Shadow Banking Concerns: The Case of Money Market Funds*

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Abstract

Implosion of the Money Market Fund (MMF) industry in 2008 has raised alarms about MMF risk-taking; inevitably drawing the attention of financial regulators. Regulations were announced by the U.S. Securities and Exchange Commission (SEC) in July 2014 to increase MMF disclosures, lower incentives to take risks, and reduce the probability of future investor runs on the funds. The new regulations allowed MMFs to impose liquidity gates and fees, and required institutional prime MMFs to adopt a floating (mark-to-market) net asset value (NAV), starting October 2016. Using novel data compiled from algorithmic text-analysis of security-level MMF portfolio holdings, as reported to the SEC, this paper examines the impact of these reforms. Using a difference-in-differences analysis, we find that institutional prime funds responded to this regulation by significantly increasing risk of their portfolios, while simultaneously increasing holdings of opaque securities. Large bank affiliated MMFs hold the riskiest portfolios. This evidence suggests that the MMF reform of October 2016 has not been effective in curbing MMF risk-taking behavior; importantly, MMFs still pose a systemic risk to the economy given large banks' significant exposure to them. We propose a two-pronged solution to the MMF risk-taking behavior. First, the big bank sponsoring the MMF should have sufficient equity capitalization. Second, the compensation incentives of the big bank managers and directors should be focused on creating and sustaining long-term bank shareholder value.

JEL classification: G20, G21, G23, G24, G28

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1 Introduction

The shadow banking system consists of financial intermediaries that perform functions similar to traditional banks – maturity, credit, and liquidity transformation. They borrow short-term and invest in long-term illiquid assets; also, they are highly leveraged. However, unlike the traditional banks, they do not have access to deposit insurance or central bank liquidity guarantees. Most of the shadow banks are off-balance sheet entities of the traditional big banks. Examples of shadow banks include money market funds (MMFs), structured investment vehicles, securitization entities, mortgage companies, and broker-dealers. This paper focuses on U.S. based MMFs, an important shadow banking conduit with roughly $3 trillion in assets under management as of March 2017.

Total global assets summed to $321 trillion as of 2015. Figure 1 provides a breakdown of these total global financial assets: banks (deposit-taking corporations) 41.6%, insurance corporations 8.6%, pension funds 9.1%, central banks 7.4%, public financial institutions 4.2%, other financial intermediaries (OFIs, includes equity funds, fixed income funds, hedge funds, money market funds, structured finance vehicles, trusts, and real estate investment trusts) 28.8%. Figure 2 highlights the growth in the global financial system. Note the decline of OFIs in 2008 and its sharp recovery since. Figure 3 illustrates the relative size of MMFs (6%) as a percentage of OFIs. Figure 4 highlights the growth of MMFs in the countries that are the main players in this market, which include the U.S., Ireland, France, China, and Japan.[1]

MMFs are open-ended funds and hold short-term debt securities that are both almost risk-free, such as, US Treasury bills, and risky securities, such as, variable rate demand notes, repurchase agreements, and commercial paper. MMFs may be considered a special type of mutual fund. While mutual funds buy and sell shares on the next determined net asset value (NAV), MMFs are different in that they can issue and sell shares at $1 as permitted by Rule 2a-7 of the Investment Company Act of 1940. To wit, MMFs issue claims with the intent of a stable NAV at a $1 denomination.[2] The MMF attempts to maintain $1 stable NAV to signal that the fund does not lose money, and in the rare event that NAV drops below $1, it is said that the fund "broke the buck". MMFs have historically been regarded as safe investment vehicles and a profitable venue for cash compared to bank saving accounts. Some have noted that MMFs would function well in

[1] The underlying data in Figures (1)-(4) are from FSB (2017).

[2] The $1 NAV is made possible by using amortized cost accounting method to value the assets in a fund's portfolio. This approach uses book value of the assets, and ignores the daily effects of security market prices.

an economy in their role as narrow banks that provide liquidity (Gorton & Pennacchi (1993); Pennacchi (2006); Miles (2001); Scott (1998)).

MMFs date to 1971 when Bruce Bent and Henry Brown established the first MMF. Given that banks could not pay interest on demand deposits, and interest rates were capped pursuant to Regulation Q, this was an attractive proposition for demand depositors who wanted to earn a rate of return higher than what banks offered. As such, MMFs were created as a form of regulatory arbitrage. Per former Chairman of the Federal Reserve, Paul Volcker [3]:

> *"I happened to be there at the birth of money market funds. It was pure regulatory arbitrage. Banks could not pay interest on demand deposits. So there was a gap in the market, which was filled by money market funds saying: we'll pay you interest, and we'll provide a demand deposit...It is a shadow bank."*

MMFs also provide conventional banks with regulatory capital requirements arbitrage. Banks issue commercial papers for wholesale short term funding, and the majority of these securities are held by MMFs on their portfolios. Banks used to benefit from issuing commercial paper given that asset backed commercial paper were not included in the measurement of risk-based capital requirements (Goldstein (2016); Acharya, Schnabl & Suarez (2013)). This regulatory loophole was identified and closed by the Federal Reserve in January 2010 (Kisin & Manela (2016)).

Proponents of MMFs argue that such funds had a central role in growing the short-term debt markets, and that it facilitated capital allocation for short-term borrowers. However, an important question arises: What mechanisms did MMFs have to safeguard against runs at a time of crisis? The answer is none. MMFs do not have a backstop or a discount window, no equity capital buffer to absorb potential losses, no mandate for sponsors to step in and provide capital, and no federal deposit insurance like the FDIC insurance for banks and deposit institutions. The lack of such backstops make MMFs vulnerable to runs as in Diamond & Dybvig (1983). Indeed, this happened in September 2008 when Reserve Primary Fund broke the buck. At the time, the fund held $65B in assets under management, $785M of which was an exposure to Lehman Brothers in the form of asset backed commercial paper (ABCP). Even though such holdings represented only 1.2% of the total assets held by the fund, it was enough to trigger a run by panicked investors when they learned of Lehman's collapse. Within two days, the fund's assets plunged to $23B, and the fund froze withdrawals. This panic propagated to other MMFs, many of

[3] Full transcript of the roundtable is available at https://www.sec.gov/spotlight/mmf-risk/mmf-risk-transcript-051011.htm

which did not have exposure to Lehman, and $310B worth of assets were withdrawn from the industry within one week. The majority of the redemption was from institutional investors.

In response to this crisis, various federal agencies rushed to help stabilize this market. The Treasury Department announced a "Temporary Guarantee Program" for MMFs as a mechanism to calm investors.[4] Further, the Federal Reserve Bank established a number of liquidity facilities that allowed banks to purchase securities from MMFs in order to increase liquidity in the funds portfolios. At the peak, the Federal Reserve Bank held $452B of ABCP and CP securities from more than 105 prime MMFs (Duygan-Bump, Parkinson, Rosengren, Suarez & Willen (2013)). This effectively meant that the Federal Reserve was a buyer of last resort of troubled MMF assets.

