08*** (3.75)	0.12*** (4.47)	0.03 (0.92)	0.05 (0.58)	-0.02 (-0.19)
log(WAM)	-5.84*** (-4.39)	-11.31*** (-3.89)	-17.01*** (-4.23)	-8.95*** (-4.47)	-16.88*** (-4.51)	-19.69*** (-3.72)
Chgd Expense Ratio (bps)	-0.01 (-0.49)	-0.01 (-0.39)	-0.04 (-0.76)	-0.00 (-0.21)	0.00 (0.10)	-0.02 (-0.29)
Time Deposits (%)	-0.19** (-2.12)	-0.46** (-2.23)	-0.67** (-2.02)	-0.12 (-0.85)	-0.33 (-1.00)	-0.41 (-0.92)
Bank Obligations (%)	0.05 (1.06)	0.06 (0.46)	0.08 (0.51)	0.08 (1.43)	0.23* (1.78)	0.45** (2.37)
Floating Rate Notes (%)	-0.02 (-0.37)	-0.08 (-0.58)	-0.09 (-0.54)	-0.03 (-0.59)	0.01 (0.11)	0.17 (1.00)
Commercial Paper (%)	-0.04 (-0.79)	-0.09 (-0.87)	-0.10 (-0.82)	0.00 (0.05)	0.05 (0.51)	0.21 (1.49)
ABCP (%)	-0.07** (-2.11)	-0.20** (-2.04)	-0.23* (-1.81)	-0.02 (-0.55)	-0.08 (-0.73)	0.03 (0.19)
log(Minimum Investment)	-0.18** (-2.25)	-0.38** (-2.18)	-0.59** (-2.29)	-0.17** (-2.11)	-0.43** (-2.38)	-0.70** (-2.52)
Constant	7.82 (1.34)	24.66** (2.21)	42.52*** (2.88)	-63.71*** (-3.97)	-184.36*** (-4.62)	-227.22*** (-3.78)
Observations	3,990	3,625	3,267	702	696	693
R-squared	0.036	0.045	0.059	0.218	0.231	0.162

Table 5: This table presents the results of a Logit model for the analysis on the likelihood of receiving support from sponsors. Get Support is a binary variable that equals one if the fund gets support from its sponsor and zero otherwise. BHC is a dummy variable that equals one for BHC-sponsored funds and zero otherwise. Business Spillover is defined as the sponsor's assets under management excluding its PI-MMF divided by the sponsor's total assets under management (Kacperczyk and Schnabl, 2013). Maximum Monthly Asset Loss is the negative of the largest monthly percentage change in net assets during the analysis period experienced by a fund. We use instances of sponsor support instances reported in annual SEC financial statement filings with fiscal year-end dates falling between February 2008 and January 2010 to conservatively capture all the support instances occurred during February 2008 to February 2009. The sample period for MMF data is from February 2008 to February 2009. Standard errors are clustered at sponsor level. Robust z-statistics are in parentheses. The *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

VARIABLES	(1) Get Support (1/0)	(2) Get Support (1/0)	(3) Get Support (1/0)	(4) Get Support (1/0)	(5) Get Support (1/0)	(6) Get Support (1/0)
BHC	1.087 (1.13)	2.225* (1.69)	-0.528 (-0.41)	-2.043 (-1.08)	4.021 (0.96)	-2.044 (-1.16)
BHC * CP (Excluding ABCP)		-0.044 (-0.92)				
BHC * ABCP			0.103* (1.95)			
BHC * Commercial Paper				0.073 (1.62)		
BHC * Risky Holdings					-0.038 (-0.65)	
BHC * Max Monthly Loss						0.067** (1.96)
CP (Excluding ABCP) (%)	0.043 (1.01)	0.058 (1.24)	0.035 (0.82)			0.040 (0.96)
ABCP (%)	0.016 (0.50)	0.021 (0.62)	-0.012 (-0.30)			0.022 (0.67)
Commercial Paper (%)				0.002 (0.06)		
Risky Holdings					0.022 (0.63)	
Maximum Monthly Asset Loss	0.039** (2.19)	0.042** (2.33)	0.041* (1.92)	0.031* (1.72)	0.021 (1.30)	0.017 (1.08)
Business Spillover	-0.016 (-0.93)	-0.017 (-1.01)	-0.020 (-1.20)	-0.014 (-0.73)	-0.021 (-0.95)	-0.017 (-1.08)
log(Complex Assets)	0.336 (1.43)	0.268 (1.02)	0.136 (0.55)	0.226 (1.14)	0.141 (0.82)	0.327 (1.52)
log(WAM)	1.673 (1.42)	1.693 (1.38)	2.146 (1.50)	1.999 (1.54)	1.107 (0.96)	1.684 (1.56)
Time Deposits (%)	0.150 (1.26)	0.150 (1.24)	0.183 (1.43)	0.183 (1.61)		0.194 (1.64)

