HOW SAFE ARE MONEY MARKET FUNDS?*

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We examine the risk-taking behavior of money market funds during the financial crisis of 2007–2010. We find that (1) money market funds experienced an unprecedented expansion in their risk-taking opportunities; (2) funds had strong incentives to take on risk because fund inflows were highly responsive to fund yields; (3) funds sponsored by financial intermediaries with more money fund business took on more risk; and (4) funds suffered runs as a result of their risk taking. This evidence suggests that money market funds lack safety because they have strong incentives to take on risk when the opportunity arises and are vulnerable to runs. *JEL* Codes: G21, G23, E44.

I. INTRODUCTION

Money market funds were at the center of attention during the financial crisis of 2007–2010. Following the default of Lehman Brothers in September 2008, a well-known fund—the Reserve Primary Fund—suffered a run due to its holdings of Lehman's commercial paper. This run quickly spread to other funds, triggering investors' redemptions of more than $300 billion within a few days after Lehman's default. Its consequences appeared so dire to financial stability that the U.S. government decided to intervene by providing unlimited insurance to all

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money market fund depositors. The intervention was successful in stopping the run, but it transferred the entire risk of the $3 trillion money market fund industry to the government.

This turmoil in the money fund industry came as a surprise to many market participants. Prior to the run, investors regarded money funds as a low-risk investment that was almost as safe as cash. Indeed, for most of their history, money funds had invested in safe assets and had generated yields similar to those of U.S. Treasuries. However, during the early part of the financial crisis the average fund yield increased relative to that of U.S. Treasuries. As shown in Figure I, the yield differential was 15 basis points before August 2007 and increased to 90 basis points after August 2007. Moreover, the cross-sectional dispersion in fund yields increased from less than 30 to more than 150 basis points. This sudden increase in the level and the dispersion of fund yields suggests that the underlying asset risk of the funds changed fundamentally during the financial crisis.[1]

In this article, we ask: How risky are money market funds? The answer to this question is important for assessing risks to financial stability in the United States. Money market funds are the largest provider of short-term financing to financial institutions, are similar in size to the entire sector of equity mutual funds, and are also the largest provider of liquidity to corporations, issuing about the same amount of demand deposits as the entire U.S. commercial banking sector. Money market funds thus add a layer of financial intermediation between issuers (mainly financial institutions) and investors (mainly corporations). If money market funds have incentives to take on risk, this additional layer of financial intermediation can weaken financial stability through reducing market discipline on financial institutions and making them more vulnerable to runs.[2]

Our analysis delivers four main results. First, money market funds experienced an expansion in their risk-taking opportunities starting in August 2007. Money market fund regulation

1. The crisis had also a wide-reaching impact on other parts of money markets, such as the repo market (Gorton and Metrick 2009); unsecured and asset-backed commercial paper (Brunnermeier 2009; Kacperczyk and Schnabl 2010; Acharya, Schnabl, and Suarez 2013); Treasuries market (Krishnamurthy and Vissing-Jorgensen 2010); and banks' funding liquidity (Cornett et al. 2011).

2. Money funds have been discussed in Christoffersen (2001), Christoffersen and Musto (2002), Kacperczyk and Schnabl (2010), McCabe (2010), and Strahan and Tanyeri (2012).

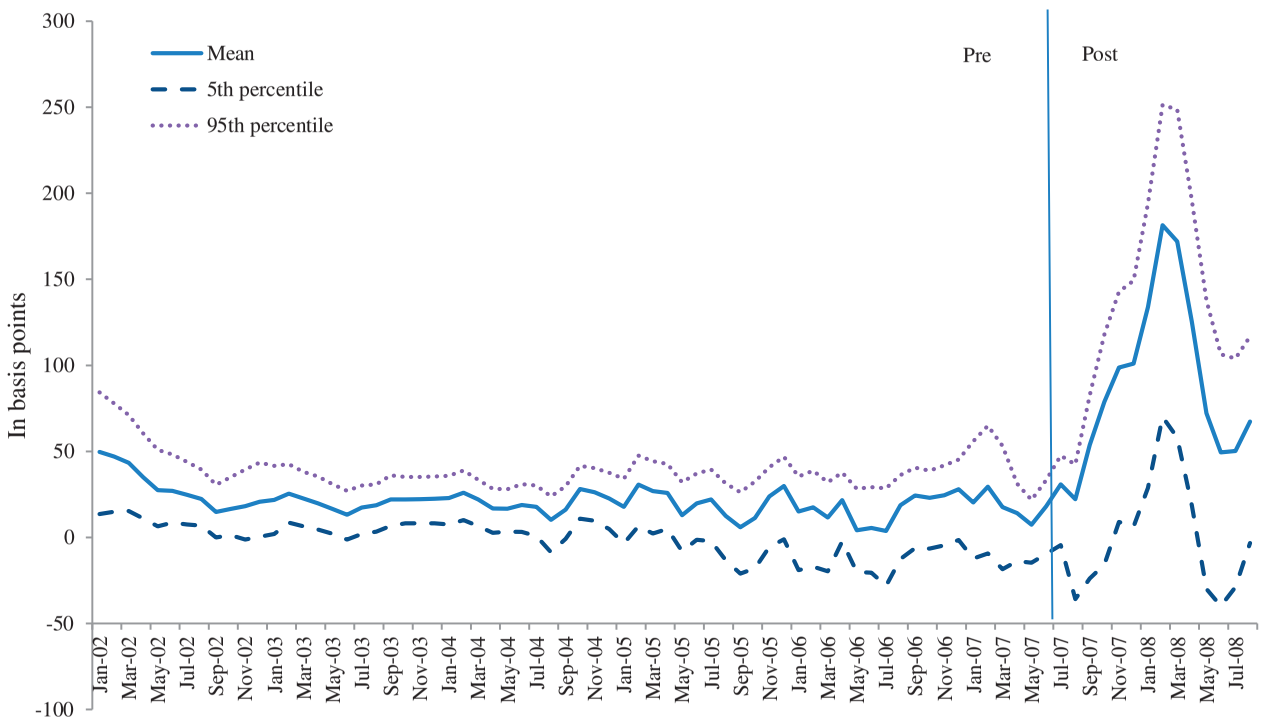

FIGURE I

Dispersion in Money Market Fund Yields

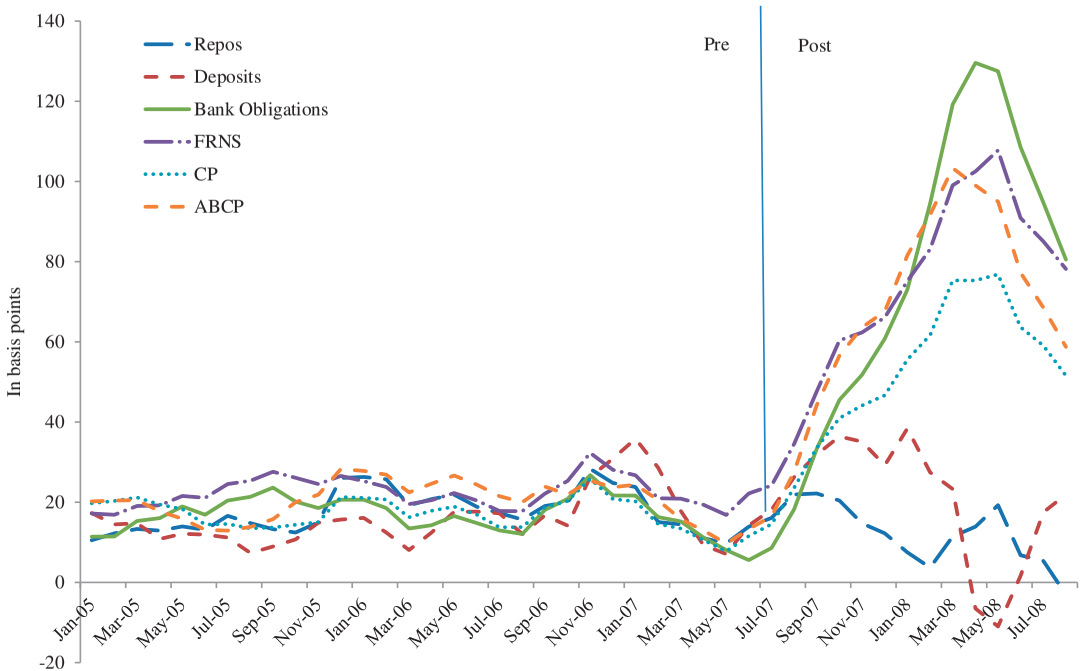

FIGURE II

Spread by Money Market Instrument

We implement the regression model in Table III for the period from January 2005 to August 2008. Each point represents the three-month average of coefficients on the interaction between month fixed effects and an indicator variable for repurchase agreements (*Repos*), bank deposits (*Deposits*), bank obligations (*Bank Obligations*), floating rates notes (*FRNS*), commercial paper (*CP*), and asset-backed commercial paper (*ABCP*), respectively. Each point represents the return relative to the omitted category (*Treasuries and agency debt*) measured in basis points.

requires funds to invest exclusively in highly rated, short-term debt securities. As shown in Figure II, the spread between eligible money market instruments and U.S. Treasuries was at most 25 basis points prior to August 2007, thus leaving little scope for risk taking. However, after the run on asset-backed commercial paper conduits in August 2007, many investors became aware that collateral and liquidation values underlying money market instruments had declined due to the U.S. subprime mortgage crisis, which then prompted a repricing of risks in money markets. As shown in Figure II, the spread between risky instruments, such as bank obligations, and safe instruments, such as U.S. Treasuries, increased from 25 up to 125 basis points after August 2007. Hence, for the first time since their origin in the 1970s, money funds had a choice of whether to invest in assets with a substantial risk premium relative to safe government securities.[3]

Second, using weekly data on the universe of institutional prime funds, we find that such funds had especially strong incentives to take on risk.[4] Our analysis reveals that fund flows are highly responsive to current yields: a 1 standard deviation increase in fund yields raises annualized fund assets by 43%. This effect is economically large given that money funds charge their investors a fixed share of assets under management. The relationship is robust to including various controls, such as fund age, expenses, assets size, fund flow volatility, fund family size, and fund fixed effects. Also, the relationship is stronger after August 2007 and coincides with the expansion in risk-taking opportunities after the start of the financial crisis.

Third, we find that funds sponsored by financial intermediaries with more money fund business took on more risk. Specifically, a 1 standard deviation increase in institutional prime money funds assets as a share of a sponsor's total mutual funds assets raises the share of risky fund assets by 3.7 percentage points, average maturity by 2.3 days, and fund yield by 3.0 basis points. This result is economically significant in that each

3. In general, the run on asset-backed commercial paper conduits marks the start of the financial crisis (Acharya, Schnabl, and Suarez 2013). Historically, there were other periods during which the yields of risky money fund instruments were elevated for short periods. However, none of the episodes lasted for more than a few weeks.

4. We focus on prime funds because we do not expect the subprime crisis to have an economically meaningful effect on Treasury funds, which invest solely in government securities.

respective effect accounts for 14.9%, 19.4%, and 19.2% of the cross-sectional standard deviation of each risk measure. Similarly, if a fund sponsor is a stand-alone asset manager, the respective fund risks increase by 27.6%, 14.1%, and 46.7% relative to those of a fund whose sponsor is part of a financial conglomerate with non–money fund businesses. These results are robust to including fund controls and fund fixed effects.

Our explanation for these results is that fund sponsors with more non–money market fund business expect to incur large costs if their money market funds fail. Such costs are typically reputational in nature, in that an individual fund's default generates negative spillovers to the fund's sponsor other business. In practice, these costs are outflows from other mutual funds managed by the same sponsor or a loss of business in the sponsor's commercial banking, investment banking, or insurance operations.

We conduct several tests to check the robustness of these results. First, we show that our main findings remain the same when we analyze stand-alone asset managers and control for a sponsor's credit rating, which suggests that the size of a sponsor's non–money fund business does not simply proxy for the sponsor's financial strength. Next, our results on risk taking do not hold for the group of retail prime funds. Retail funds constitute a useful placebo group because the same fund sponsors also offer funds to retail investors, but retail investors are much less sensitive to yield differentials than institutional investors are. This finding suggests that our results are not driven by unobserved sponsor characteristics, such as a sponsor's risk aversion or the quality of a sponsor's risk management. Finally, our results on risk taking gradually disappear after the government introduced unlimited deposit insurance after Lehman's default. Hence, it is unlikely that our results are driven by the expectation of (implicit) government guarantees prior to Lehman's default.

Fourth, we find that sponsor characteristics predict the strength of runs in the immediate aftermath of Lehman's default. We focus on the one-week period after Lehman's default because the run stopped after the government provided unlimited deposit insurance to all funds. We find that funds with more money fund business and funds that took more risks before Lehman's default experienced larger runs. Moreover, funds sponsored by stand-alone asset managers were less likely to provide financial support during the run, even after controlling for risk taking before the run. The run also triggered long-term adjustments in the money

market fund industry. Sponsors with less money fund business were more likely to exit the money market fund industry, consistent with the notion that negative spillovers were larger for this group. Among the funds that remained in business, some funds changed their names to incorporate their sponsors' names, probably to make their support more salient.