At the time, the newly created Financial Stability and Oversight Council (FSOC) expressed concern regarding MMFs and issued recommendations to the SEC calling for structural reform. In 2010, the SEC implemented a number of reforms. These reforms mandated that MMFs shorten their portfolio maturities, increase holdings' disclosures by filing a monthly (N-MFP) report to the SEC that lists all of their holdings, and hold certain levels of daily and weekly liquid assets.[5]

In 2012, the SEC suggested disclosures and regulations passed in 2010 would not have been enough to prevent a scenario similar to the one faced during the crisis with Reserve Primary Fund.[6] In response, then SEC Chairman Mary Schapiro drafted three proposals to reform MMFs:

1. Require funds to fully float their NAVs, and mark-to-market, in order to reduce the perceived notion that investors should not expect losses. The result would be a system that is similar to other mutual funds.

2. Require funds to maintain an equity capital buffer of 1%, which would have the ability to absorb small and daily fluctuations and losses when the fund's underlying assets dip in value. In addition, investors with more than $100,000 would be subjected to a possible 30-day delay of 3% of their shares upon redemption as a holdback for loss-absorption when losses are realized. This would not apply to Treasury MMFs.

3. Funds that choose not to float their NAVs would be required to hold 3% equity buffer against the fund assets, along with more strict investment guidelines on asset

[4]Press Release, U.S. Department of the Treasury, Treasury Announces Guaranty Program for Money Market Funds (Sept. 19, 2008), available at http://www.treas.gov/press/releases/hp1147.htm
[5]The 2010 SEC reform is available at https://www.sec.gov/rules/final/2010/ic-29132.pdf
[6]SEC memo available at http://www.sec.gov/news/studies/2012/money-market-funds-memo-2012.pdf

quality and securities that the funds can hold. This would not apply to Treasury MMFs.

Central to these proposals is removal of the incentive for MMF shareholders to make mass withdrawals when the fund is suspected of experiencing significant losses. Indeed, this was an important reason behind the institutional run on the Reserve Primary Fund during the collapse of Lehman Brothers. SEC staff have prepared a list of more than 300 cases during the past 40 years where MMF sponsors sought SEC permission to support their funds.

On July 23, 2014, the SEC announced a ruling that amends a number of rules in the Investment Company Act of 1940 and related requirements that govern MMFs.[7] The amendments contain two fundamental reforms to Rule 2a-7, intended to go into full effect beginning October 2016. The reforms are (1) institutional prime MMFs are required to float their NAVs and mark-to-market; and (2) MMF boards are permitted, under certain circumstances, to impose liquidity fees and gates in response to unanticipated run of redemptions by investors.[8]

This paper considers all MMFs, with a special focus on *prime* MMFs. Prime funds generally invest in riskier securities than other types of MMFs. Such securities include variable rate demand notes, repurchase agreements, commercial paper, and corporate bonds. Other types of funds include (1) government funds that invest 99.5% or more of their holdings in government securities, cash, or repurchase agreements collateralized with U.S. Government securities; (2) Treasury funds that invests in U.S. T-bills, Bonds, and Notes; (3) Tax-exempt funds that invest mainly in state and municipal securities that are U.S. federal income tax exempt. Each fund can either be retail or institutional depending on the type of investor (natural person or institution) as well as the minimum initial investment required to open an account. Institutional funds tend to have highly concentrated ownership with investors who are very sensitive to small movements in fund performance (Kacperczyk & Schnabl (2013); Chernenko & Sunderam (2014)).

We investigate the impact of the October 2016 SEC reforms on MMF risk-taking. The data on MMF portfolio holdings is made available publicly by the SEC, in forms N-MFP. Given the large size of the average MMF portfolio, the MMF filings to the SEC are prohibitively long and extensive to analyze manually. The N-MFP filings are not

[7]The document outlining the final SEC ruling on MMF reform is available at: https://www.sec.gov/rules/final/2014/33-9616.pdf

[8]Also, the SEC requires the flotation of NAV by institutional funds that primarily invest in municipal and tax exempt securities to float their NAVs. Such funds hold claims on state and local government/municipality that pay federal income tax exempt interest. In the final ruling, the SEC states that municipal securities pose credit and liquidity risk that is greater than U.S. government securities, and hence they have to adhere to floating NAV regulations.

reported in a systematic fashion, and hence require text-based search algorithms. We collect SEC N-MFP filings of *security-level* holdings of *every* registered MMF across all fund categories for the period November 2010 through March 2017.[9]

We construct a non-parametric risk index, which is constructed from five fund-level risk proxies. We find that bank affiliated funds, both prime and non-prime, consistently hold riskier portfolios as measured by the risk index. Additionally, this relationship is robust to using the five individual risk proxies separately.

We employ a difference-in-differences methodology to measure the outcome of the change in SEC regulation on institutional prime MMFs. We find that in the aftermath of the October 2016 MMF reforms, a substantial amount of assets, amounting to approximately $1.5 trillion, has shifted away from prime funds to other types of funds. Within the prime MMF category, institutional funds responded to the reforms by (1) increasing portfolio risk; as measured by the risk index (2) increasing the proportion of opaque and derivative-like securities in their portfolios; (3) increasing the weighted average life maturity of their portfolio; (4) increasing the percentage of assets that are unsecured; (5) decreasing the quality of their assets as proxied by the issue-level credit ratings; and (6) increasing the risk of their holdings as proxied by the CDS spread of the issuers of their holdings. Further, institutional funds generated higher net yields, and paid greater management fees compared to retail prime funds. These results indicate that prime institutional funds, perhaps in an attempt to retain institutional investors, have increased the risk level of their investment compared to their retail counterparts. Also, we find that bank affiliated funds hold riskier portfolios compared to other funds. This raises the question about the efficacy of the October 2016 MMF reforms, as well as the concern that banks remain exposed to excessive risks in their shadow banking activities. The excessive risks are in the context of negative NPV projects; specifically, the expected return from the MMF investments are not commensurate with their risk.

These findings warrant a more careful look at the current MMF regulations. By the SEC's own admission, the first set of regulations passed in 2010, which aimed to improve transparency and increase fund disclosures, failed to yield desired results given the MMFs exposures to troubled European banks in 2011.[10] Evidence in this paper suggests the

[9] Chernenko & Sunderam (2014) collect data similar to this study - based on N-MFP SEC filings; however, their data covers only prime funds from November 2010 through May 2012, that is, they are unable to consider the impact of the October 2016 regulation. Other papers in the literature use iMoneyNet (Crane Data), which provides excellent fund-level coverage of most MMF funds, but does not extend down to security-level holdings (Kacperczyk & Schnabl (2013); Duygan-Bump et al. (2013); McCabe (2010)).