Bank Obligations (%)	-0.051 (-1.23)	-0.041 (-0.88)	-0.034 (-0.67)	-0.044 (-1.08)		-0.056 (-1.23)
Floating Rate Notes (%)	0.043 (0.95)	0.050 (1.09)	0.042 (0.84)	0.031 (0.68)		0.044 (0.99)
log(Minimum Investment)	-0.039 (-0.50)	-0.032 (-0.38)	-0.015 (-0.15)	-0.033 (-0.43)	-0.029 (-0.46)	-0.015 (-0.20)
Constant	-13.594** (-2.52)	-13.989*** (-2.58)	-13.237** (-2.25)	-12.149** (-2.33)	-8.595* (-1.83)	-12.782*** (-2.62)
Observations	80	80	80	80	80	80

Table 6: This table presents the results from the analysis on the relation between the charged expense ratio and the likelihood of receiving support. Each column shows results from a sample funds that experienced greater than 5%, 10%, 15%, 20%, or 25% asset losses in at least one month during the sample period, respectively. BHC is a dummy variable that equals one for BHC-sponsored funds and zero otherwise. Prob(Support) is the estimated, obtained from a Logit model, probability of getting support. Max Monthly Asset Loss is the largest monthly percentage change in net assets during the analysis period experienced by a fund. The sample period is from February 2008 to February 2009. Standard errors are clustered at sponsor level. Robust t-statistics are in parentheses. The *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

	>5% Asset Loss	>10% Asset Loss	>15% Asset Loss	>20% Asset Loss	>25% Asset Loss
VARIABLES	(1) Charged Expense Ratio (bps)	(2) Charged Expense Ratio (bps)	(3) Charged Expense Ratio (bps)	(4) Charged Expense Ratio (bps)	(5) Charged Expense Ratio (bps)
BHC	3.538 (1.07)	1.614 (0.44)	2.364 (0.55)	-0.640 (-0.18)	-1.653 (-0.40)
Prob(Support)	-16.754 (-1.27)	-27.575** (-2.29)	-21.541* (-1.67)	-29.224*** (-3.27)	-33.849*** (-3.06)
BHC * Prob(Support)	21.193** (2.46)	29.219** (2.43)	26.636* (1.99)	36.278*** (3.33)	38.719*** (3.05)
log(Complex Assets)	-1.421 (-1.39)	-1.205 (-1.19)	-1.920** (-2.52)	-2.137*** (-3.04)	-2.266*** (-3.01)
30-Day Gross Yield (bps)	0.084** (2.04)	0.125*** (2.72)	0.104* (1.91)	0.080 (1.58)	0.071 (1.40)
Max Monthly Asset Loss	-0.107 (-1.37)	-0.065 (-0.78)	-0.040 (-0.43)	0.086 (1.39)	0.081 (1.32)
log(WAM)	4.922** (2.17)	5.748** (2.37)	8.005*** (3.18)	10.574*** (3.75)	10.072*** (3.55)
Time Deposits (%)	-0.478 (-1.10)	-0.431 (-1.40)	-0.339 (-1.02)	-0.193 (-0.67)	-0.034 (-0.09)
Bank Obligations (%)	-0.104 (-0.55)	-0.140 (-0.89)	-0.156 (-1.16)	-0.285*** (-2.71)	-0.253** (-2.06)
Floating Rate Notes (%)	-0.146 (-1.11)	-0.152 (-0.99)	-0.238 (-1.60)	-0.237* (-1.77)	-0.104 (-0.79)
Commercial Paper (%)	0.013 (0.13)	0.012 (0.09)	-0.036 (-0.31)	-0.098 (-0.77)	-0.011 (-0.09)
ABCP (%)	-0.088 (-0.68)	-0.188 (-1.59)	-0.170 (-1.63)	-0.300*** (-2.71)	-0.262** (-2.52)
log(Minimum Investment)	-0.626** (-2.01)	-0.706** (-2.21)	-0.599** (-2.13)	-0.474* (-1.76)	-0.494 (-1.68)
Constant	17.529 (1.22)	4.814 (0.38)	7.749 (0.64)	5.111 (0.38)	6.508 (0.48)
Observations	130	116	102	80	66
R-squared	0.323	0.354	0.391	0.582	0.559