Overall, our main message is that money market funds are risky. They add an additional layer of financial intermediation between financial institutions and corporations, which exerts a potentially destabilizing effect on financial markets. Funds have strong incentives to chase yield (and risk), which reduces the market discipline on financial institutions and makes them more vulnerable to runs. Our results also shed light on the role of demand deposits in limiting risk taking. While some theoretical work argues that demand deposits mitigate intermediaries' incentives to take risk through the threat of runs (e.g., Diamond and Rajan 2000, 2001), our results suggest that in the context of institutional prime funds, demand deposits may exacerbate risk taking because of yield chasing by depositors.

The rest of the article proceeds as follows. Section II describes our research setting. Section III summarizes the data. Section IV discusses the identification strategy and presents empirical results. Section V concludes.

II. Institutional Setting: Money Market Funds

II.A. Primer on Money Market Funds

Money market funds emerged in the 1970s as an alternative to bank deposits. At that time, Regulation Q limited the interest that banks could pay on deposits to a rate that was much lower than the yield on money market instruments. Money market funds became an attractive alternative to investors because they paid higher interest for taking on comparable risks. Even though Regulation Q was eventually abolished, the size of the fund industry grew steadily, reaching $2 trillion at the beginning of 2006 (see Federal Reserve Flow of Funds Data).

An important characteristic of money funds is that, contrary to bank deposits, money fund investments are not insured by the government. But unlike other mutual funds, money funds have a constant net asset value, typically $1 per share. This allows them to offer demand deposits that can be purchased and redeemed on

demand and that are considered almost as safe as bank deposits. Money funds maintain the stable net asset value by using historical cost accounting to assess the value of their holdings. They are allowed to do so as long as the market value does not drop more than 0.5% below the constant net asset value.

The down side of the constant net asset value is that it exposes money funds to runs because the demand deposits are backed by illiquid assets. If the market value of a fund's holdings is expected to drop below the constant net asset value, investors tend to redeem their shares, which can exacerbate the market value drop due to forced liquidation at fire-sale prices. Also, funds may suffer losses on their investments because of changes in interest rates or individual securities' defaults, which can trigger runs by investors wishing to redeem their shares before the constant net asset value is suspended. As a result, money market funds are susceptible to self-fulfilling runs as in Diamond and Dybvig (1983).

To limit such risks, money market funds are regulated under Rule 2a-7 of the Investment Company Act of 1940. This regulation restricts fund holdings to short-term money market instruments. Moreover, it requires short-term debt to be of high credit quality. For example, it limits commercial paper holdings to those that carry either the highest or second-highest rating from at least two of the nationally recognized credit rating agencies. Also, the regulation requires portfolio diversification: money market funds must not hold more than 5% of their assets in any instrument by a single issuer with the highest rating and not more than 1% of their assets in any instrument of a single issuer with the second-highest rating.

To provide an overview of the various money market instruments held by money market funds, we use data provided by iMoneyNet. These data are the most comprehensive data source on money market funds' holdings. We focus on taxable funds because nontaxable funds hold tax-exempt instruments issued by state and municipal governments, which are not the focus of our study. Taxable funds account for 84.5% of all assets under management.

As of January 2006, there were 485 taxable funds, sponsored by 148 companies, holding assets worth $1.67 trillion. Our study focuses on prime funds, which can invest in debt other than government securities. There were 218 prime funds with total assets under management of $1.26 trillion, 76.2% of total assets. The

remainder of $396 billion, 23.8% of total assets, were held by 267 Treasury funds, which only hold government debt, government-backed agency debt, and repurchase agreements. Among prime funds, the largest asset class was commercial paper, accounting for $325.3 billion, or 25.6% of total assets. The other sizable investments were in floating-rate notes ($265.9 billion), bank obligations ($235.3 billion), asset-backed commercial paper ($186.3 billion), repurchase agreements ($151.1 billion), Treasuries and government-backed agency debt ($62.5 billion), and bank deposits ($39.4 billion).

In terms of funding, institutional and retail investors account for 57% and 43% of prime fund assets, respectively. Most large prime funds are geared toward institutional investors. As of January 2006, the 20 largest institutional prime funds accounted for a total of $429 billion worth of assets.[5] The largest fund was the J.P. Morgan Prime Money Market Fund with assets under management of $68.1 billion, followed by Columbia Cash Reserves and BlackRock Liquidity, which were about half the size. The smallest among the funds, Dreyfus Institutional Cash Fund, still managed a considerable $12.6 billion. On average, the funds were well diversified across instrument types but highly exposed to risks in the financial industry as a whole. Assets originated by the financial industry—measured as a total of financial commercial paper, structured securities, bank obligations, and repurchase agreements—accounted for 91.4% of money market fund assets.

II.B. The Role of a Fund Sponsor

A fund sponsor plays an important role in the money market fund's operation. Usually, the sponsor is a financial institution that is either a stand-alone asset manager or a financial conglomerate. The main tasks of the fund sponsor include managing the fund and ensuring a smooth fund operation. Most important, the sponsor chooses the fund portfolio and thus determines a fund's risk.[6]

5. In our analysis, we classify a fund as institutional if it offers at least one institutional class and as retail if it does not offer any institutional share classes.

6. In our tests, we assume that a fund sponsor can set its fund's risk. In doing so, we abstract from agency problems between the fund sponsor and fund manager. We believe this assumption is plausible in the money fund industry because a fund's portfolio risk is observable and there is little scope for manager skill in portfolio choice.

In general, the sponsor's incentives to take on risk depend on the shape of the sponsors's payoff function, which in turn is determined by the benefits and costs of risk taking. On the benefit side, funds typically experience large inflows as a result of high yields. This raises a sponsor's incentive to invest in high-yielding assets, especially if investors do not fully risk-adjust returns.

On the cost side, excessive risk taking can trigger a run on a fund. If there is a run, fund sponsors have the option, but not the obligation, to support failing funds. Even though fund sponsors have no contractual obligation to support their funds during runs, they may find it optimal to do so because of negative spillover costs to other parts of the sponsors' business.[7] Such costs are typically reputational in nature, in that an individual fund's default could generate outflows from other mutual funds managed by the same sponsor, or a loss of the sponsor's general business. A significant part of our empirical tests is devoted to estimating the importance of such business spillovers for risk choices.

Our primary measure of business spillovers is *Fund Business*, defined as the sponsor's assets under management excluding institutional prime funds divided by the sponsor's assets under management. For example, in January 2006, Fidelity had $973 billion in assets under management, out of which $59 billion was in institutional prime funds, which implies *Fund Business* of 93.9%. The idea behind this measure is that fund families with more assets under management in non–money market funds have more at stake in case their money market fund faces distress. Our second measure of business spillovers is *Conglomerate*—an indicator variable equal to 1 if the fund sponsor is part of a financial conglomerate (i.e., commercial bank, investment bank, or insurance company), and 0 otherwise. This complements our first measure in that it captures a broader idea of a franchise value at stake, as is the case for financial conglomerates. In our tests, we use both measures, bearing in mind

7. Many investors expect a sponsor to provide financial support to their fund if the fund suffers a run. This expectation is evident in an investor alert by the Financial Industry Regulatory Authority (FINRA), which states: "Typically, there has been an expectation that when a money market fund reaches a point where it might break the buck [i.e., suspend the constant net asset value], the investment management firm that sponsors the fund will take action to infuse the fund with cash so that the fund can maintain a stable NAV of $1.00 per share" (FINRA 2010).

that each one captures a slightly different type of cross-sectional variation in the data.[8]

II.C. Money Market Funds during the Financial Crisis

1. Change in Risk-Taking Opportunities. Before August 2007, the yields of money market instruments were almost the same as the yields of U.S. Treasuries. Given that fund regulation restricted money funds to investing in money instruments, it effectively prevented funds from differentiating their risks. As a result, money funds invested in similar instruments and had similar yields.

However, starting in August 2007, a number of events changed funds' risk-taking opportunities. On August 9, 2007, the French bank BNP Paribas halted withdrawals from three of its mortgage-backed securities funds and suspended calculation of their net asset values. Even though defaults on mortgages had been rising throughout 2007, the suspension of withdrawals by BNP had a profoundly negative effect on money market instruments. Within one day, the interest rate spread of overnight asset-backed commercial paper over the Fed funds rate rose from 10 to 150 basis points, as investors became concerned about the quality of collateral backing these instruments.

Money market funds suffered almost no direct losses from impaired asset-backed commercial paper. The reason was that these instruments were effectively insured by commercial banks through the provision of liquidity guarantees that paid off maturing asset-backed commercial paper in case of a run.[9] However, going forward, it became clear to many investors that liquidation values of money market instruments were lower and that financial institutions issuing money market instruments were riskier than previously thought. As a result, money market fund instruments that were backed by financial

8. We also considered another measure of business spillovers that additionally accounts for the size of the sponsor's total assets by adding total sponsor assets to total mutual fund assets, which is especially important for financial conglomerates. This measure implicitly assumes that both fund assets and other types of assets carry equal weight in the sponsor's business activity, which is plausible but difficult to measure. Our results remain qualitatively unchanged if we use this alternative measure.

9. Acharya, Schnabl, and Suarez (2013) provide a detailed account of the structure of asset-backed commercial paper conduits and show that losses to outside investors, such as money market funds, were small.

institutions—bank obligations, floating-rate notes, and commercial paper—were perceived as risky and had to offer higher yields. At the same time, the yields of safe instruments, such as U.S. Treasuries, repurchase agreements, and bank deposits, remained at much less elevated levels.

Figure II presents evidence of the sudden change in yields of money market instruments.[10] From January 2005 to July 2007, all instruments had yields of about 15–25 basis points relative to those of U.S. Treasuries and agency debt. However, starting in August 2007, the yields of risky instruments started to increase rapidly with a peak in March 2008 when spreads reached 125 basis points. After March 2008, the spreads started to decline but were still at 60 basis points in August 2008. Over the same period, the spreads of safe instruments remained constant at around 20 basis points or even declined. In sum, the start of the financial crisis in August 2007 provided money funds with the opportunity to invest in riskier assets.[11]

2. Tale of Two Funds: Reserve Primary Fund and Fidelity Institutional Prime. We illustrate the response to these risk-taking opportunities with an example of two funds: the Reserve Primary Fund (RPF) and the Fidelity Institutional Prime (FID). The RPF was particularly well known in the industry because its owner, Bruce Bent, was the founder of the first money market fund. Similarly, the FID was well known because of its sponsor, which is one of the largest asset managers. The funds were quite similar before August 2007. Each managed about $25 billion in

10. The yields of individual instruments are not directly observable to us, but we can impute them using fund-level data on yields and holdings. To this end, we regress fund yields on interaction terms of indicator variables for each instrument type and month-fixed effects plus standard controls. For each instrument type, the corresponding interaction term captures the monthly yield relative to that of U.S. Treasuries and agency debt.

11. The observed variation in yields of risky and safe assets coincided with key events during the crisis. First, the expansion in risk-taking opportunities occurred at the same time as the run on asset-backed commercial paper in August 2007. Furthermore, the peak in yields of risky assets happened at the same time as the near-bankruptcy of the investment bank Bear Stearns. Finally, the decline in spreads prior to August 2008 and the sudden spike in September 2008 (not shown in the figures) matched market conditions around the Lehman's bankruptcy. Indeed, common indicators of market distress during the crisis, such as the LIBOR-OIS spread, exhibited similar time-series patterns, as did the yields of risky instruments of money funds.

assets and charged similar management fees. In what follows, we present the evolution of each fund's yields, assets, and holdings over the period from August 2006 to August 2008.

In Figure III, we present the gross yields of both funds relative to the value-weighted industry average. Prior to August 2007, the yields of the two funds roughly matched the industry average. However, starting in August 2007, the relative yields diverged sharply: the yield of RPF increased by about 50 basis points while the yield of FID stayed constant. The yield differential triggered significant differences in money flows. Relative to the average asset growth of all institutional prime funds, by August 2008 RPF increased its assets under management by 140%, whereas FID's assets value grew only by 40%.

The observed differences in both yields and fund flows were largely a consequence of the differences in the underlying fund portfolios after August 2007. Figure IV shows that RPF increased its holdings of risky assets from 0% to 60% while it reduced its exposure to U.S. Treasuries and repurchase agreements from 40% to 10%. In contrast, the share of risky assets held by FID remained steady in 2008.