[10] See https://www.sec.gov/rules/final/2014/33-9616.pdf ; page 39: "Based on the DERA Study, we believe that, although the 2010 reforms were an important step in making money market funds better

October 2016 reforms failed to discourage the MMFs' incentives to take excessive risks. We propose a solution to the MMF excessive risk-taking behavior by drawing on the work of Admati & Hellwig (2014), Bhagat, Bolton & Romano (2014) and Bhagat (2017). Specifically, we propose a two pronged solution. First, the big bank sponsoring the MMF should have sufficient equity capitalization. Second, the compensation incentives of the big bank managers and directors should be focused on creating and sustaining long-term bank shareholder value. This two pronged solution will provide big bank managers the correct incentives to sponsor (or not) MMFs and encourage/discourage risk-taking by their sponsored MMF.

The remainder of this paper is organized as follows. Section 2 details the background of the shadow banking system and MMFs. Section 3 describes the data used in the empirical analysis. Section 4 discusses the empirical methods and results. Section 5 describes a battery of robustness tests. Section 6 discusses the policy implications of our results, and Section 7 concludes.

2 Background on shadow banking

In the wake of the 2007-2008 financial crisis, bank and non-bank financial institutions faced increased scrutiny for their excessive risk-taking. As noted above, excessive risk is in the context of negative NPV projects. Perhaps the fundamental problem is the incentive that encourages shadow banks to take excessive risks when searching for yields in a competitive market (Becker & Ivashina (2015)).[11] Chernenko & Sunderam (2014) show that lending in shadow banking have significant frictions that create a channel for risk taking to create negative spillovers.

One major trait that distinguishes shadow banks from commercial banks is the fact that the financial intermediation chain is split among different entities. In commercial banks, loan origination and deposit creation takes place in-house. Figure 5 illustrates this distinction in a diagram. Banks use depositor's money, debt and equity to fund loan origination to borrowers. With shadow banks, loss absorbing equity capital does not exist. Typically, an MMF is considered the first entity in the shadow banking intermediation chain. MMFs receive deposits, issue claims to depositors, and then invest the funds in securities of financial intermediaries such as broker dealers, mortgage

able to withstand heavy redemptions when there are no portfolio losses (as was the case in the summer of 2011 and the fall of 2013), these reforms do not sufficiently address the potential future situations when credit losses may cause a fund's portfolio to lose value or when the short-term financing markets more generally come under stress."

[11] See https://blogs.wsj.com/economics/2014/07/02/feds-yellen-says-regulating-shadow-banks-a-huge-challenge/

companies, and securitization vehicles, among others. This process is only parallel to commercial banks in that MMFs create liquid money claims, except this happens without FDIC insurance for depositors and outside federal deposit regulation. Hence, compared to traditional deposit institutions, the chain between the lender and the borrower has additional layers of intermediation and increased complexity. One can argue that credit intermediation through securitization can be potentially more efficient; however, it also exacerbates agency problems (Ashcraft, Schuermann & others (2008)).

The lack of access to government sources of liquidity, such as the Federal Reserve's discount window, makes shadow banks fragile during times of economic distress. It is a well-established stylized fact that failures in credit intermediation generally result in adverse economic effects (Ashcraft (2005) and Bernanke (1983)). This is exactly why central banks and governments choose to shield traditional depositary institutions by giving them access to liquidity and deposit insurance.

The intraday liquidity and attractive yields, along with the perceived notion of safety and stability, made the MMF market grow considerably. Over the last four decades, the MMF industry has steadily grown in size, and the share of deposits that go into MMFs now constitutes 25% of all US deposits, and more than 200% of all US demand deposits.[12].

Most claims held in the shadow banking system are ‘‘guaranteed" by their issuers, who are commercial banks and other financial institutions, and hence the presumption of safety. However, these forms of liquidity and credit insurance are originating from the private sector. Funding illiquid assets with long maturities using short maturity liabilities, as practiced by MMFs, created another layer of risk in the form of duration-mismatch. Further, pushing credit through the shadow banking system made the cost of borrowing cheaper, but this was at the expense of making the tail-risk in an event of distress more costly on depositors, MMF sponsors, and, ultimately, the tax-payer.

The three key markets in the shadow banking are MMFs, commercial paper (CP) market, and the repo market. Within the shadow banking system, securities from the repo and CP markets would appear on the asset side, whereas claims from MMFs would appear on the liability side. Being on opposite sides of the balance sheet, one would expect the CP and repo markets to be interlinked with the MMF market. The commercial paper market receives most of its funding from MMFs. There are several reasons for this: (1) commercial papers were understood to be of low risk, though unsecured; (2) commercial papers carried short maturities; and (3) they are relatively liquid. Typically, banks and financial corporations are the main issuers of commercial papers.

[12]Macro data on deposits are available from: (1) https://fred.stlouisfed.org/series/WDDNS and (2) https://fred.stlouisfed.org/series/DPSACBM027NBOG

Commercial paper can be backed by an underlying asset, and, hence, called asset backed commercial paper (ABCP). When Lehman collapsed, their issues of ABCP became virtually worthless and illiquid, and this triggered a run on the commercial paper market. MMFs holding ABCP securities, whether from Lehman or not, also rushed to liquidate their ABCP holdings. This underscores the high correlation of risk between the commercial paper and MMF markets, and the fragility of these markets during times of financial crisis.

Rizi, Kishor & Marfatia (2016) show that a common long-term cointegrating trend exists among MMFs, the commercial paper market, and the repo market. Their evidence suggests that cyclical components in MMFs capture large swings in the commercial paper and repo markets, and these swings were particularly exacerbated during the financial crisis. In 2011, approximately 20% of all MMF industry holdings were repo securities, and about 30% were commercial paper.

2.1 MMF vulnerabilities

Domian (1992) and DeGennaro & Domian (1996) found that asset managers at MMFs played passive roles, and that funds, on average, cannot outperform benchmarks. Domian & Reichenstein (1997) highlight that variations in net yields are primarily driven by expense ratios, and not the underlying performance of the fund. By examining net and gross yields generated by MMFs, Koppenhaver & others (1999) document that funds which engaged in more risk taking, as proxied by agency and commercial paper security holdings in the portfolio, have rewarded investors with higher net yields. Advocates of MMFs have asserted that MMFs are unlikely to face runs owing to their highly liquid holdings, and concluded that MMFs are parallel to traditional banks (Gorton & Pennacchi (1993); Scott (1998)).