Table 7: This table presents the results from the analysis on the sample of BHC-sponsored PI-MMFs. Column (1) shows the relation between the charged expense ratio and the lagged BHCs' financial variables. Column (2) shows the relation between the charged expense ratio and the lagged BHCs' financial variables sorted into four quartile groups. Column (3) shows the relation between the charged expense ratio and the lagged BHCs' financial variables in quarterly data regression. Columns (4) – (6) augment the analysis in Columns (1) – (3) with the inclusion of the uninsured deposits ratio. Column (7) shows the relation between quarterly asset inflow to PI-MMFs and the change in BHCs' uninsured deposits. Liquid Assets include Federal funds sold, Federal funds for resell, noninterest bearing balance (currency), interest bearing balances (domestic) and interest-bearing balances (foreign). The ratios are relative to BHCs' total assets. Columns (1) and (2) have a sample period from February 2008 to February 2009. Column (3) has a sample period from 2nd quarter of 2008 to 1st quarter of 2009. Standard errors are clustered at sponsor level. Robust t-statistics are in parentheses. The *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

VARIABLES	(1) Charged Expense Ratio (bps)	(2) Charged Expense Ratio (bps)	(3) Charged Expense Ratio (Quarterly, bps)	(4) Charged Expense Ratio (bps)	(5) Charged Expense Ratio (bps)	(6) Charged Expense Ratio (Quarterly, bps)	(7) Quarterly Asset Inflow (%)
Liquid Assets Ratio	0.36** (2.42)		0.43** (2.70)	0.32** (2.19)		0.39** (2.56)	-1.09 (-1.69)
Equity Ratio	-0.04 (-0.05)		0.27 (0.33)	-0.23 (-0.28)		-0.01 (-0.01)	4.74** (2.45)
Uninsured Deposits Ratio				0.40* (1.98)		0.47** (2.60)	
Uninsured Deposits Outflow (%)							0.03 (0.83)
Liquid Assets Ratio Quartiles							
2nd Quartile		3.37 (1.08)			2.57 (0.77)		
3rd Quartile		6.11 (1.33)			5.52 (1.19)		
4th Quartile		13.29*** (3.19)			13.16*** (3.17)		
Equity Ratio Quartiles							
2nd Quartile		-1.51 (-0.46)			-1.68 (-0.50)		
3rd Quartile		2.51 (0.68)			2.98 (0.78)		
4th Quartile		-2.82 (-0.45)			-1.37 (-0.22)		
Uninsured Dep Ratio Quartiles							