We argue that the difference in risk taking between RPF and FID can be largely attributed to the difference in their sponsors' non–money market fund business. While RPF was managed by a stand-alone fund company with almost no other funds under management, FID's manager—Fidelity—is one of the world's largest assets managers with lots of other business. As of January 2006, Fidelity sponsored 252 non–money market mutual funds with $814 billion in assets under management. These funds accounted for 93.9% of Fidelity's assets under management and an even larger share of revenues because they charge higher expense ratios than do money market funds. Hence, Fidelity could suffer large losses from a failure of its money market fund business if the run on FID triggered outflows from its other funds.

3. Collapse of the RPF and Money Market Fund Runs. One of the important instruments among RPF's holdings was commercial paper issued by Lehman Brothers. According to quarterly Securities and Exchange Commission (SEC) filings, RPF had no holdings of Lehman's commercial paper prior to August 2007, but by November 2007 the fund had purchased $375 million worth of

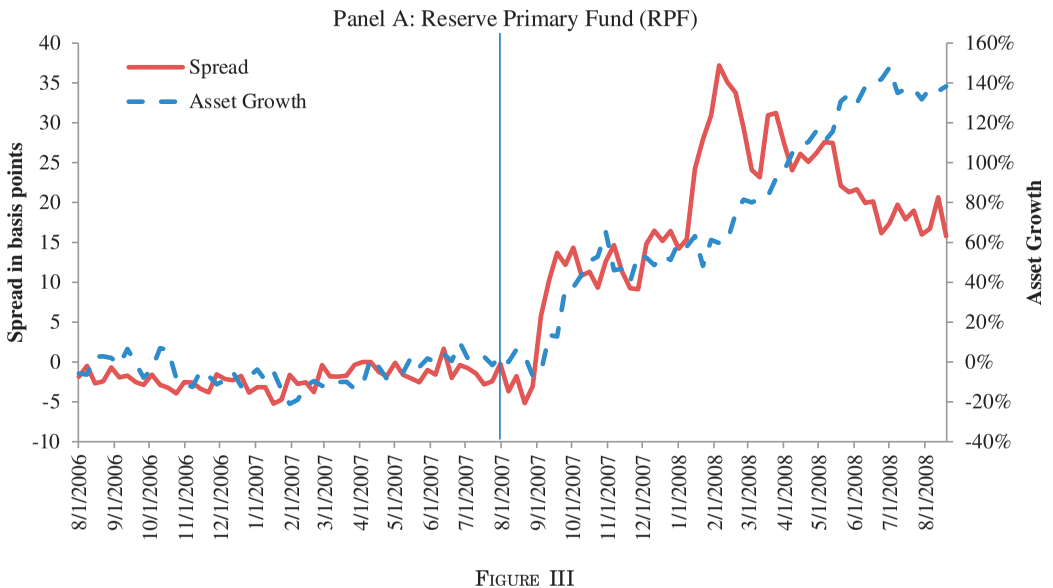

FIGURE III

Relative Performance and Assets: Reserve Primary versus Fidelity Institutional Prime

This figure plots weekly industry-adjusted spread and industry-adjusted asset growth of the Reserve Primary Fund (Panel A) and the Fidelity Institutional Prime Money Market Fund (Panel B) from August 2006 to August 2008. The industry-adjusted spread is computed as the difference between each individual fund's spread and the value-weighted average spread of all institutional prime funds. The industry-adjusted asset growth is computed as the fund's asset growth deflated by total asset growth of all institutional prime funds. We normalize asset growth to zero as of August 1, 2008.

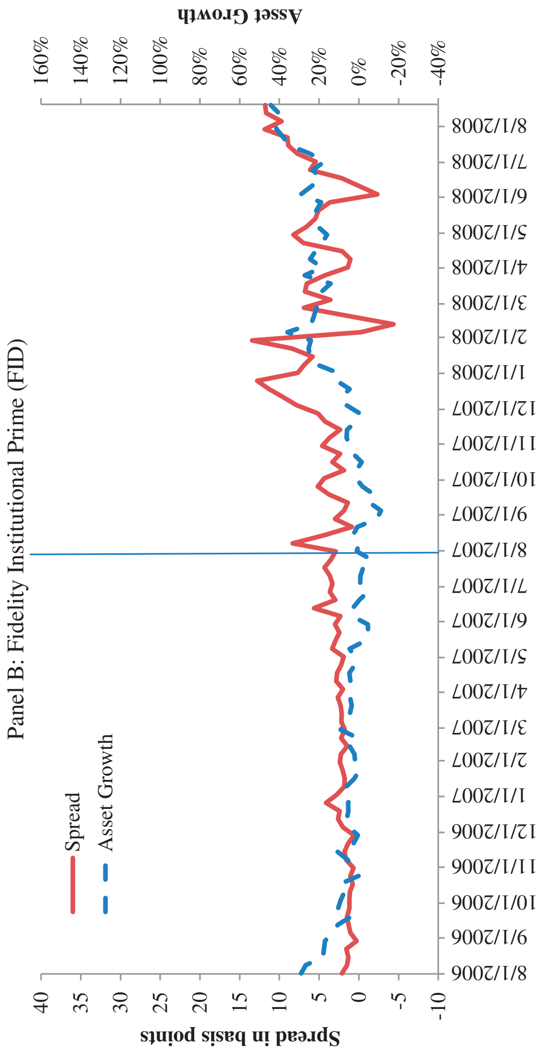

FIGURE III

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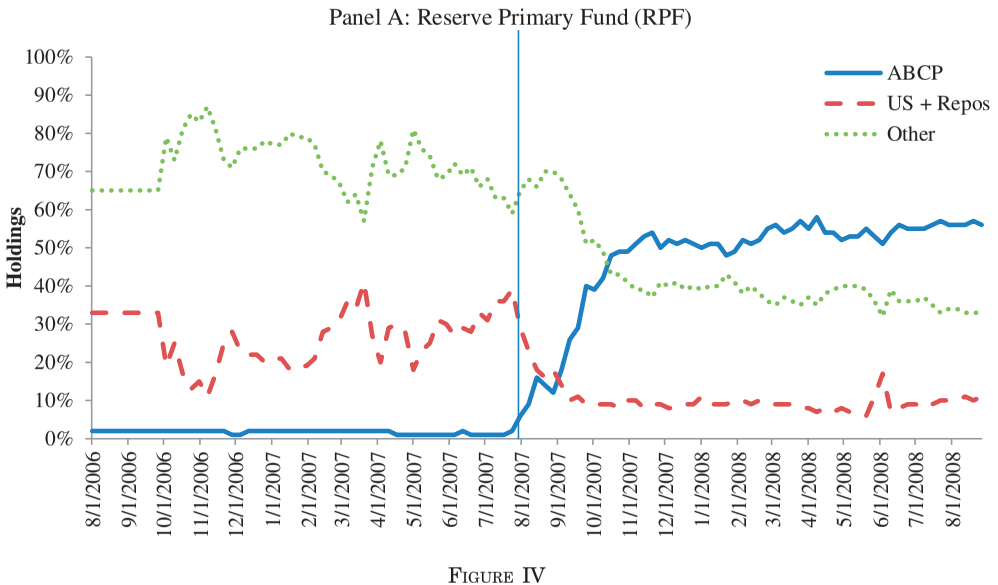

FIGURE IV

Assets Holdings: Reserve Primary versus Fidelity Institutional Prime

This figure plots weekly holdings of the Reserve Primary Fund (Panel A) and the Fidelity Institutional Prime Money Market Fund (Panel B) from August 2006 to August 2008. U.S. + Repos is the share of assets invested in U.S. Treasuries, agency debt, and repurchase agreements. ABCP is the share invested in asset-backed commercial paper. Other is the share invested in other securities.

Panel B: Fidelity Institutional Prime (FID)

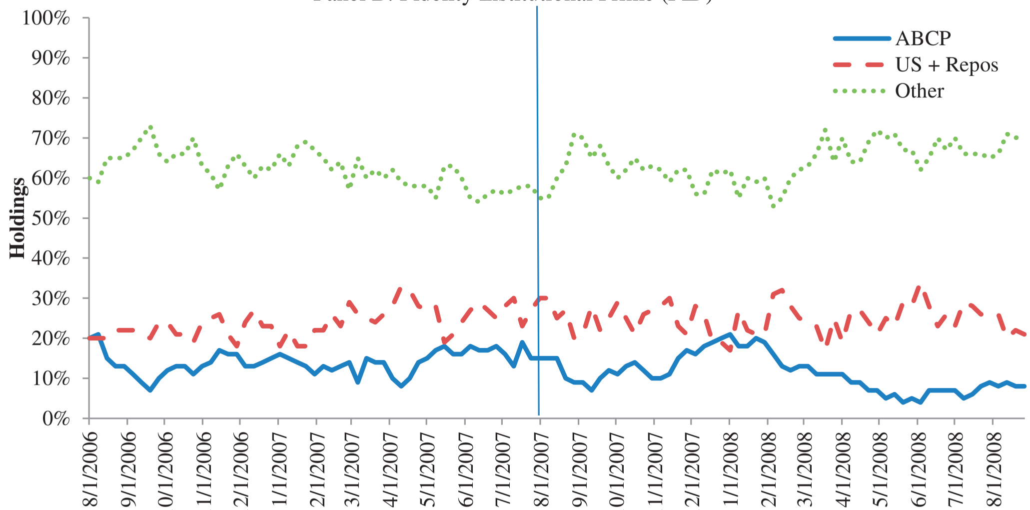

FIGURE IV

Continued

Lehman's paper. By May 2008, the fund further increased its Lehman's holdings to $775 million, which at the time accounted for about 1% of its holdings.

On September 15, 2008, Lehman Brothers declared bankruptcy. Its failure triggered a panic in financial markets and led to a credit market freeze. As a result of the bankruptcy, the net asset value of RPF fell below $1 per share. The revelation of the fund's exposure to Lehman's risk caused an immediate run on the fund. On September 16, 2008, the fund was forced to redeem $10.8 billion in withdrawals and faced $28 billion of additional withdrawal requests. The fund's sponsor did not have sufficient financial resources to guarantee payments and was forced to halt redemptions. The run on RPF quickly spread to other money funds. Within a week, institutional investors reduced their investments in money funds by more than $172 billion.[12]

Eventually, several funds became distressed and the consequences of the redemptions became dire. To stop the run on funds, on September 19, 2008, the U.S. Department of the Treasury announced an explicit deposit insurance covering all money fund investments made prior to Lehman's default. This announcement stopped the run and redemption requests receded shortly after. However, the announcement meant that the U.S. government had effectively insured the risk of $3 trillion in fund assets holdings.

III. Data and Summary Statistics

We collect data from five sources. First, we obtain data on the universe of taxable money market funds from iMoneyNet, which cover the period from January 2005 to September 2011 and include weekly fund-level data on yields, expense ratios (charged and incurred), average maturity, holdings by instrument type, and fund sponsor. Second, we complement the data with information from the CRSP Mutual Fund Database, especially assets under management of the fund sponsor. Third, we use COMPUSTAT and companies' websites for information on fund sponsor characteristics. Fourth, we use S&P RatingsXpress,

12. This was the first industry-wide run in the history of money market funds. Prior to Lehman's default, only one fund ever broke the buck. In 1994, a small money market fund, Community Bankers Money Fund, defaulted because of its exposure to the Orange County bankruptcy.

Lehman Brothers' Bond Database, COMPUSTAT, and companies' websites to collect data on credit ratings. Fifth, we collect data on no-action letters issued by the SEC—an indication that a sponsor provided financial support to its fund. Altogether, we obtain a novel data set that, to the best of our knowledge, has not been used in academic research before. Additional details on the data collection are presented in the Appendix.

We conduct our analysis at the fund level. We therefore aggregate all share classes by fund and type of investor (retail, institutional). We compute fund characteristics (e.g., expense ratio) as the weighted average with assets per share class as weights. Some funds offer both retail and institutional share classes. Institutional shares are generally larger; hence, we classify a fund as institutional if it offers at least one institutional class and as retail if it does not offer institutional share classes.[13]

Column (1) of Table I provides summary statistics for all institutional prime money funds as of January 2006. Our sample includes 148 funds. The average fund size is $4.9 billion and the average fund age is 10.6 years. We compute the spread as the annualized gross yield (i.e., before expenses) minus the yield of the one-month Treasury bill. The average spread is 6.9 basis points and the average expense ratio is 32 basis points. In terms of assets holdings, funds hold 32.0% in commercial paper, 19.8% in floating-rate notes, 13.5% in repurchase agreements, 13.4% in asset-backed commercial paper, 12.2% in bank obligations, 6.0% in U.S. Treasuries and agency-backed debt, and 3.2% in deposits.

As discussed, a significant part of our empirical analysis analyzes the effect of a sponsor's non–money market fund business on risk taking. To examine whether funds differ in their characteristics depending on a sponsor's non–money market fund business, we divide fund sponsors into two groups based on a sponsor's non–money market fund assets. Column (2) of Table I provides summary statistics for funds whose sponsors have *Fund Business* (non–money market fund as a share of total mutual fund assets) above the median value of 81.6% as of January 2006, and column (3) shows summary statistics for funds whose sponsors have values

13. As a robustness check, we also estimate our regressions for funds that only offer institutional shares. The coefficients are stable and remain statistically significant (albeit standard errors widen slightly because of the reduction in observations).