Interest in MMFs and other shadow banking conduits has increased in the wake of the financial crisis. There is consensus that rapid expansion of the short-term debt finance market in the last two decades has been facilitated by the growing shadow banking sector (Coval, Jurek & Stafford (2009); Gorton & Metrick (2012); Gorton & Pennacchi (1990)). The majority of this debt is securitized by regulated traditional banks through various layers of third-party financial intermediaries.

The transmission of risk from commercial banks to the shadow banking sector can have important monetary policy consequences. For example, Xiao (2016) shows that shadow banks create more money when the Federal Reserve reduces money supply through monetary policy. This finding is also noted in Dempsey (2017). As a result, the

growing presence of unregulated shadow banks causes regulators to lose effectiveness in transmitting monetary policy when reducing money supply, and this recursively pressures shadow banks to grow even larger. Figure 6 from Adrian (2014) shows the evolution of total liabilities from shadow banks, traditional banks, and bank holding companies over the past five decades. The share of bank liabilities as a percentage of GDP remains stable at roughly 70%, whereas the share of shadow bank liabilities went from 1% in 1960 to roughly 80% at the height of the financial crisis.

McCabe (2010) examines MMF risks around the financial crisis, and classifies those risk as (1) portfolio holdings risk, (2) MMF sponsor risk, and (3) investor run and unanticipated large redemptions risk. The author finds that all of these risks were positively correlated with large withdrawals during the run on the ABCP market during the crisis. Further, funds with high portfolio risk, and bank-sponsored funds are more likely to receive sponsor financial support. Financial Support from a MMF sponsor is not uncommon. Brady, Anadu & Cooper (2012) provide a detailed analysis of the discretionary support that sponsors provided to their MMFs during the financial crisis. The authors find that at least 31 funds would have "broken the buck" had it not been for their sponsors stepping in with capital injection.

Highlighting the structural vulnerabilities of the short-term credit market, and the efficacy of the Federal Reserve liquidity facilities during the MMFs run in the financial crisis, Duygan-Bump et al. (2013) find that the emergency liquidity facilities were instrumental in restoring the stability of MMFs. The authors argue for tighter regulations to reduce systemic risks given the MMFs inherent susceptibility to runs.

Kacperczyk & Schnabl (2013) document the risk taking behavior of MMFs in the short period leading to the financial crisis. The authors find that MMF money inflows were highly responsive to fund yields, which created a strong incentive for the funds to take on excessive portfolio risks. Also, the authors find that MMFs sponsored by financial intermediaries took more risk.

In the three years after the crisis, MMFs were back on the spotlight and remained under heavy scrutiny given the large exposures prime funds had to troubled European banks in the height of the Eurozone crisis. Rosengren (2012) shows that in September 2011, approximately 37% of prime MMF holdings had an issuer with a CDS of 200 basis points or more, mostly emanating from troubled European banks. Further, Chernenko & Sunderam (2014) show that funds with exposure to troubled European banks experienced large outflows between June and August 2011. Their findings demonstrate that risk-taking by MMFs can affect issuers, of whom the majority are regulated banks. This highlights the significance of the systemic risk transmission channel that exists between regulated

and shadow banks. Their findings are consistent with Locke, Mitra & Locke (2013), who find that the 2010 reporting regime mandated by the SEC was not effective in setting the appropriate risk-taking incentives for fund managers.

Hanson, Scharfstein & Sunderam (2015) analyze the MMF reforms that were proposed between 2010 and 2012. Their analysis suggests that requiring MMFs to hold subordinated capital would lower the probability of runs and generate significant financial stability benefits. They argue against a floating NAV since such measures rely entirely on market forces which would likely fail to deter MMFs incentives to take excessive risks. The authors calibrate a standard portfolio credit loss model and estimate that holding 3 to 4 percent equity capital buffer against a well-diversified portfolio of unsecured assets would yield a 99.9 percent unconditional probability of loss. They estimate that this equity capital buffer will lower fund yields by 5 basis points.

2.2 MMF risk incentives

There is substantial evidence in the MMF literature that prime funds have strong incentives to take excessive risk.[13] Kacperczyk & Schnabl (2013) estimate the fund flow and fund performance relationship and find that depositor fund flows are very responsive to fund yields. They find that a one standard-deviation increase in fund yields is associated with a 42% increase in assets held under management. Such sensitivity to yields is not surprising given the ease with which investors can withdraw their deposits. This problem is further exacerbated when considering institutional investors, who are quite yield sensitive, and have highly concentrated ownerships. Chernenko & Sunderam (2014) show that institutional investors are willing to migrate large holdings across funds to gain as little as 10 basis points in additional yields. This highlights the threats that institutional MMFs could be exposed to during times of financial crisis if investors rush to withdraw their deposits.

At the height of the Eurozone sovereign debt crisis in 2011, yields on securities issued by troubled EU banks increased significantly, and this created an additional risk-taking opportunity for MMFs. Despite having just come out of the 2007-2008 crisis bail-out, and the 2010 SEC reforms, MMFs dramatically increased their portfolio risks by holding risky EU assets issued by troubled Eurozone banks. Rosengren (2012) documents that on September 2011, approximately 5% of the prime MMF holdings belonged to institutions with a CDS spread of over 400 basis points. Such risky holdings typically generate higher yields, which is rewarded by institutional investors as they provide additional deposits.

[13] As noted earlier, the excessive risks are in the context of negative NPV projects; specifically, the expected return from the MMF investments are not commensurate with their risk.

Anecdotal evidence suggests that certain prime MMFs continue to hold very risky securities. City National Bank, a subsidiary of the Royal Bank of Canada, had exposures to Venezuelan government bonds in 2015; CDS spread reached 6000 basis points at the height of the Venezuelan government debt crisis. In the period between September 2016 and March 2017, MMFs affiliated with JP Morgan, Legg Mason, T.Rowe Price, BlackRock, Dreyfus, Morgan Stanley, and Goldman Sachs had 1 to 5% of their assets invested in Greek banks and Greek government bonds with a CDS spread range of 1000 to 1750 basis points. This anecdotal evidence is an indication that prime MMFs risk taking behavior remains undeterred despite the October 2016 SEC reforms.

2.3 MMFs and transmission of systemic risk

Approximately 93% of the non-government securities held by prime funds are claims against large banks (Hanson et al. (2015)). As such, prime MMFs are an important financing vehicle to fund large banks, who in turn use the proceeds to make loans. In many instances, large banks use their commercial banking network to attract depositors onto their MMFs. For example, in 2016 approximately 70% of the assets held by the various JP Morgan prime funds were initiated by JP Morgan Chase, the commercial banking arm of JP Morgan. This flow of funds to MMFs comes either through "cash sweep" programs for commercial banking customers with investment accounts, or through other private banking programs.[14] This fund flow between commercial banks and their MMF conduits highlights one particular concern of risk transmission between the traditional and shadow banking system. Specifically, this exposes banks' balance sheets to risks from the associated bank's MMF holdings, since MMF assets are not consolidated in a bank's balance sheet. If the MMF portfolio suffers losses, the bank is expected (for reputational reasons), though not required, to step in and provide financial support; this impacts the bank's balance sheet, which would have significant effects on the bank's equity-holders, as well as taxpayers at a time of severe financial distress.