2nd Quartile					-0.37		
					(-0.17)		
3rd Quartile					-0.79		
					(-0.31)		
4th Quartile					6.62		
					(1.40)		
After Lehman	2.79	2.79	0.78	3.15	2.78	3.17	205.38
	(1.36)	(1.30)	(0.06)	(1.55)	(1.34)	(0.21)	(1.68)
log(Complex Assets)	-1.59	-1.00	-2.34	-0.92	-0.44	-1.51	2.50
	(-1.22)	(-0.67)	(-1.71)	(-0.72)	(-0.29)	(-1.08)	(0.80)
Treasury Yield (bps)	-0.02	-0.02	-0.04	-0.01	-0.02	-0.02	1.42
	(-1.20)	(-1.29)	(-0.42)	(-0.87)	(-1.19)	(-0.20)	(1.53)
log(WAM)	16.47***	16.85***	17.35***	16.56***	17.20***	17.47***	20.34
	(4.43)	(4.61)	(4.54)	(4.36)	(4.87)	(4.51)	(1.71)
Time Deposits (%)	0.26	0.24	0.52	0.25	0.21	0.46	1.18
	(1.25)	(1.24)	(1.48)	(1.21)	(0.99)	(1.32)	(1.43)
Bank Obligations (%)	0.04	-0.01	0.07	-0.02	-0.02	-0.01	0.18
	(0.31)	(-0.04)	(0.50)	(-0.17)	(-0.15)	(-0.06)	(0.67)
Floating Rate Notes (%)	-0.05	-0.09	-0.01	-0.07	-0.09	-0.04	-0.51
	(-0.40)	(-0.86)	(-0.08)	(-0.60)	(-0.85)	(-0.32)	(-1.20)
Commercial Paper (%)	-0.09	-0.15	-0.02	-0.10	-0.15	-0.05	-0.26
	(-0.78)	(-1.40)	(-0.18)	(-0.91)	(-1.36)	(-0.39)	(-0.75)
ABCP (%)	-0.06	-0.15	0.17	-0.10	-0.18	0.12	-0.52
	(-0.43)	(-1.17)	(0.96)	(-0.75)	(-1.40)	(0.67)	(-1.20)
log(Minimum Investment)	-2.13***	-2.14***	-1.86***	-2.08***	-2.10***	-1.81***	0.69
	(-2.91)	(-2.89)	(-3.27)	(-2.82)	(-2.84)	(-3.17)	(0.97)
Constant	21.28	18.92	15.86	13.77	11.97	5.32	-338.12*
	(0.95)	(0.84)	(0.72)	(0.60)	(0.53)	(0.25)	(-1.99)
Observations	1,072	1,072	421	1,072	1,072	421	421
R-squared	0.234	0.241	0.195	0.240	0.246	0.203	0.031

Table 8: This table presents the results from a robust difference-in-differences method as proposed by Bertrand, Duflo and Mullainathan (2004) for the yields and expense ratios of PI-MMFs before and after the Money Market Fund Reform in 2016. The analysis uses the same sample of fund complexes as the analysis in Table 2. BHC is a dummy variable that equals one for BHC-sponsored funds and zero otherwise. After Reform equals one for observations in November 2016 – July 2018 and zero for observations in July 2014 – October 2016. The sample period is from July 2014 to July 2018. Standard errors are clustered at sponsor level. Robust t-statistics are in parentheses. The *, **, and *** denotes significance at the 10%, 5%, and 1% level, respectively.

VARIABLES	(1) 30-Day Gross Yield (bps)	(2) 30-Day Net Yield (bps)	(3) Charged Expense Ratio (bps)
BHC	-0.89 (-0.67)	-7.77*** (-4.93)	6.88*** (3.61)
After Reform	1.69 (0.38)	-10.02 (-1.38)	11.71** (2.23)
BHC * After Reform	1.35 (0.72)	8.22** (2.51)	-6.87** (-2.29)
log(Complex Assets)	1.60*** (3.08)	-1.48* (-1.91)	3.08*** (5.63)
Treasury Yield (bps)	1.08*** (28.43)	1.08*** (13.94)	-0.00 (-0.00)
log(WAM)	5.08*** (3.02)	2.76 (1.43)	2.33 (1.69)
Time Deposits (%)	0.09 (0.82)	0.04 (0.33)	0.05 (0.48)
Bank Obligations (%)	0.04 (1.15)	-0.00 (-0.02)	0.05 (0.91)
Floating Rate Notes (%)	0.03 (0.56)	-0.22** (-2.05)	0.25** (2.73)
Commercial Paper (%)	0.02 (0.31)	-0.13 (-1.45)	0.15* (2.00)
ABCP (%)	-0.03 (-0.38)	-0.05 (-0.46)	0.02 (0.22)
log(Minimum Investment)	0.05 (0.59)	1.11*** (7.37)	-1.06*** (-5.53)
Constant	-14.85** (-2.08)	3.28 (0.42)	-18.12** (-2.23)
Observations	338	338	338
R-squared	0.991	0.932	0.307

Appendix A: Sample prime institutional funds as of September 2008 and corrections to fund sponsors reported by *iMoneyNet*.