TABLE I

SUMMARY STATISTICS OF INSTITUTIONAL PRIME MONEY MARKET FUNDS

	(1) All	(2) High FB	(3) Low FB
Fund characteristics			
Spread (bp)	6.93	6.60	7.28
	(6.44)	(7.54)	(5.00)
Expense ratio (bp)	31.64	32.40	30.81
	(19.10)	(18.43)	(19.90)
Fund size ($mil)	4,886	2,981	6,951***
	(8,685)	(4,833)	(11,169)
Maturity (days)	34.32	35.12	33.45
	(11.02)	(12.48)	(9.17)
Age (years)	10.61	10.43	10.81
	(4.75)	(5.53)	(3.75)
Family size ($bil)	72.8	97.5	45.9**
	(149.1)	(200.9)	(39.2)
Fund business	0.764	0.897	0.619***
	(0.198)	(0.064)	(0.192)
Conglomerate (in %)	60.1	55.8	64.8
	(49.1)	(50.0)	(48.1)
Portfolio holdings			
U.S. Treasuries & agency	0.060	0.072	0.048
	(0.109)	(0.120)	(0.095)
Repurchase agreements	0.135	0.142	0.126
	(0.150)	(0.169)	(0.128)
Bank deposits	0.032	0.021	0.044**
	(0.057)	(0.039)	(0.069)
Bank obligations	0.122	0.111	0.135
	(0.126)	(0.120)	(0.132)
Floating-rate notes	0.198	0.192	0.204
	(0.162)	(0.168)	(0.156)
Commercial paper	0.320	0.356	0.280**
	(0.224)	(0.252)	(0.182)
Asset-backed CP	0.134	0.106	0.164**
	(0.155)	(0.151)	(0.154)
Funds	148	77	71

Notes. This table shows summary statistics for all U.S. institutional prime money market funds as of January 1, 2006. *Fund Business* (*FB*) is mutual fund assets other than institutional prime fund assets as a share of total sponsor's mutual fund assets. High (Low) FB includes all funds with *Fund Business* above (below) the median value of *Fund Business* (81.6%). Fund characteristics are spread, expenses, fund size, average portfolio maturity, age, family size (mutual funds assets other than money market fund assets), and whether the fund sponsor is part of a conglomerate (in %). Holdings are the share of assets invested in Treasuries and agency debt, repurchase agreements, bank deposits, bank obligations, floating-rate notes, commercial paper, and asset-backed commercial paper. Cross-sectional standard deviations of the given characteristics are in parentheses. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

below the median. We find that both groups are quite similar in terms of observable characteristics, such as spread, expense ratio, maturity, age, and holdings. The main difference is that funds sponsored by firms with high *Fund Business* are on average more likely to be part of financial conglomerates. These results suggest that the extent of a fund sponsor's non–money fund business was not chosen in anticipation of changes in risk-taking opportunities in the money market fund sector.

IV. Empirical Strategy and Results

In this section, we describe our empirical results. First, we analyze how the financial crisis created opportunities to take risk in the money market fund industry. We then estimate the flow–performance relationship to study the risk-taking incentives. Next, we analyze the importance of a sponsor's non–money fund business for the the risk-taking behavior of money funds. Finally, we examine the ex post consequences resulting from the collapse of RPF and the run on the money market fund industry.

IV.A. Expansion of Risky Investment Opportunities

We document the change in opportunities to take risk using weekly data on fund holdings and fund yields in the following regression model:

$$(1) \quad Spread_{i,t+1} = \alpha_i + \mu_t + \sum_j \beta_j Holdings_{i,j,t} + \gamma X_{i,t} + \varepsilon_{i,t+1},$$

where $Spread_{i,t+1}$ is the gross yield of fund i in week $t+1$ minus the risk-free rate, $Holdings_{i,j,t}$ denotes fund i's fractional holdings of instrument type j in week t, α_i denotes fund fixed effects, and μ_t denotes week fixed effects. The instrument types include repurchase agreements, bank deposits, bank obligations, floating-rate notes, commercial paper, and asset-backed commercial paper. The omitted category is Treasuries and government agency debt. $X_{i,t}$ is a vector of fund-specific controls that includes the natural logarithm of fund size (*Log(Fund Size)*), fund expenses (*Expense Ratio*), fund age (*Age*), and the natural logarithm of the fund family size (*Log(Family Size)*). In all regressions, we allow for flexible correlation of error terms within funds by clustering standard errors at the fund level. Our coefficients of interest are

β_j, which measure the return on money market instrument j in week $t+1$ relative to that of Treasuries and agency debt.

We estimate the regression model separately for the *post* period from August 2007 to August 2008 and the *pre* period from January 2006 to July 2007. The post period starts with the subprime crisis in August 2007 and ends right before the market-wide run in September 2008. We do not include observations during the run and the period thereafter because subsequent government interventions significantly altered risk-taking incentives. Our estimation strategy is akin to estimating a standard difference-in-differences regression model.

Columns (1) and (2) of Table II report the post-period and pre-period results. We find that risky instruments have significantly larger yields in the post period relative to those in the pre period, whereas safe instruments have similar yields during both periods. For example, in the post period, the yield of a fund fully invested in (risky) bank obligations would have been 88 basis points higher than the yield of a fund fully invested in (safe) Treasury and agency debt. The comparable differential in the pre period would have only been 16 basis points. We find similar effects for other risky instruments, such as floating-rate notes, commercial paper, and asset-backed commercial paper. In contrast, the yield of a fund fully invested in (safe) repurchase agreements would have been only 13–18 basis points higher than the yield of a fund fully invested in Treasury and agency instruments, both in the pre and post periods.[14]

One possible concern with the results is that funds with large holdings of risky assets might also be riskier, along other unobserved dimensions. For example, these funds may choose the most risky assets within an asset class such that we would overestimate the impact of holding riskier assets. To address this concern, we introduce fund fixed effects, which account for any unobserved time-invariant fund characteristics within the pre or post periods.

We find quantitatively and qualitatively similar results, as reported in column (3). The yield of a fund fully invested in bank obligations would have been 91 basis points higher than the yield of a fund fully invested in Treasury and agency instruments. In

14. The results on repurchase agreements are consistent with the findings in Krishnamurthy, Nagel, and Orlov (2012).

TABLE II
RETURNS BY INSTRUMENT TYPE

	$Spread_{i,t+1}$			
	(1) Post	(2) Pre	(3) Post	(4) Pre
Holdings				
Repurchase Agreements$_{i,t}$	13.483	17.937***	39.748**	11.470**
	(8.638)	(3.525)	(17.739)	(5.609)
Bank Deposits$_{i,t}$	39.445**	17.550***	50.392**	18.993***
	(17.350)	(4.044)	(20.459)	(6.906)
Bank Obligations$_{i,t}$	88.339***	15.909***	90.868***	6.845
	(7.929)	(3.564)	(19.307)	(4.885)
Floating-Rate Notes$_{i,t}$	81.953***	22.709***	89.466***	9.761
	(7.804)	(3.556)	(22.629)	(6.514)
Commercial Paper$_{t}$	57.430***	16.330***	71.256***	16.252***
	(8.169)	(3.370)	(24.596)	(5.694)
Asset-backed CP$_{i,t}$	76.619***	20.997***	84.627***	15.626**
	(8.036)	(3.230)	(19.852)	(6.190)
Fund characteristics				
Log(Fund Size)$_{i,t}$	0.513	0.259***	3.864**	0.562
	(0.349)	(0.096)	(1.946)	(0.486)
Expense Ratio$_{i,t}$	10.925***	1.812*	87.327***	53.502***
	(2.995)	(0.963)	(25.457)	(11.597)
Age$_{i,t}$	−1.18	−0.394	−0.576	−0.621
	(1.427)	(0.505)	(0.548)	(0.457)
Log*(Family Size)*$_{i,t}$	−0.02	0.013	−4.352	0.369***
	(0.225)	(0.067)	(5.193)	(0.139)
Constant	67.527***	6.031	68.901	−12.645
	(10.849)	(4.310)	(68.832)	(8.067)
Week fixed effects	Y	Y	Y	Y
Fund fixed effects	N	N	Y	Y
Observations	7,807	11,984	7,807	11,984
R-squared	0.94	0.79	0.95	0.80

Notes. The sample is all U.S. institutional prime money market funds. The dependent variable *Spread* is computed as the annualized yield minus the Treasury bill rate. Holdings variables are the share of assets invested in repurchase agreements, bank deposits, bank obligations, floating-rate notes, commercial paper (CP), and asset-backed CP (omitted category is U.S. Treasury and agency). Fund characteristics are natural logarithm of fund size, expense ratio, fund age, and natural logarithm of fund family size. All regressions are at the weekly level and include week fixed effects. Columns (3) and (4) include fund fixed effects. Columns (1) and (3) cover the period 8/1/2007–8/31/2008 (*post* period). Columns (2) and (4) cover the period 1/1/2006–7/31/2007 (*pre* period). Standard errors are clustered at the fund level. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

contrast, the comparable differential would have only been 7 basis points in the pre period. Hence, our findings are not driven by unobserved time invariant fund characteristics.

Overall, these results suggest that money funds experienced a large exogenous expansion in their risk-taking opportunities.

The expansion was economically significant in that the yields of risky instruments, relative to safe ones, were five times larger after August 2007, compared to before. Moreover, the expansion was likely exogenous to money market funds as it was caused by financial distress among issuers of money market instruments and not by the funds themselves. Hence, starting in August 2007, funds were given a choice of whether to invest in risky or safe assets.[15]

IV.B. The Flow–Performance Relationship

Funds can increase their revenues by attracting new flows. This can happen by increasing risk and thus fund yields, which in turn translates into greater fund inflows. Given that money funds are paid fees as a fixed percentage of assets under management, fund inflows lead to a higher income to the fund sponsor.[16] We assess the benefits of investing in riskier instruments by estimating the sensitivity of fund flows to past yields using the following regression model:

$$(2) \qquad Fund\ Flow_{i,t+1} = \alpha_t + \beta Spread_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t+1},$$

where $Fund\ Flow_{i,t+1}$ is the percentage increase in a fund's i size from week t to week $t+1$ accounting for earned interest, winsorized at the 0.5% level; $Spread_{i,t}$ and $X_{i,t}$ are defined as in equation (1). In addition, we include the volatility of fund flows, $Flow\ Volatility_{i,t}$, measured as the standard deviation of weekly fund flows over the previous quarter. We allow for correlation of error terms within funds by clustering observations at the fund level. Our coefficient of interest is β, which measures the sensitivity of fund flows to fund past yields.

Table III reports the results. Columns (1) and (2) show the results separately for the post and pre periods. We find that a 1

15. Note that the overall issuance of riskier assets declined over this period. For example, total asset-backed commercial paper outstanding dropped by almost 50%, from $1.3 trillion in August 2007 to $700 billion in August 2008 (Acharya, Schnabl, and Suarez 2013). Our focus is on the variation in holdings *across* funds. While the majority of funds decreased their holdings of risky assets, some funds, such as the RPF, increased them.

16. This model of competition has been documented in studies of equity mutual funds. These studies find that past performance is one of the strongest predictors of flows to equity funds (e.g., Chevalier and Ellison 1997).