Pursuant to FAS 166 and 167, public and non-public entities typically have to disclose and consolidate variable interest entities (VIEs) onto their balance sheets. From an accounting stand point, bank affiliated MMFs are considered VIEs. However, banks are given an exemption to not consolidate their MMF VIE assets, but only disclose them (to the SEC) pursuant to Rule 2a-7 of the Investment Company Act of 1940. This poses a problem: Banks hold significantly more assets through their MMF VIEs than

[14]Please see (1) https://www.chase.com/investments/sweep-options-yields, (2) https://www.jpmorgansecurities.com/pages/am/securities/legal/sweepoption, and (3) https://am.jpmorgan.com/blob-gim/1383216421608/83456/SAI-MMKT.pdf

their balance sheets portray, and this overestimates the balance sheet based equity capital ratio.

3 Data

3.1 Sample

Starting November 2010, MMFs were required to file form N-MFP with the SEC on a monthly basis, where they have to disclose summary information about the fund, including fund performance, size and flow of the fund, and security holdings in detail.[15] In this paper, we construct a novel dataset where we collect data on the universe of MMFs available from EDGAR on the SEC website down to each security-level holding by every fund. MMFs are required to file this form within 5 business days after the end of each month, and the files are made publicly available 60 days later. The final dataset spans the period November 2010 through March 2017, covering 777 unique funds associated with 168 unique asset management firms.[16] We exclude funds that have less than $1M in assets under management since such funds are not required to register with the SEC. Each fund typically holds anywhere from 20 to 1500 securities. The securities are identified by their issue-level CUSIP, LEI, ISIN, or some other unique identifier.

At the security-holding level, we complement the dataset by matching the security-fund-month observations to other databases. We match each security-fund-month observation with its concurrent issuer CDS spread from Markit, through the FactSet portal, where available. Finally, we match each security with its respective guarantor, where available, from the master CUSIP database available from WRDS.

To arrive at a fund-month unit of observation, we collapse security holdings weighted by security dollar value (proportion to fund total assets).[17] The final sample has 46,002 fund-month observations. At the fund level, we classify funds by sponsor affiliation into 3 categories: (1) Bank affiliated funds (for example, JP Morgan, Wells Fargo); (2)

[15] For references, a blank form N-MFP is available at https://www.sec.gov/files/formn-mfp.pdf

[16] Large asset management firms typically have multiple funds spanning different investment categories (prime, tax-exempt, government, etc). Within each category, such firms also offer multiple funds that cater to different clientele (i.e. retail vs institutional).

[17] As reported to the SEC, a fund typically comprises one or more "share classes", with each being a claim on the same asset portfolio. The SEC does not attribute what assets are held by which class, but rather pools the assets at the fund level. As such, gross-yields are reported at the fund level, while net yields and expense ratios (gross minus net yield) are reported at the class level. Hence, given a class size and an overall fund size, we collapse expense ratios and net yields using class asset weighted averages.

Non-bank financial conglomerates (for example, Fidelity, Vanguard, BlackRock); and (3) other (small boutique) funds. Table 1 reports the names of banks and financial conglomerate affiliates, along with their mean holdings in the sample. Further, we classify funds by clientele type (Institutional and Retail).[18] The third fund classification is by the six investment category types as reported to the SEC: Prime, Treasury, Single State, Government Exempt, Other Tax Exempt, and Government/Agency. Given our special interest in prime funds, we use a simple fund category classification: Prime and Non-prime (which includes, Treasury, Single State, Government Exempt, Other Tax Exempt, and Government/Agency).

Finally, we compare the coverage of the sample to aggregate statistical publications by the SEC and the Office of Financial Research (OFR). The published number of funds, total assets in the industry, industry break down by fund category, as well as other annual statistical figures all confirm accurate coverage in our sample.[19]

3.2 Variables overview

Some variables are constructed from the raw data. One such variable is *Fund Family Size*, which is the sum of all MMFs owned by a particular asset management firm. Also, we construct *Expense Ratio* as the difference between gross and net yield, as is commonly defined by the SEC.[20] *Management Fees* is defined as the expense ratio multiplied by the fund size (total assets in dollars). *6M Trailing Flow Vol* and *6M Trailing Yield Vol* are the volatilities of fund net flows and gross yields, respectively, over the trailing 6 months.

3.2.1 Opaque Spread

We construct a measure that proxies for fund opacity, denoted *Opaque Spread*. This measure has not been used in the literature previously as a proxy for portfolio risk, since data on opaque holdings in the SEC filings have not been compiled. We are able to collect this risk measure at the individual security level given our text-based data collection methodology. [21]

[18] Funds do not disclose whether a fund is institutional or retail. As such, using data from the initial investment required to open an account, we use $100,000 as a cutoff. Funds that require an initial minimum investment equal to or above this amount are flagged as institutional, otherwise they are considered retail. This number is chosen based on the SEC's publications showing aggregate statistics on the size of the retail and institutional funds.

[19] The MMF industry publications are available from the SEC at https://www.sec.gov/reports and from the OFR at https://www.financialresearch.gov/money-market-funds/

[20] See https://www.sec.gov/divisions/investment/mmf-statistics/mmf-statistics-2016-7.pdf

[21] When filing form N-MFP, a fund has to disclose the category of the security. Out of 16 categories (i.e. Treasury note, ABCP, Certificate of Deposit, etc.) the fund can choose "Other" as the catch-all

3.2.2 Credit Ratings

We use data on security (issue-level) credit rating, as required per Rule 17g-2, to construct a portfolio risk measure based on credit quality. A similar risk proxy based on issuer-level (e.g., sponsor) is discussed in Kacperczyk & Schnabl (2013). We construct an issue-level credit ratings score that takes the value of 1 for speculative/non-investment grade holdings and 5 for high and prime investment-grade holdings. Speculative and non-investment grade holdings are B through BB+ (Baa1), while high-grade and prime investment-grade holdings are AAA (Aaa) to AA- (Aa3). These scores are given at the issue level as reported on the SEC filings.