Complex	Number of Funds	Number of Share Classes	<i>iMoneyNet</i> Sponsor Indicator	Corrected Sponsor
<i>BHC status change within sample period (2 complexes / 8 funds / 32 share classes)</i>				
Goldman Sachs	5	21	BHC/Non-BHC	Non-BHC then - BHC
Morgan Stanley	3	11	BHC	Non-BHC then BHC
<i>No domestically domiciled regulatory high-holder (7 complexes / 10 funds / 20 share classes)</i>				
Barclays	2	8	BHC/Non-BHC	Non-BHC
BMO (BHC of Montreal)	1	1	BHC	Non-BHC
Credit Suisse	1	3	BHC	Non-BHC
HSBC	1	2	BHC	Non-BHC
ING	3	3	BHC	Non-BHC
RBC	1	1	Non-BHC	BHC
UBS	1	2	BHC	Non-BHC
<i>Data error (9 complexes / 21 funds / 41 share classes)</i>				
American Century	2	2	Non-BHC	BHC
BlackRock	8	16	BHC/Non-BHC	Non-BHC
CitizensSelect	1	4	BHC	Non-BHC
Legg Mason	4	9	BHC/Non-BHC	Non-BHC
Monarch	1	4	Non-BHC	BHC
Munder	2	3	BHC/Non-BHC	Non-BHC
RidgeWorth	1	1	BHC	Non-BHC
Virtus	1	1	BHC	Non-BHC
BBH (Brown Brothers Harriman)	1	1	BHC	Non-BHC
<i>No change from iMoneyNet data (55 complexes / 97 funds / 236 share classes)</i>				
Advisors Inner Circle	1	1	Non-BHC	Non-BHC
Allegiant	2	3	BHC	BHC
Ambassador	1	1	Non-BHC	Non-BHC
American Beacon	1	4	Non-BHC	Non-BHC
AMF	1	1	Non-BHC	Non-BHC
Bishop St	1	1	BHC	BHC
BNY Mellon	1	1	BHC	BHC
BofA Global Capital	2	10	BHC	BHC
Cadre	1	2	Non-BHC	Non-BHC
Calvert	1	1	Non-BHC	Non-BHC
Cavanal Hill	1	2	BHC	BHC
Deutsche	3	7	BHC	BHC
Dreyfus	7	24	BHC	BHC
Evergreen	2	9	BHC	BHC

Federated	6	15	Non-BHC	Non-BHC
Fidelity	5	18	Non-BHC	Non-BHC
Fifth Third	1	4	BHC	BHC
First American	1	4	BHC	BHC
Fortis	2	3	Non-BHC	Non-BHC
Franklin	1	2	Non-BHC	Non-BHC
GE	2	2	Non-BHC	Non-BHC
Hancock Horizon	1	1	BHC	BHC
Invesco	3	16	Non-BHC	Non-BHC
Janus	2	3	Non-BHC	Non-BHC
JPMorgan	2	11	BHC	BHC
Lehman Brothers	4	11	Non-BHC	Non-BHC
Meeder	1	1	Non-BHC	Non-BHC
Nationwide	1	1	Non-BHC	Non-BHC
North Track	1	1	Non-BHC	Non-BHC
Northern	2	6	BHC	BHC
OppenheimerFunds	1	3	Non-BHC	Non-BHC
Pax World	1	1	Non-BHC	Non-BHC
Performance	1	1	BHC	BHC
PFM	1	1	Non-BHC	Non-BHC
Pioneer	2	4	Non-BHC	Non-BHC
PNC	1	1	BHC	BHC
Principal	1	1	Non-BHC	Non-BHC
Prudential	2	3	Non-BHC	Non-BHC
Reich & Tang	1	2	Non-BHC	Non-BHC
Reserve	2	10	Non-BHC	Non-BHC
RMK	1	1	BHC	BHC
Schwab	2	4	Non-BHC	Non-BHC
SEI	2	9	Non-BHC	Non-BHC
SSgA (State Street)	2	3	BHC	BHC
Sterling Capital	1	1	BHC	BHC
TD Asset Mgmt USA	1	2	BHC	BHC
Thrivent	1	1	Non-BHC	Non-BHC
TIAA-CREF	2	3	Non-BHC	Non-BHC
Touchstone	2	3	Non-BHC	Non-BHC
Utendahl	1	1	Non-BHC	Non-BHC
Vanguard	1	1	Non-BHC	Non-BHC
Victory	1	2	BHC	BHC
Wells Fargo	4	7	BHC	BHC
Wilmington	2	4	BHC	BHC
Wilmington Trust	1	1	BHC	BHC
Total	136	329		