TABLE III
FLOW–PERFORMANCE RELATIONSHIP

	Fund Flow$_{i,t+1}$					
	(1) Post	(2) Pre	(3) Post	(4) Pre	(5) Post	(6) Pre
Spread$_{i,t}$	0.013***	0.003	0.024***	0.000	0.026***	0.009
	(0.005)	(0.005)	(0.008)	(0.004)	(0.009)	(0.010)
Fund Business$_{i,2006}$* *Spread*$_{i,t}$					−0.003	−0.009
					(0.006)	(0.009)
Conglomerate$_{i,2006}$* *Spread*$_{i,t}$					0.000	0.003
					(0.003)	(0.005)
Log(*Fund Size*)$_{i,t}$	−0.120**	−0.077***	−7.658***	−4.146***	−7.655***	−4.148***
	(0.051)	(0.029)	(1.341)	(0.720)	(1.345)	(0.720)
Expense Ratio$_{i,t}$	−0.549*	−1.276***	−2.668	−1.365	−2.680	−1.475
	(0.320)	(0.354)	(5.965)	(3.703)	(5.915)	(3.704)
Age$_{i,t}$	0.159	−0.078	0.015	0.715**	0.014	0.713**
	(0.180)	(0.149)	(0.322)	(0.323)	(0.322)	(0.323)
Flow Volatility$_{i,t}$	4.245*	2.476**	1.381	−0.213	1.331	−0.230
	(2.322)	(1.243)	(3.175)	(2.152)	(3.166)	(2.146)
Log(*Family Size*)$_{i,t}$	0.026	0.032**	0.528	0.042	0.521	0.045
	(0.023)	(0.014)	(1.238)	(0.126)	(1.245)	(0.127)
Week fixed effects	Y	Y	Y	Y	Y	Y
Fund fixed effects	N	N	Y	Y	Y	Y
Observations	7,807	11,984	7,807	11,984	7,807	11,984
R-squared	0.022	0.017	0.085	0.052	0.085	0.052

Notes. The sample is all U.S. institutional prime money market funds. Columns (1), (3), and (5) cover the period from 8/1/2007 to 8/31/2008 (*post* period). Columns (2), (4), and (6) cover the period from 1/1/2006 to 7/31/2007 (*pre* period). The dependent variable is *Fund Flow*, computed as the percentage change in total net assets from time t to time $t+1$, adjusted for market appreciation and winsorized at the 0.5% level. Independent variables are the weekly annualized spread from t to $t-1$, natural logarithm of fund size, fund expense ratio, fund age, volatility of fund flows based on past 12-week fund flows, and natural logarithm of fund family size. In columns (5) and (6), additional independent variables are the interactions of *Spread* with *Fund Business* and *Conglomerate*. *Fund Business* (FB) is mutual fund assets other than institutional prime fund assets as a share of total sponsor's mutual fund assets. *Conglomerate* is an indicator variable equal to 1 if the fund sponsor is affiliated with a financial conglomerate and 0 otherwise. All regressions are at the weekly level and include week fixed effects. Columns (3) to (6) also include fund fixed effects. Standard errors are clustered at the fund level. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

standard deviation increase in fund spread, equal to 65.9 basis points, increases subsequent fund flows by 0.83% per week. This effect is economically large because it implies that a fund could increase its annual revenue by 43% by investing in riskier instruments. Conversely, we find no significant effect of fund yields on flows in the pre period. To rule out the possibility that our results are driven by unobserved time-invariant fund-specific attributes correlated with fund spreads, we estimate the model with fund fixed effects. The flow–performance sensitivity, in columns (3) and (4), is even larger. As before, we observe no impact on flows in the pre period.

The flow–performance relationship may also vary by sponsor characteristics. We are particulary interested in the effect of a sponsor's non–money market fund business. This characteristic may affect the flow–performance relationship if it affects how investors risk adjust fund returns or whether investors expect a sponsor to support a fund in case of a run.

We test this hypothesis by estimating the flow-performance relationship in equation (2) with additional controls for the sponsor's non–money market fund as a share of total mutual fund assets (*Fund Business*) and whether a fund is affiliated with a financial conglomerate (*Conglomerate*) and interactions of these variables with fund spread. We present the results in columns (5)–(6). For both subperiods, we find that the coefficients of the interaction terms are statistically and economically insignificant for both measures of business spillovers. Hence, conditional on flow performance, there is no effect of sponsor characteristics on fund flows. We also estimate all the regressions without adding interaction terms. We find no statistically or economically significant effect of *Fund Business* or *Conglomerate* on fund flows. These findings suggest that investors do not risk adjust yields based on sponsor characteristics.[17]

IV.C. Business Spillovers and Risk Taking

This section analyzes the risk-taking incentives in the cross-section of money market funds. We examine whether fund sponsors' concerns over their non–money fund business reduce their funds' risk.[18]

An important advantage of our setting is that the size of a sponsor's non–market fund business was not driven by risk-taking opportunities in the money market fund industry. Before August 2007, money market funds typically constituted

17. This evidence is consistent with theoretical models that show that the expected benefit of acquiring such information is low relative to the cost of learning this information (Dang, Gorton and Holmstrom 2009). It is also consistent with models in which investors neglect risks that are not salient to them given the absence of negative events from past data (Gennaioli and Shleifer 2010; Gennaioli, Shleifer, and Vishny 2012).

18. We focus on non–money market fund business because this sponsor characteristic is featured prominently in industry studies on money funds. However, there might be other variables that affect the fund's payoff function. Hence, we interpret our analysis as an example of how variation in the payoff function affects risk taking.

a small part of larger fund families and the choice regarding the fund family's organization profile was likely independent of money funds themselves. Money funds were considered a low-fee, low-cost business with little scope for exploiting private information or superior managerial ability. They simply invested in safe assets and were offered in conjunction with other, more profitable funds. Hence, it is unlikely that sponsors actively chose the size of their non–money fund businesses in anticipation of changes in risk-taking opportunities in the money market fund sector.

We analyze funds' risk taking by estimating the following regression model:

$$Risk_{i,t+1} = \alpha + \mu_t + \beta_1 Business\ Spillovers_{i,2006} + \beta_2 Post_t * Business\ Spillovers_{i,2006} + \gamma X_{i,2006} + \varepsilon_{i,t+1}, \quad (3)$$

where $Business\ Spillovers_{i,2006}$ is a generic name for either *Fund Business* or *Conglomerate*. *Post* is an indicator variable equal to 1 for the post period and 0 for the pre period. $X_{i,2006}$ is a vector of control variables similar to those in equation (2). Both business spillovers variables and other controls are measured as of January 2006, which mitigates the concern that fund risk choices are driven by changes in fund characteristics due to investment opportunity change.[19] Our regression model also includes week fixed effects (μ_t), which account for any time differences in aggregate fund flows or macroeconomic conditions driving the risk-taking decisions of fund sponsors. Since *Business Spillovers* is a fund sponsor attribute, risk taking within the same sponsor may be correlated across its funds. To address this concern, we cluster standard errors at the sponsor level.

We use three measures of risk (*Risk*), measured at a weekly frequency. The first measure, *Spread*, is the gross yield minus the Treasury bill rate.[20] In the context of money market funds, spread

19. This is in contrast to specifications (1) and (2), which use time-varying controls. As a result, the sample size is slightly smaller than in Tables II and III. The results in Tables II and III are robust to using the smaller sample.

20. We use the spread instead of the yield for consistency with the previous section. We note that this has no effect on our coefficient of interest because all regressions include week fixed effects.

is a good measure of risk because it carries little scope for managerial skill, which makes fund spread largely reflect fund portfolio risk. A potential problem with using this measure is that it may vary over time even though managers may not make any active changes in the risk profile of their portfolios, only because the yields of individual assets in the portfolio change.

To account for such mechanical changes in portfolio riskiness, we propose two other measures. *Holdings Risk* is the fraction of bank obligations net of repurchase agreements and Treasuries in a fund portfolio. As reported in Table II, repos and U.S. Treasuries are the safest instruments and bank obligations are the riskiest instrument. *Maturity Risk* is the weighted average maturity of assets in a fund portfolio. In general, funds with longer maturities of their assets would be considered riskier.

We begin with a nonparametric analysis of the observed effects. For each month between January 2006 and August 2008, we estimate the coefficient β from the cross-sectional regression model (3) by interacting our main variable *Fund Business* with month-fixed effects. Panel A of Figure V presents the estimates for *Holdings Risk*. We find no visible differences in the impact of *Fund Business* on portfolios' risk prior to August 2007, but starting from August 2007 the effect is negative and large. Panel B reports the results for *Maturity Risk*, and Panel C for *Spread*. Again, we observe similar patterns in loadings on *Fund Business* as for *Holdings Risk*.

Next, we present the results from the difference-in-differences model corresponding to the nonparametric analysis. In columns (1), (4), and (7) of Table IV, we show the results for specification (3). For the post period, we find that a 1 standard deviation increase in *Fund Business* reduces *Holdings Risk* by 3.7 percentage points, *Maturity Risk* by 2.3 days, and *Spread* by 3.0 basis points. The results are statistically and economically significant: a 1 standard deviation increase in *Fund Business* corresponds to a 14.9% reduction in *Holdings Risk* relative to the cross-sectional standard deviation of *Holdings Risk*. The respective quantities for *Maturity Risk* and *Spread* are 19.4% and 19.2%. We obtain similar results for *Conglomerate*. In contrast, we do not find any statistically significant impact of business spillovers on risk in the pre period.

Our results might be also driven by unobserved time-invariant differences among funds or fund sponsors that are correlated

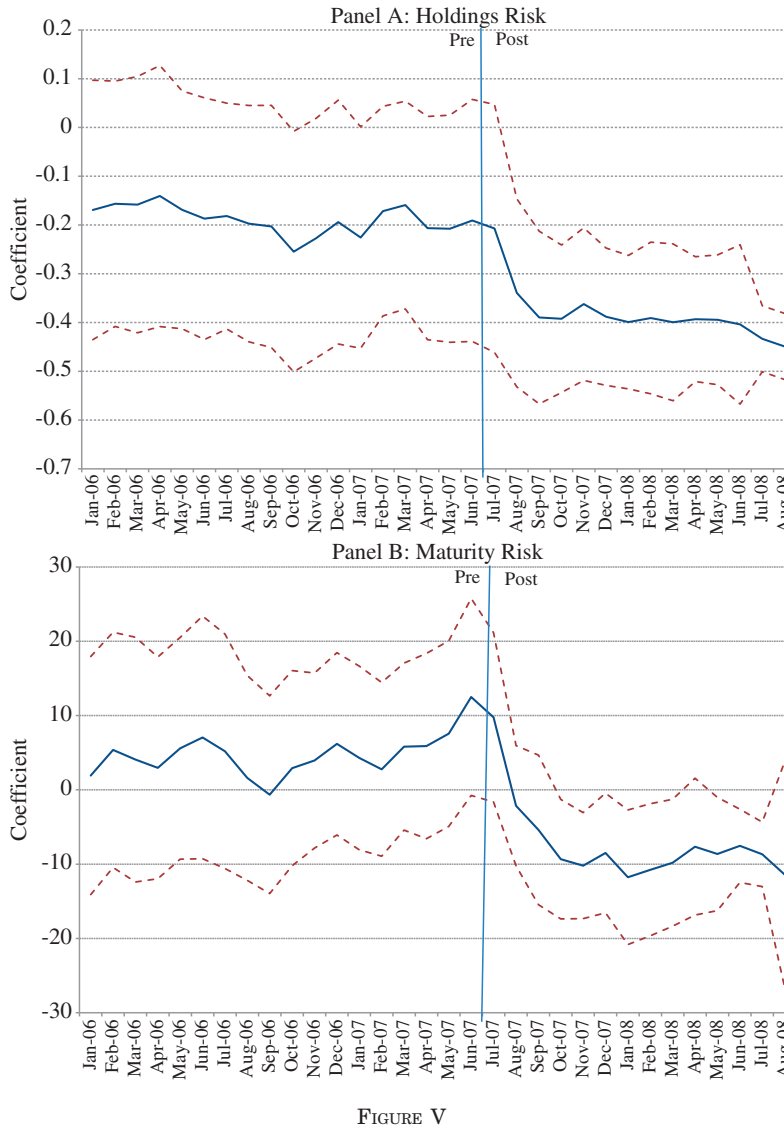

FIGURE V

Sponsor's Fund Business Spillovers and Risk Taking

Each of the three panels plots interaction coefficients from an OLS regression. The dependent variable is one of the three risk measures: holdings risk (A), maturity (B), and spread (C). The main independent variable is the interaction of the fund sponsor's share of other mutual fund assets relative to all total fund assets and monthly indicator variables. We include all control variables defined in Table IV.

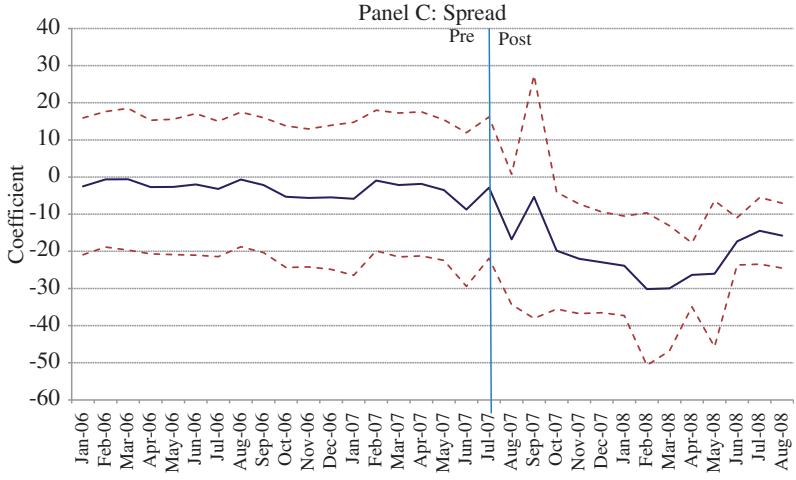

FIGURE V
Continued

with business spillovers. We address this issue by including sponsor fixed effects in columns (2), (5), and (8), and fund fixed effects in columns (3), (6), and (9). In all these specifications, our results are almost unchanged.