3.2.3 CDS Spread

For each security held in a portfolio, we identify the CDS spread of the underlying issuer to construct a portfolio risk measure based on CDS spreads. This portfolio risk measure is based on Rosengren (2012), who uses CDS spreads to proxy for the credit risk of prime funds sponsors, security issuers, and liquidity providers of the holdings. McCabe (2010) uses a similar measure, albeit to measure the fund sponsor credit risk. In our setting, we are interested in portfolio risk, and hence use the CDS spreads of a portfolio security issuer. We construct *CDS Spread* of a portfolio security's underlying issuer based on 5-year mid-spread in basis points.

3.2.4 Pct Unsecured

We construct another portfolio risk proxy using data on security asset backing and guarantees from the CUSIP database. This portfolio risk, denoted *Pct Unsecured*, is inspired by the proxy used in Chernenko & Sunderam (2014), who construct a portfolio risk measure based on the fraction of unsecured commercial paper and repurchase agreement claims on Eurozone banks in the fund's portfolio. Our measure uses data from the CUSIP Service Bureau, and carries all issue level (9-digit) CUSIP identifiers. This database contains issue level attributes for all CUSIP issues, and one key item is whether the security is secured by FDIC, GINNIE MAE, FCFAC, FFCB, FHLBA, FHLMC, Financial Corporation, FNMA, Government, RTC, or SALLY MAE. Securities that are flagged "unsecured" in this database have the highest coupons/yields. We define a dummy variable *Unsecured Flag* that is equal to 1 if the security is listed as 'Unsecured' in the CUSIP database, and 0 otherwise. We collapse this variable at the

category. This "Other" includes CDOs, CLOs, or other type of synthetic/derivative instruments, and hence can be very opaque.

fund-month using asset weights to arrive at the fund holdings *Pct Unsecured* risk proxy, which measures the percentage of unsecured assets in a portfolio.

3.2.5 WAL

WAL measures a portfolio's weighted average life maturity of the underlying securities, reported in number of days.[22] In general, funds with longer WAL are considered riskier; see Kacperczyk & Schnabl (2013).

3.3 Risk index

We consider five risk measures for each fund in our sample: portfolio opacity *Opaque Spread*, weighted average life maturity of the fund (WAL), percentage of unsecured assets (without a guarantee) in the portfolio, portfolio weighted average security credit rating, and security issuer CDS spread. These risk measures are correlated, and more importantly, each risk measure is correlated with the underlying aggregate risk of the fund. To capture the aggregate risk, we construct an aggregate fund risk measure from these five risk measures. However, constructing a parametric aggregate risk measure is non-trivial (Bhagat, Bolton & Romano (2008)).

We construct a non-parametric aggregate risk measure, denoted *Risk Index*, for each fund. First, we rank order each risk measure into ten deciles using the available observations across the time series. Next, we assign each fund-month observation to its corresponding risk-measure decile rank. Funds with the highest risk are denoted with a rank of 10, and funds with the least risk are denoted with a rank of 1. Next, we take the mean value of the five risk measures' decile ranks to compute a time-varying fund specific *Risk Index*, spanning a range from 1 to 10.

3.4 Summary and test statistics

Table 2 provides summary statistics for all MMFs in the sample. The mean fund size in the sample is $5.2 billion in assets under management, and the mean fund family size is $117.2 billion. The average fund holds approximately 100 different securities, with a gross and net yield of 42.2 and 7.9 basis points, respectively. Fund size distribution are skewed; the largest 10 funds have a combined $950 billion in assets under management

[22] WAL is different from the weighted average maturity (WAM): WAL is based on security life, and is based on the final maturity date of the security when the fund has an unconditional right to receive principal payment. The calculation of WAM takes into consideration demand features and other put-like security options.

as of March 2017. Consistent with the SEC limitation on average maturity, the reported mean for the weighted average life maturity (WAL) of the funds is approximately 48 days. The mean CDS spread for the sample holdings, based on a five-year mid spread, is 70 basis points. As a benchmark, the US government has a CDS spread of 18 basis points, and the AAA US corporate composite index has a spread of 23 basis points.

Table 3 provides the correlation matrix for key variables in the sample. Notice the high correlation among the underlying risk measures: *Opaque Spread*, *CDS Spread*, *Pct Unsecured*, and *Credit Ratings*.

3.5 Time-varying trends

Figure 7 describes the time series evolution of the MMF industry. In Panel (A), we plot the number of prime and non-prime MMF funds. We notice a secular decline in the number of prime funds, and a slight increase in the number of non-prime funds. The number of prime funds decreased from approximately 280 funds in 2011 to approximately 100 funds in April 2017, and this highlights an industry-wide consolidation of the funds. Panel (B) plots the dollar value of the asset holdings between prime and non-prime funds. From 2011 through 2016, the total MMF asset holdings remained relatively stable at around $3 trillion. However, the assets held in prime funds shrunk significantly from $1.8 to $0.7 trillion during this period. It appears the shrinkage was not money leaving the MMF industry but rather a reallocation to non-prime MMFs. Also, Panel (B) plots the total U.S. demand deposits held in depository institutions, which grew from $0.5 to $1.4 trillion in the same time period. Panel (C) highlights the asset breakdown within the prime MMF category. The majority of the decrease in asset holding was due to institutional funds, with a smaller decrease in assets in the retail prime sector. Panel (D) compares the MMF assets held across different MMF types categorized by their sponsor affiliations. Bank and conglomerate affiliated MMFs consistently held more than 85% of the assets in the MMF industry. Panel (E) shows that the share of assets in the MMF industry held by prime institutional funds dropped significantly around October 2016, whereas the non-prime institutional share increased.

Figure 8 shows the time series evolution of our *Risk Index* measure. Panel (A) compares prime and non-prime funds with respect to their aggregate risk index, and plots the risk index using cross-sectional asset weights. We notice that prime funds have consistently had a larger risk index compared to non-prime funds by about three and a half decile ranks. Panel (B) shows that the prime retail and prime institutional funds have had very similar levels of risk, but diverged in the period surrounding the

implementation of the July 2014 SEC reforms. This wedge is driven by both an increase in risk index by prime institutional, and a decrease in risk index by prime retail funds. Panel (C) shows that bank affiliated funds have consistently held the riskiest portfolios in the prime sector since 2013.

As a robustness check, we plot the individual risk measures that make up *Risk Index* in a similar fashion, and discuss results in Section 5.

4 Methodology and results

4.1 OLS regressions

The first part of the empirical analysis considers the MMF industry as a whole. We consider fund characteristics such as gross and net yields, expense ratio, size of the fund, management fees, portfolio risk index, as well as fund sponsor affiliation. The second part of the analysis uses a difference-in-differences approach and exploits the natural experiment to examine the impact of the implementation of the October 2016 SEC regulations. Here, we limit the analysis to prime MMF funds. The treatment group is institutional prime funds, and the control group is the retail prime funds. The *post* regulation period starts after the SEC reforms went into effect in October 2016.

4.1.1 Determinants of fund yields

In the first part of the empirical analysis, we test the relationship between observable fund characteristics and fund yields. The following equation describes the regression specification employed in this test.

$$\begin{aligned} Y_{i(t+1)} \;=\; & \beta_1\, Risk\, Index_{it} + \beta_2\, Log(Fund\, Size)_{it} + \beta_3\, Log(Family\, Size)_{it} \\ & + \beta_4\, Exp\, Ratio_{it} + \beta_5\, Fund\, Net\, Flow\, Ratio_{it} + \beta_6\, 6M\, Trailing\, Flow\, Vol_{it} \\ & + \beta_7\, 6M\, Trailing\, Yield\, Vol_{it} + \beta_8\, Log(Management\, Fees)_{it} + M_t + F_i + \epsilon_{it} \\ & + M_t + F_i + \epsilon_{it} \end{aligned} \tag{1}$$

Where *Risk Index* measures aggregate portfolio risk, *Log(Fund Size)* measures the fund size by dollar asset holdings, *Log(Family Size)* measures the total assets across all funds owned by the asset management parent of the fund, *Net Yield Spread* is the annualized fund return above the risk free rate[23], *Exp Ratio* measures the funds expense

[23]The spread in gross and net yields is relative to the risk free rate, defined here as the one month treasury

ratio, which is the difference between gross and net yield, *6M Trailing Flow Vol* and *6M Trailing Yield Vol* are the volatilities of fund net flows and gross yields, respectively, over the trailing 6 months. *Log(Management Fees)* measures the size of the annualized management fees, defined as the expense ratio multiplied by the fund size of assets in dollars. The specifications that do not include fund fixed effects have the following additional variables: *Bank Affiliated*, *Conglomerate Affiliated*, *Prime Fund Flag*, as well as interaction terms *Prime x Bank* and *Prime x Conglomerate*. These variables are absorbed in the fund fixed effects regressions. In the specifications that include these covariates, we drop *Log(Family Size)* from the regression given the high correlation between this variable and Bank/Conglomerate dummies.

Table 4 show the OLS results of these tests. In Panel (A), the dependent variable is the next period gross yield spread $(Gross\ Yield\ Spread)_{i(t+1)}$. The key independent variable is *Risk Index* which measures a fund's aggregate risk using five distinct MMF portfolio risk proxies. These proxies are portfolio opacity *Opaque Spread*, weighted average life maturity of the fund *WAL*, percentage of unsecured assets (without a guarantee) in the portfolio *Pct Unsecured*, portfolio weighted average security credit rating *Credit Rating*, and security issuer CDS spread *CDS Spread*. *Risk Index* is fund-specific and time-varying non-parametric index that spans a range from 1 to 10. Funds with the highest risk will have a rank of 10, and funds with the least risk will have a rank of 1. Across all regression specifications in Panel (A) of Table 4, *Risk Index*, *Exp Ratio*, and *Log(Management Fees)* are positive and statistically significant covariates. In columns (2) and (4), we notice that bank and conglomerate affiliated funds perform worse than other funds, and we notice that prime funds outperform non-prime funds by about 8 basis points. The dependent variable in Panel (B) is $(Net\ Yield\ Spread)_{i(t+1)}$, and again, we see that *Risk Index* has a positive and statistically significant coefficient in columns (1), (3), and (5). *Log(Fund Size)* is also positive and statistically significant across all specifications. Interestingly, *Log(Management Fees)* has a negative and statistically significant coefficient across all specifications. This is consistent with the argument that the more funds carve out from gross yields to fund management fees, less is left for investors. There are no significant differences in net yields across the bank, conglomerate, and other fund affiliations. Finally, prime funds are associated with approximately 3 basis points additional net yield spread compared to non-prime funds, and bank affiliated prime funds are associated with an additional 2 basis points in net yield spreads.

bill return. The yields are annualized.

4.1.2 Determinants of portfolio risk

Next, we test the relationship between portfolio risk and observable fund characteristics. The following equation describes the regression specifications employed in this test.

$$\begin{aligned} Risk\,Index_{i(t+1)} &= \beta_1\,Log(Fund\,Size)_{it} + \beta_2\,Log(Family\,Size)_{it} + \beta_1\,Net\,Yield\,Spread_{it} \\ &+\beta_4\,Exp\,Ratio_{it} + \beta_5\,Fund\,Net\,Flow\,Ratio_{it} + \beta_6\,6M\,Trailing\,Flow\,Vol_{it} \\ &+\beta_7\,6M\,Trailing\,Yield\,Vol_{it} + \beta_8\,Log(Management\,Fees)_{it} + M_t + F_i + \epsilon_{it} \\ &+M_t + F_i + \epsilon_{it} \end{aligned} \tag{2}$$

Table 5 show the OLS results of these tests. The dependent variable is the next period aggregate portfolio risk *(Risk Index)*$_{i(t+1)}$. We notice that net yield spreads and management fees are associated with positive and statistically significant future portfolio risk. We also notice that that institutional funds, prime funds, bank and conglomerate affiliated funds are associated with more portfolio risk. The interaction term *Prime X Conglomerate* has a negative and statistically significant coefficient, indicating that prime conglomerate funds are associated with less portfolio risk compared to other funds. Interestingly, the opposite is true for bank affiliated funds. The interaction term *Prime X Bank* has a positive and statistically significant coefficient, indicating that prime bank funds are associated with more portfolio risk compared to other funds. This indicates that out of all funds in the prime sector, bank affiliated funds hold the riskiest portfolios.[24]

The above evidence from the OLS regressions suggest: 1) Portfolio risk taking is associated with higher yields. 2) Higher management fees are associated with higher portfolio risks. 3) Prime funds are associated with significantly higher portfolio risks. 4) Bank and conglomerate funds have riskier portfolios, and banks drive significantly more risk taking in the prime sector.