IV.D. Robustness

1. Do Unobserved Sponsor Characteristics Explain Risk Choices? Our results suggest that a sponsor's non–money market business has a significant impact on its funds' risk taking. However, our effects may be driven by unobserved differences in investment styles or manager ability across fund families, which in turn may be correlated with business spillovers. Specifically, a fund sponsor's business spillovers may be correlated with the quality of a sponsor's risk management or a sponsor's risk aversion. To the extent that the variation in this variable among funds is permanent, our estimator already accounts for such differences. However, our empirical approach might fail if the variation differentially affects risk taking in the pre and post periods. For example, fund sponsors may differ in their reactions to any changes in the quantity of risk, or in their propensities to take risk when risk-taking opportunities arise, because of these unobserved variables.

TABLE IV

SPONSOR'S BUSINESS SPILLOVERS AND RISK TAKING

	$Holdings\ Risk_{i,t+1}$			$Maturity\ Risk_{i,t+1}$			$Spread_{i,t+1}$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$Fund\ Business_{i,2006}{*}Post_t$	−18.346*	−21.289**	−19.636**	−11.449**	−12.588**	−11.902**	−15.040**	−15.473**	−14.218*
	(9.298)	(8.705)	(8.942)	(5.335)	(5.782)	(5.910)	(7.470)	(7.443)	(7.419)
$Conglomerate_{i,2006}{*}Post_t$	−6.781**	−5.580*	−6.326**	−1.665	−1.520	−1.703	−7.263***	−7.215***	−7.321***
	(3.017)	(2.885)	(2.962)	(1.722)	(1.750)	(1.762)	(2.429)	(2.424)	(2.428)
$Fund\ Business_{i,2006}$	−18.126			5.398			−2.764		
	(13.540)			(5.310)			(1.929)		
$Conglomerate_{i,2006}$	−6.539			−1.698			−1.212*		
	(4.233)			(1.938)			(0.655)		
$Controls_{i,2006}$	Y	Y	Y	Y	Y	Y	Y	Y	Y
Week fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Sponsor fixed effects	N	Y	N	N	Y	N	N	Y	N
Fund fixed effects	N	N	Y	N	N	Y	N	N	Y
Observations	19,096	19,096	19,096	19,096	19,096	19,096	19,096	19,096	19,096
R-squared	0.209	0.624	0.780	0.142	0.482	0.587	0.952	0.957	0.959

Notes. The sample is all U.S. institutional prime money market funds for the period from 1/1/2006 to 8/31/2008. The dependent variables are: the fraction of assets held in risky assets net of the riskless assets (*Holdings Risk*) in columns (1)–(3), average portfolio maturity (*Maturity Risk*) in columns (4)–(6), and the weekly annualized spread (*Spread*) in columns (7)–(9). *Fund Business* is the sponsor's share of mutual fund assets other than institutional prime money market funds in total sponsor's assets. *Conglomerate* is an indicator variable equal to 1 if the fund sponsor is affiliated with a financial conglomerate, and 0 otherwise. *Post* is an indicator variable equal to 1 for the period from 8/1/2007 to 8/31/2008, and 0 otherwise. The other independent variables (*Controls*) are fund assets, expense ratio, fund age, and fund family size as of 1/1/2006, and interactions of these variables with *Post* (coefficients not shown). All regressions are at the weekly level and include week fixed effects. Columns (2), (5), and (8) include sponsor fixed effects, and columns (3), (6), and (9) include fund fixed effects. Standard errors are clustered at the sponsor level. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

Although we believe such differences are not obvious a priori, we conduct a more direct test, in which we identify the coefficients of interest based on the differences between institutional and retail funds. This test is based on the observation that most fund sponsors offer funds to both retail and institutional clients. Hence, we expect that funds with the same sponsor should have similar levels of risk if their behavior is governed by sponsor-specific characteristics, such as the quality of the sponsor's risk management or a sponsor's risk aversion. However, retail investors react much less to yield differentials across funds than do institutional investors; therefore, we expect a much smaller effect for retail funds if risk taking is driven by business spillovers. Given that retail funds have a different asset base, we adjust our previously used measure of business spillovers accordingly and introduce a corresponding measure, *Retail Fund Business*, computed as the sponsor's share of mutual fund assets other than retail prime money market funds in total sponsor's assets.

We begin our analysis with estimating the flow–performance relationship for retail funds, separately for the pre and post periods, with and without fund fixed effects. We restrict our sample to sponsors that offer both retail and institutional prime funds. Our results are robust to including sponsors that only offer retail prime funds. Panel A in Table V presents the results in columns (1) to (4). Although we observe a positive coefficient in the pre period, we find that the flow–performance relationship is quite weak in the post period. Thus, retail investors react less to yield differentials across funds. Also, the effect is not driven by business spillovers of fund sponsors as shown in columns (5) and (6). Hence, the risk-taking incentives of retail funds are smaller than those of institutional funds.

Building on this result, we further analzye risk taking of retail funds using the setting of Table IV. We present the results in Panel B of Table V and find striking differences relative those for institutional funds in Table IV. Although we observe statistically and economically significant coefficients for institutional funds, the coefficients are insignificant for retail funds. If anything, the results go in the opposite direction.

Overall, our results on risk taking across funds are unlikely to be driven by differences among sponsors along some unobserved characteristics, such as the quality of risk management or risk aversion.

TABLE V
EVIDENCE FROM RETAIL FUNDS

	(1)	(2)	(3)	(4)	(5)	(6)
	Fund Flow$_{i,t+1}$					
	Post	Pre	Post	Pre	Post	Pre
Panel A: Flow–performance relationship						
Spread$_{i,t}$	0.002	0.008**	0.003	0.008**	0.008	0.021***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)
Retail Fund					−0.007	−0.015**
Business$_{i,2006}$*					(0.005)	(0.007)
Spread$_{i,t}$						
Conglomerate$_{i,2006}$*					−0.001	0.002
Spread$_{i,t}$					(0.002)	(0.004)
Controls$_{i,t}$	Y	Y	Y	Y	Y	Y
Week fixed effects	Y	Y	Y	Y	Y	Y
Fund fixed effects	N	N	Y	Y	Y	Y
Observations	3,724	6,004	3,724	6,004	3,724	6,004
R-squared	0.058	0.022	0.109	0.075	0.110	0.076

	Holdings Risk$_{i,t+1}$		*Maturity Risk*$_{i,t+1}$		*Spread*$_{i,t+1}$	
Panel B: Business spillovers and risk taking						
Retail Fund	16.098	15.229	2.491	2.263	−8.427	−8.076
Business$_{i,2006}$*	(14.417)	(14.332)	(6.324)	(6.276)	(14.702)	(14.803)
Post$_t$						
Conglomerate$_{i,2006}$*	7.072	6.726	−4.045	−3.989	−4.017	−3.973
Post$_t$	(6.125)	(6.178)	(2.529)	(2.643)	(5.455)	(5.466)
Controls$_{i,2006}$	Y	Y	Y	Y	Y	Y
Week fixed effects	Y	Y	Y	Y	Y	Y
Sponsor fixed effects	Y	N	Y	N	Y	N
Fund fixed effects	N	Y	N	Y	N	Y
Observations	9,492	9,492	9,492	9,492	9,492	9,492
R-squared	0.772	0.74	0.606	0.631	0.909	0.911

Notes. The sample is all U.S. retail prime money market funds for the period from 1/1/2006 to 8/31/2008. In Panel A, we examine the flow–performance relationship for retail prime money market funds (similar to Table III). In Panel B, we examine the relationship between business spillovers and risk for retail prime money market funds (similar to Table IV).

2. Do Implicit Government Guarantees Explain Risk Choices? Money market funds experienced a run after the default of Lehman Brothers in September 2008. Because the likely consequences of this run were severe, the government decided to bail out the entire money fund industry and extended explicit guarantees to all money funds and their investors. Effectively, for the duration of the guarantee (which lasted over a year), this

intervention largely eliminated the risk of fund failure. Given that the government did not rescue the RPF, this guarantee was likely unexpected. However, we can test for the importance of implicit guarantees because if the expectation of future government bailouts drives funds' risk taking before Lehman's default, then we should find similar differences in risk taking after the introduction of explicit guarantees.

To evaluate this hypothesis, we extend our analysis in Table IV to three periods: January 2006–July 2007, August 2007–August 2008, and April 2009–December 2010. We do not include the data for the two quarters immediately following Lehman's default because funds need some time to adjust the risk of their funds.[21] Also, many financial markets were illiquid right after the default, so any adjustment of risk by the funds was difficult to accomplish. Our empirical strategy involves estimating the risk model, in which *Business Spillovers* is interacted with two indicator variables: *Post*, equal to 1 for the period August 2007–August 2008, and 0 otherwise; and *Post-Lehman* equal to 1 for the period April 2009–December 2010, and 0 otherwise. We expect a zero effect of *Business Spillovers* in the pre period, a negative effect in the post period, and again a zero effect in the post-Lehman period.

We report the results in Table VI. Per our hypothesis, the coefficient of the interaction term between *Business Spillovers* and *Post-Lehman* is close to 0 for two risk measures. Hence, the importance of business spillovers has become negligible once the government rolled out an explicit support for all funds. This finding indicates that our results cannot be explained by implicit government guarantees prior to Lehman's default.[22]

3. Does Variation in Sponsor Financial Strength Explain Our Results? Our empirical analysis so far reveals the importance of business spillovers as a driver of risk-taking decisions of money market funds. This result should be particularly strong if the

21. Duygan-Bump et al. (2013) and Kacperczyk and Schnabl (2010) discuss the workings and exact timing of different government interventions.

22. Our findings stand in contrast with theoretical and empirical work on the effect of bailouts on risk taking, which has examined the role of deposit insurance and bank charter value (Keeley 1990; Freixas, Loranth, and Morrison 2007), managerial control (Saunders, Strock, and Travlos 1990), monitoring by depositors (Esty 1997), implicit guarantees provided by stakeholders (Panageas 2010), and provision of systemic guarantees by the government (Kelly, Lustig, and Van Nieuwerburgh 2011).

TABLE VI

RISK TAKING AFTER GOVERNMENT GUARANTEE

	Holdings Risk$_{i,t+1}$		*Maturity Risk*$_{i,t+1}$		*Spread*$_{i,t+1}$	
	(1)	(2)	(3)	(4)	(5)	(6)
Fund Business$_{i,2006}$**Post*$_t$	−22.319**	−19.636**	−12.465**	−11.902**	−15.326**	−14.218*
	(8.529)	(8.935)	(5.625)	(5.906)	(7.429)	(7.413)
Fund Business$_{i,2006}$**Post-Lehman*$_t$	−22.999	−9.592	−9.419	−5.162	−2.965	−1.057
	(18.611)	(19.229)	(6.488)	(6.283)	(7.175)	(7.502)
Conglomerate$_{i,2006}$**Post*$_t$	−5.278*	−6.326**	−1.399	−1.703	−7.123***	−7.321***
	(2.899)	(2.959)	(1.728)	(1.760)	(2.413)	(2.426)
Conglomerate$_{i,2006}$**Post-Lehman*$_t$	−0.860	−3.569	−4.081*	−5.010**	−3.441	−4.044*
	(5.894)	(5.649)	(2.159)	(2.131)	(2.168)	(2.237)
Controls$_{i,2006}$	Y	Y	Y	Y	Y	Y
Week fixed effects	Y	Y	Y	Y	Y	Y
Sponsor fixed effects	Y	N	Y	N	Y	N
Fund fixed effects	N	Y	N	Y	N	Y
Observations	28,409	28,409	28,409	28,409	28,409	28,409
R-squared	0.579	0.694	0.457	0.537	0.953	0.954

Notes. The sample is all U.S. institutional prime money market funds for the period from 1/1/2006 to 12/31/2010. We estimate the same regression models as in Table IV for the period from July 2006 to December 2010. We drop the month of the Lehman's bankruptcy and the two quarters immediately after the Lehman's bankruptcy to focus on risk taking after a short adjustment period. We interact our main variables of interest with an indicator variable for the post period (July 2007–August 2008) and the post-Lehman period (April 2009–December 2010). All regressions include the control variables specified in Table IV and interactions of the control variables with the post-Lehman indicator variable (coefficients not shown). The regressions are at the weekly level and include week fixed effects. Columns (1), (3), and (5) include sponsor fixed effects, and columns (2), (4), and (6) include fund fixed effects. Standard errors are clustered at the sponsor level. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

TABLE VII
CONTROLLING FOR FINANCIAL STRENGTH

	Stand-alone asset managers					
	Holdings Risk$_{i,t+1}$		*Maturity Risk*$_{i,t+1}$		*Spread*$_{i,t+1}$	
	(1)	(2)	(3)	(4)	(5)	(6)
Fund *Business*$_{i,2006}$*	−39.968***	−38.720***	−11.210**	−10.029**	−22.829***	−22.413***
Post$_t$	(12.720)	(12.656)	(4.462)	(4.403)	(7.399)	(7.470)
No Rating$_{i,2006}$*	−8.901	−8.273	−2.121	−1.689	−7.858**	−7.777**
Post$_t$	(5.394)	(5.406)	(1.437)	(1.355)	(3.082)	(3.065)
Controls$_{i,2006}$	Y	Y	Y	Y	Y	Y
Week fixed effects	Y	Y	Y	Y	Y	Y
Sponsor fixed effects	Y	N	Y	N	Y	N
Fund fixed effects	N	Y	N	Y	N	Y
Observations	7,645	7,645	7,645	7,645	7,645	7,645
R-squared	0.607	0.715	0.589	0.671	0.968	0.968

Notes. The sample is all U.S. institutional prime money market funds affiliated with an independent asset manager for the period 1/1/2006–8/31/2008. The dependent variables, *Fund Business* and *Post,* are defined in Table IV. *No Rating* is an indicator variable equal to 1 if the sponsor has no credit rating, and 0 otherwise. All regressions include the same control variables as in Table IV (coefficients not shown). They are at the weekly level and include week fixed effects and fund fixed effects. Standard errors are clustered at the sponsor level. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

bailouts by fund sponsor are ex post optimal. However, the likelihood of a bailout also depends on a sponsor's ability to do so, which depends on the fund sponsor's financial strength. If the degree of business spillovers is correlated with financial strength, then our main results may reflect the ability (rather than the incentive) to bail out a fund. Even though these concepts are closely related, we would like to distinguish empirically between the effect of spillovers and the effect of financial strength.

To allow for such separation we refine our empirical design. We analyze risk choices only for funds sponsored by stand-alone asset managers. By analyzing stand-alone asset managers, we can fix the financial strength margin while varying the business spillovers margin. The key assumption underlying this test is that stand-alone managers are highly constrained in their ability to bail out funds. This assumption is plausible because stand-alone managers, unlike financial conglomerates, do not have access to outside sources of funding in times of crises. Table VII presents the results from estimating the same model as in Table IV for stand-alone asset managers only. Consistent with our earlier results, we find that the extent of non–money market fund business (*Fund Business*) has an economically and

statistically significant negative effect on all three risk measures.

Although the premise of our test is similarity in financial strength, we additionally control for any remaining variation in a sponsor's financial strength. Our measure of financial strength is a fund sponsor's credit rating. The reason credit rating might be a good proxy for our purpose is that fund sponsors with good credit standings may be more able to access short-term funding markets and as such they may have more capacity to provide support. We measure rating quality with an indicator variable (*No Rating*) equal to 1 if the fund sponsor has no rating and 0 otherwise, that is, fund sponsors without a credit rating are deemed to have lower financial strength.[23]

We find that the coefficient of the interaction term with *No Rating* is negative for all risk measures. However, it is statistically significant only for one measure. This result is not entirely surprising because our test was designed to eliminate much of the cross-sectional variation in financial strength, and thus any unexplained variation in financial strength is likely to have a low statistical power to explain variation in risk.[24] Overall, the results strengthen our interpretation that—conditional on financial strength—the degree of business spillovers negatively affects risk taking.

4. Additional Evidence. One possible explanation of our findings could be that fund managers or fund management companies differ in their compensation levels; hence, they have different incentives to take on risk. For example, if managers of funds sponsored by companies with significant non–money market fund business had lower compensation, such managers could have greater incentives to take risk to increase their funds' assets under management. We evaluate this possibility by relating the value of a fund's compensation to *Fund Business*. We compute total compensation as the product of fund size and expense ratio, which is the percentage fee charged by the fund on its assets. The results from this estimation do not support the idea

23. We also explored the continuous version of ratings, while additionally assigning a low rating value for sponsors without rating. The results are similar.

24. The correlation between *No Rating* and *Fund Business* is relatively low a 32.4%. This provides further evidence that financial strength does not simply proxy for business spillovers.

that differences in risk can be attributed to differences in managerial compensation. If anything, we observe the opposite effect. Funds with more non–money market fund business, on average, have higher compensation levels.

In another test, we explore the importance of outliers. Money funds in our sample exhibit a significant cross-sectional dispersion in their business spillovers. In fact, a few funds display particularly low levels, largely because they specialize in the money market fund management. The presence of such cases raises the possibility that our results might be driven by a few extreme observations. We inspect the data using various scattered plots and find no good reason to believe that the outliers drive our results. Furthermore, we exclude all fund observations with *Fund Business* below 50% and reestimate the regression model in Table IV. The results remain qualitatively unchanged and if anything become quantitatively stronger.

The workings of money market funds often depend on the size of the fund company. Anecdotally, large funds are considered to be more involved in active risk choices, whereas smaller funds are considered to be simple cash-parking vehicles that do not engage in active risk-taking strategies. Hence, one would expect our results to be stronger for large funds. To this end, we estimate the regression model in Table IV for the subsample of funds with assets under management over $1 billion, the value often treated by practitioners as a cutoff for the fund to be considered large and important. We find that the risk effect indeed becomes stronger, but not by much.

Finally, a possible concern with our results relates to our motivating example. In particular, the case of the RPF constitutes one of the most extreme risk-shifting behaviors among all fund sponsors. To the extent that the RPF is sponsored by an asset manager without business spillovers, our results might be partially driven by the RPF. We exclude the fund from our sample and reestimate the regression model in Table IV on the restricted sample. We find no significant difference in magnitude of the coefficients of *Business Spillovers*.

IV.E. Post-Lehman Analysis

In this section, we assess the cross-sectional variation in the response of fund investors and sponsors after Lehman's default. We focus on the one-week period after Lehman's default because

the run started with the redemption requests from RPF immediately after Lehman's default and ended with the introduction of government deposit insurance on money market funds.[25] In our first test, we assess the impact of risk taking and business spillovers on fund redemptions. To this end, we estimate the following regression model:

$$Redemptions_i = \alpha + \beta_1 Business\ Spillovers_i + \beta_2 Spread_i + \gamma X_i + \varepsilon_i, \quad (4)$$

where *Redemptions* is the change in a fund size between September 18 and September 25, 2008. *Business Spillovers* is measured as before and *Spread* is the fund yield minus the one-month Treasury bill rate in the week before the run. *X* is a vector of controls that includes *Log(Fund Size)*, *Age*, *Expense Ratio*, and *Log(Family Size)* measured in the week prior to the run.

We present the results in column (1) of Table VIII. We find that funds whose sponsors have greater business spillovers have smaller redemptions: A 1 standard deviation increase in *Fund Business* reduces redemptions by 3.4 percentage points, or by 32.0% of the average redemption. We find no statistically significant effect of *Conglomerate* on redemptions. Importantly, this effect is over and above the effect of prior risk taking as captured by *Spread*. Funds with higher *Spread* also receive higher redemption requests: a 1 standard deviation increase in spread raises redemption requests by 3.3 percentage points. Hence, these findings are strongly supportive of our hypothesis that funds should take into account runs when choosing their risk levels.

Subsequently, we assess the effect of business spillovers on the likelihood of financial support. To assess financial support, we collect data on no-action letters filed by the SEC. Funds typically request such letters from the SEC before providing financial support to avoid charges of insider trading, and these requests are routinely approved by the SEC. To illustrate the scale and scope of the support, in Appendix Table A.1 we provide detailed information about support arrangements established in the aftermath of Lehman's collapse. It is apparent that the support was not limited to a few funds but was a common occurrence during that period. In total, we observe 28 support events in the week following Lehman's default.[26]

25. Wermers (2011) also examines the relation between redemption requests and fund characteristics in this period.

TABLE VIII
POST-LEHMAN RESULTS

	(1) Redemptions	(2) Support	(3) Exit	(4) Name change
Fund Business$_i$	−0.159**	−0.119	−0.156	0.334*
	(0.074)	(0.366)	(0.247)	(0.174)
Conglomerate$_i$	0.001	0.294**	0.243***	−0.018
	(0.029)	(0.133)	(0.079)	(0.101)
Spread$_i$	0.001**	0.001	0.001	0.000
	(0.000)	(0.002)	(0.001)	(0.002)
Log(*Fund Size*)$_i$	0.026***	0.019	−0.061**	0.023
	(0.007)	(0.015)	(0.030)	(0.018)
Expense Ratio$_i$	−0.191***	−0.019	−0.188	−0.216
	(0.055)	(0.185)	(0.207)	(0.504)
Age$_i$	−0.028	−0.086	0.07	0.012
	(0.033)	(0.083)	(0.059)	(0.067)
Log(*Family Size*)$_i$	0.015***	0.03	0.028*	−0.002
	(0.004)	(0.022)	(0.016)	(0.007)
Constant	−0.041	0.273	0.166	−0.369
	(0.193)	(0.444)	(0.360)	(0.389)
Observations	105	105	105	105
R-squared	0.381	0.189	0.135	0.053

Notes. The sample is all U.S. institutional prime money market funds that were active from 1/1/2006 until 10/1/2009. In column (1) the dependent variable is *Redemptions* defined as total value of redemptions (fund outflows) in the week after Lehman's bankruptcy (9/18–25/2008). In column (2) the dependent variable is *Support*, an indicator variable equal to 1 if the fund's sponsor filed a no-action letter with the SEC in the week after the Lehman's bankruptcy and 0 otherwise (20 funds declared support). In column (3) the dependent variable is *Exit*, an indicator variable equal to 1 if the fund was closed in the two years after the expiration of the government guarantee (10/1/2009), and 0 otherwise (16 out of 105 fund closures). In column (4) the dependent variable is *Name*, an indicator variable equal to 1 if the fund name was changed to match the sponsor name, 0 if the name was unchanged, and equal to –1 if the fund name was changed to be different from the sponsor name (eight name changes). All independent variables are defined in Table III. In columns (1) to (3), the independent variables are measured as of the week before the Lehman bankruptcy. In column (4), the independent variables are defined as of the end of the government guarantee (10/1/2009). Standard errors are clustered at the sponsor level. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

We analyze the effect of business spillovers on financial support using the following regression:

$$Support_i = \alpha + \beta Business\ Spillovers_i + \gamma X_i + \varepsilon_i, \quad (5)$$

where *Support* takes a value of 1 if the fund sponsor offered financial support to its fund and 0 otherwise.

26. Brady, Anadu, and Cooper (2012) use data from money market SEC filings to determine the extent of financial support. They find that several funds received sponsor support before September 2008. Importantly, these instances were triggered by idiosyncratic events. In contrast, the post-Lehman run was the first industry-wide run in the history of money market funds.

We present the estimation results in column (2) of Table VIII. We find no effect of *Fund Business* on financial support. This result suggests that funds incorporate the likelihood of providing financial support in their ex ante risk taking. We find a positive and statistically significant effect of *Conglomerate* on the probability of receiving financial support: funds affiliated with financial conglomerates are 29.4% more likely to receive financial support in the week after Lehman's default relative to stand-alone asset managers. These findings provide strong support for our earlier tests suggesting that stand-alone managers have limited ability to provide financial support.

Next, we evaluate the impact of business spillovers on fund exit in the two years following October 1, 2009, which is the expiration date of the government guarantee program. We identify 16 instances of fund closures during that period, which we want to relate to reputation effects. We estimate the following regression model:

$$Exit_i = \alpha + \beta Business\ Spillovers_i + \gamma X_i + \varepsilon_i, \tag{6}$$

where *Exit* is an indicator variable equal to 1 if a fund exited the market between October 1, 2009 and September 30, 2011, and 0 otherwise. *Business Spillovers* and *X* are defined as before.

The results in column (3) of Table VIII show that funds associated with conglomerates are more likely to exit the market following the run on the industry. In contrast, we find no evidence of such effect for *Fund Business*. The results suggest that in response to adverse conditions in the industry sponsors with greater business spillovers exit the market, possibly to shield themselves from negative spillovers in the future.

Finally, we analyze the effect of business spillovers on fund naming strategies. Prior to the run, some funds had names that were distinctly different from the names of their fund sponsors. However, in the aftermath of the run, some funds decided to change their names in a way that would closely reflect the underlying sponsor name. For example, Bank of America used to offer a fund named Columbia Cash Reserves, but this fund changed its name to Bank of America Cash Reserves in November 2009. We posit that funds with greater business spillovers might be more likely to change their names because they want to signal to their investors the potential safety of their operations. Our sample includes eight such name changes over the period of two years.

To evaluate the hypothesis, we estimate the following regression model:

$$(7) \quad NameChange_i = \alpha + \beta Business\ Spillovers_i + \gamma X_i + \varepsilon_i,$$

where *Name Change* is an indicator variable equal to 1 if a fund changed its name to mimic its sponsor's name between October 1, 2009, and September 30, 2011, equal to –1 if the fund changed its name away from that of its sponsor,[27] and 0 otherwise. *Business Spillovers* and *X* are defined as before and measured as of October 2009. The results in column (4) of Table VIII show that funds with greater business spillovers, as measured by *Fund Business*, are more likely to change their names following the run on the industry.

Overall, our analysis suggests that concerns over possible loss of business played an important role in the way fund investors and fund sponsors evaluated their funds in the aftermath of the run on money market fund industry.

V. Concluding Remarks

We study the risk-taking incentives of money market funds. We show that funds have strong incentives to take on risk because their flows are highly responsive to changes in fund yields. We also find that observable fund characteristics predict funds' risk taking. Using the change in relative risks of money market instruments during the financial crisis of 2007–10 as an exogenous shock to the funds' risk-taking opportunities, we show that funds sponsored by companies with more money fund business took on more risk. We further show that funds whose sponsors had less money fund business experienced smaller outflows, were more likely to provide financial support during a market-wide run in September 2008, and were more likely to exit the industry or change their fund names.[28]

Our findings suggest that money market funds exert a potentially destabilizing effect on financial markets. Money market

27. In our data, we observe only one instance of such a reverse name change.

28. The idea of tracing the impact of an exogenous crisis shock on money market funds has been also used in a recent paper by Chernenko and Sunderam (2012). They examine the "quiet run" on money market funds in 2011 and focus on the impact on money market fund borrowers. Similar to our article, they find a strong flow–performance relationship and thus offer further robustness to our findings.

funds thus add a layer of financial intermediation between issuers (mainly financial institutions) and investors (mainly corporations). Our results indicate that money market funds have strong incentives to chase yields and are vulnerable to runs if the risk materializes. Hence, this reduces the market discipline on financial institutions and makes them more vulnerable to financial shocks.

In addition, our results provide new insights into the role of short-term claimants in the modern theories of financial intermediation (e.g., Diamond and Rajan 2000, 2001). Although these theories argue that such claimants can mitigate intermediaries' incentives to take risk through the threat of runs, our results suggest that they may instead exacerbate risk-taking incentives because of yield chasing by depositors.

Finally, although our explanation of risk taking mostly emphasizes the role of business spillovers, one could imagine other explanations of our findings, such as "conglomerate bureaucracy." In particular, stand-alone firms are known to respond more aggressively to changes in industry Q than do the divisions of a conglomerate. By the same token, an independent money fund may respond more strongly to an opportunity to rapidly grow its assets. Although the lack of precise data on internal decision making inside fund organization makes it difficult to test this theory directly, one could also argue that the bureaucracy effect is related to business spillovers and arises endogenously to protect fund sponsor's reputation from risk-taking behavior of an individual division.

APPENDIX: DATA CONSTRUCTION

The main source of our data on money market funds is iMoneyNet. The data are widely used across the money market fund industry and represent the primary source of information on money market funds. The iMoneyNet database covers the universe of money market funds. Every week all funds submit information on total assets, yields, expense ratios, and holdings by instrument. We confirm the full coverage by comparing the iMoneyNet data with the list of all funds based on SEC data. We also aggregate fund assets and compare them with total fund assets reported by the SEC. Both tests confirm that iMoneyNet covers the universe of money market funds. Most

APPENDIX TABLE A.1

DETAILED INFORMATION ON THE POST-LEHMAN SUPPORT ARRANGEMENTS

Fund company	Sponsor	Support date	Distress reason	Value of distressed assets	Support ralue	Remarks
Dreyfus Cash Mgmt. Plus	BNY Mellon	10/20/2008	Lehman Brothers notes	$97.2M		Cash contribution necessary to maintain the fund value at 0.995
All Dreyfus funds	BNY Mellon	10/20/2008	Distress of eligible assets			CSA (Cash contribution necessary to maintain the fund value at 0.995)
All Citizens funds	BNY Mellon	10/20/2008	Distress of eligible assets			CSA (Cash contribution necessary to maintain the fund value at 0.995)
All General funds	BNY Mellon	10/20/2008	Distress of eligible assets			CSA (Cash contribution necessary to maintain the fund value at 0.995)
Dreyfus Basic MMF	BNY Mellon	10/20/2008	Lehman Brothers notes	$45M		Cash contribution necessary to maintain the fund value at 0.995
Dreyfus LAP	BNY Mellon	10/20/2008	Lehman Brothers notes	$100M		Cash contribution necessary to maintain the fund value at 0.995
Dreyfus Worldwide Dollar MMF	BNY Mellon	10/20/2008	Lehman Brothers notes	$20M		Cash contribution necessary to maintain the fund value at 0.995
Russell MMF	Northwestern Mutual Life Ins.	10/20/2008	The entire fund			CSA (Cash contribution necessary to maintain the fund value at 0.995)
USAA MMF	USAA	10/22/2008	AIG notes	$81.96M		CSA USAA (Cash contribution necessary to maintain the fund value at 0.995)
	Touchstone Advisors	10/22/2008				

APPENDIX TABLE A.1

(CONTINUED)

Fund company	Sponsor	Support date	Distress reason	Value of distressed assets	Support ralue	Remarks
Touchstone Invest. Trust Instit. MMF			Morgan Stanley, Southtrust Bank, Wachovia notes	MS ($5.06M), ST ($1.4M), Wach. ($6.08M)		Cash contribution necessary to maintain the fund value at 0.995 (LOC by Western and Southern Life Insurance Company)
Touchstone Invest. Trust MMF	Touchstone Advisors	10/22/2008	Morgan Stanley, Southtrust Bank, Wachovia notes	MS ($5.1M), ST ($1.6M), Wach. ($4.07M)		Cash contribution necessary to maintain the fund value at 0.995 (LOC by Western and Southern Life Insurance Company)
Touchstone Variable Series MMF	Touchstone Advisors	10/22/2008	Morgan Stanley, Southtrust Bank, Wachovia notes	MS ($2.25M), Wach. ($1.5M)		Cash contribution necessary to maintain the fund value at 0.995 (LOC by Western and Southern Life Insurance Company)
Tamarack Prime MMF	Voyageur Asset Management	10/22/2008	The entire fund			Cash contribution necessary to maintain the fund value at 0.995 (LOC by RBC)
Tamarack Instit. Prime MMF	Voyageur Asset Management	10/22/2008	The entire fund			Cash contribution necessary to maintain the fund value at 0.995 (LOC by RBC)
RidgeWorth Prime Quality MMF	SunTrust Banks	10/22/2008	Lehman Brothers notes	$70M	$70M	Exchange of SunTrust Note for the Lehman note in the amount of $70M
Principal MMF	Principal Financial Group	10/22/2008	AIG notes			CSA (Cash contribution necessary to maintain the fund value at 0.995)
Principal Variable Contracts MMF	Principal Financial Group	10/22/2008	AIG notes			CSA (Cash contribution necessary to maintain the fund value at 0.995)
Morgan Stanley funds	Morgan Stanley	10/22/2008	The entire fund			CSA (Cash contribution necessary to maintain the fund value at 0.995)
Active Assets funds	Morgan Stanley	10/22/2008	The entire fund			CSA (Cash contribution necessary to maintain the fund value at 0.995)
Columbia MM Reserves	Bank of America	10/22/2008	The entire fund			CSA (Cash contribution necessary to maintain the fund value at 0.995)

APPENDIX TABLE A.1

(CONTINUED)

Fund company	Sponsor	Support date	Distress reason	Value of distressed assets	Support ralue	Remarks
ING LAP	ING Groep N.V.	10/22/2008	AIG notes	$46M		CSA (Cash contribution necessary to maintain the fund value at 0.995)
ING Classic MMF	ING Groep N.V.	10/22/2008	AIG notes	$28M		CSA (Cash contribution necessary to maintain the fund value at 0.995)
ING Instit. Prime MMF	ING Groep N.V.	10/22/2008	AIG notes	$46M		CSA (Cash contribution necessary to maintain the fund value at 0.995)
ING MMF	ING Groep N.V.	10/22/2008	AIG notes; Lehman notes	AIG ($8.5M), Lehman ($2M)		CSA (Cash contribution necessary to maintain the fund value at 0.995)
ING Brokerage Cash Reserves	ING Groep N.V.	10/22/2008	AIG notes	$8M		CSA (Cash contribution necessary to maintain the fund value at 0.995)
Western Asset Instit. MMF	Legg Mason	10/22/2008	Orion Finance. LLC notes (SIV)	$75M	$20M	CSA
Western Asset Instit. MMF	Legg Mason	10/22/2008	The fraction of fund	$452M		CSA (Cash contribution necessary to maintain the fund value at 0.9975)
Russell MMF	Northwestern Mutual Life	10/24/2008	Lehman Brothers notes	$403M		CSA (Cash contribution necessary to maintain the fund value at 0.995)

Notes. The columns include the fund company offered support, the sponsor company providing support, the support date, the reason for support, the values of distressed securities, the value of support, and additional remarks. CSA: Capital Support Agreement; POF: Prime Obligations Fund; DAP: Diversified Assets Portfolio; LAP: Liquid Assets Portfolio; LRP: Liquid Reserves Portfolio; POP: Prime Obligations Portfolio.

detailed and accurate information is available for the period from January 2005 to September 2011, which is the period of our analysis.

The data we obtain are reported at the share-class level. To ensure precision of our tests, we first check that all share classes are reported consistently throughout the data set (i.e., a share class is reported every week after a share class enters the data set and until it exits from the data set). We find that only 17 out of 1,820 share classes have some missing data. Almost all missing data are from funds that report monthly for the first few months of their existence and later switch to weekly reporting. We use linear interpolation to generate weekly data for these funds.

We focus on prime money market funds. We have 236,335 total observations (and 1,027 share classes) for the period of our analysis. Because our main analysis is at the fund level, we aggregate the data across share classes. For that reason, we create a unique fund identifier using information on total fund assets that is provided together with assets per share class. The data also provide an indicator variable equal to 1 for a fund's main share class and 0 for other share classes. We use this information to double-check the construction of unique fund identifiers.

We perform several data checks to ensure that the construction of fund identifiers is accurate. Specifically, we verify that the assets for all share classes add up to total fund size. These data are available for most of our data set (174,706 observations). We examine observations for which the difference between the two is greater than $100,000 (the data are reported in $100,000 increments). There are only 201 observations for which the difference exceeds $100,000. We further test whether reported asset holdings add up to 100%. We only find 28 for which asset holdings do not add up.

We construct fund-level variables by aggregating (weighted by asset size) all institutional and retail share classes at the fund-week level using the unique fund identifier. We obtain a total of 104,449 observations at the week-fund level. We label a fund as institutional if the fund has at least one institutional share class (47,959 observations). We label a fund as retail if there is no institutional share class (56,490 observations). Most of our analysis focuses on institutional funds over the period from January 2006 to August 2008 (19,998 observations). The main analysis is restricted to funds that remain in the data set throughout this period (19,096 observations).

We merge the iMoneyNet data to the CRSP Survivorship Bias Free Mutual Fund Database. The CRSP Mutual Fund data are at the monthly level and we therefore match at that frequency (any within-month variation is assumed to be constant). To perform the match, we use the share class NASDAQ identifier provided by iMoneyNet as our primary identifying variable. If the NASDAQ identifier matches to more than one observation in CRSP, we use the share class with the most assets in CRSP. For a small number of observations, iMoneyNet does not provide a NASDAQ identifier or the NASDAQ identifier is not reported by CRSP. In that case, we assign the same NASDAQ identifier based on other share classes of the same fund. If no other share classes have a valid NASDAQ identifier, we match the funds based on fund name. If there is no entry in CRSP, we match directly to the sponsor name based on the fund's SEC filings in EDGAR. We are able to match all fund observations.

For some of our analysis, we compute fund spreads by deducting the one-month Treasury bill rate from fund yields. We collect the one-month Treasury bill rate from Ken French's website at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

We assign the sponsor based on CRSP data. CRSP data provides detailed information about asset management companies that sponsor the respective funds. Most funds have a fixed sponsor during our data period. However, in a few cases, fund sponsors might change, for example, due to mergers. If the sponsor changes over the lifetime of a fund, we assign to the fund the sponsor that was in charge of the fund as of the first week of January 2006. For all sponsors, we collect information on whether the sponsor is affiliated with a commercial bank, investment bank, insurance company, or is managed by a stand-alone asset manager. We collect the information from COMPUSTAT, company websites, EDGAR, SEC filings, and press reports. We use at least two sources to ensure validity of this information. We ensure that all data are as of January 2006.

We obtain sponsor ratings from several data sources. We first match sponsor names to S&P RatingsXpress as of January 2006. Next, we match any unmatched sponsors to the Lehman Brothers' Bond Database. We ensure that both data sets provide the same information. We also double-check the information with company websites and press releases.

Finally, we collect information on financial support from the SEC website. We collect all no-action letters posted in September 2008 or thereafter. We check with Peter Crane's industry blog at cranedata.com to ensure that we cover all sponsors that provided bailouts. We collect information on the specifics of the bailouts based on the no-action letter and press releases. We report detailed information on sponsor bailouts in Appendix Table A.1.

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