4.2 Difference-in-differences regressions

The recent MMF reforms enacted by the SEC attempt to address the issue of ex-ante incentive for risk taking by prime funds. Given that this reform applies to institutional prime and not retail prime funds, we use this setting as a natural experiment to test

[24] We repeat this analysis using the five individual risk measures that make up *Risk Index*, and the results are qualitatively similar.

the impact of this regulation on prime institutional risk taking. Using a difference-in-differences (DID) approach in Table 6, we limit the analysis to prime funds only, and assign retail prime funds as the control group and institutional prime as the treatment group. *Post* takes the value of 1 starting from October 2016 when the regulation was enacted, and 0 otherwise. Hence, the DID variable *Prime-Inst X Post* measures the differential impact of the regulation on the treatment group. Typically, serial correlation could bias the standard errors in a difference-in-differences estimation. One of the methods to address this is to estimate robust standard errors that are double clustered on fund and time dimensions as suggested by Bertrand, Duflo & Mullainathan (2004) and Cameron & Miller (2015). The following equation describes the difference-in-differences estimation:

$$Y_{i(t+1)} = \beta X_{it} + \delta(Prime - Inst \times Post)_{it} + M_t + F_i + \epsilon_{it} \tag{3}$$

where $Y_{i(t+1)}$ is an outcome variable, X_{it} represents fund characteristics, $Prime - Inst$ is a dummy equal to 1 if the fund is an institutional prime fund, $Post$ is a dummy equal to 1 starting from October 2016, M_t is the month fixed effects, and F_i is the fund fixed effects. The estimated effects of the regulation is captured by $\hat{\delta}$, which measures the causal impact of the regulation on prime institutional MMFs (i.e., the treatment group). The treatment group $InstitutionalPrime_{\text{i}}$, which controls for time invariant and permanent differences between the treated and the control funds, is absorbed by the fund fixed effects. $Post_{\text{t}}$ dummies, which control for common trends shared by both groups, is absorbed by the month fixed effects. Accurate implementation of a difference-in-differences test requires establishment of common parallel trends between the control and treatment groups, which is an important identifying assumption. This assumption means that the average outcome for both groups would follow parallel paths absent the shock or treatment. Panel (B) of Figure 8) shows evidence consistent with the parallel trends assumption.

The outcome variables in this specification are *Gross Yield Spread*, *Net Yield Spread*, *Risk Index*, *Log(Mgmt Fees)*, *Opaque Spread*, *WAL*, *Pct Unsecured*, *Credit Rating*, and *CDS Spread*. The vector of fund characteristics X_{it} include the following control variables: *Log(Fund Size)*, *Log(Family Size)*, *Exp Ratio*, *Fund Net Flow Ratio*, *6M Trailing Flow Vol*, *6M Trailing Yield Vol*, and *Log(Mgmt Fees)*.

We find that the October 2016 SEC regulation led institutional prime funds to take significantly more portfolio risks, as measured by *Risk Index*, and the index constituents: *WAL*, *Opaque Spread*, *Pct Unsecured*, *CDS Spread*, and *Credit Ratings*. Further, prime institutional funds outperformed the retail funds by grossing 10 basis points and netting 14 basis points in additional yields. Interestingly, management fees for prime institutional funds were significantly higher after the regulation.

The increase in risk of institutional prime funds cannot be explained by a decrease in the supply of securities issued by banks and financial institutions (e.g., commercial paper, and bank obligations or variable rate notes). A decrease in supply should have affected both retail and institutional funds, since both types of prime funds hold such securities. The results from the within prime difference-in-differences show that institutional funds had a significant differential increase in risk taking, and a change in asset class portfolio holdings compared to retail funds post October 2016. Hence, this alleviates concern that these results are driven by a decrease in supply of securities that prime funds typically held.

Taken together, these results suggest the October 2016 SEC reforms were not successful in curbing the incentive for prime institutional funds to engage in excessive risk-taking.

5 Robustness tests

5.1 Placebo tests

In Panel (A) of Table A1, we perform a placebo test where we restrict the time-series of the analysis to the period between January 2014 and February 2015, and define the shock period as July 2014 when the SEC announcement was made, instead of the October 2016 when compliance was mandated. This specification tests whether funds reacted to the announcement rather than the compliance shock, and it examines whether the run-up to compliance period have any significant impact on the interpretation of the results. Interestingly, the only specification with significant results in the placebo test in Panel (A) of Table A1 concerns the management fees outcome variable. In the 6 months pre and 6 months post SEC announcement, institutional prime MMFs have significantly increased their management fees, perhaps in anticipation of future risk taking and investor redemption. Yield outcomes and other risk proxies show no significant changes during this time period. This alleviates concern that results in the main analysis in Table 6 are driven by events during the run-up to compliance period.

In Panel (B) of Table A1, we perform a different placebo test. Using the entire sample from November 2010 to March 2017, we generate a random number to define the month-year of the shock. This specification tests whether our results can be obtained by chance if we randomize the choice of the shock period. The *Risk Index* shows no significant changes during this time period with a randomly chosen shock. This alleviates concern that results in the main analysis in Table 6 are driven by events other than the enactment

of the SEC reform in October 2016.

5.2 Impact on municipal and tax exempt MMFs

The July 2014 SEC reform required not only prime institutional funds to float their NAVs, but also municipal and tax exempt funds. This is in addition to the discretionary liquidity fees and redemption gates which apply to all funds. The majority of the assets in the municipal and tax exempt funds belong to retail investors, and hence are not a focus of the main analysis in this paper. However, given these funds' exposure to a similar SEC shock (i.e., the requirement to float the NAV), we test the implications for these funds as a robustness check to verify if these funds responded differently.

Using a difference-in-differences approach similar to that in Table 6 and Equation (3), we limit the analysis in Table A2 to municipal and tax exempt funds only, and assign retail muni funds as the control group and institutional muni as the treatment group. *Post* takes the value of 1 starting from October 2016 when the regulation was enacted, and 0 otherwise. Hence, the DID variable *Muni-Inst X Post* measures the differential impact of the regulation on the treatment group.

Consistent with the results found for prime MMFs, we find that the regulation led institutional muni funds to take significantly more portfolio risks, as measured by *Risk Index*. Further, municipal and tax exempt institutional funds outperformed the retail funds by grossing 5 basis points and netting 7 basis points in additional yields. The increase in yields is consistent with the funds risk taking behavior, and it seems likely that the increase in fund portfolio risk was an attempt to attract new investors, as well as to keep current institutional investors from making withdrawals.

The results from this robustness test demonstrate that the failure of the SEC in curbing ex-ante risk taking incentives by MMFs is not unique to prime funds, but extends to funds that primarily hold local government and municipality issued securities. The risk-seeking behavior post reform seen in municipal and tax exempt institutional funds is very similar to that by institutional prime funds.

5.3 Consistency of results across subsamples

We test whether the results from the difference-in-difference specification in Table 6 is consistent using a shorter time-series. The current specification uses about 5 years of data before the regulatory shock and 6 months of data in the period after the shock. One concern is that long time-series in the pre-shock period could introduce noise and measurement error. In Panel (A) of Table A3, we restrict the time-series of the analysis

to the period between May 2016 and March 2017. This reduces the sample period to 6 months of pre-shock and 6 months of post-shock. The reduction in the time-series is analogous to short event studies, which allow for a more precise measurement of the regulatory impact. The results in Panel (A) of Table A3 are consistent with those found in Table 6.

In Panel (B) of Table A3, we restrict the time-series of the analysis to the period between January 2014 and March 2017, excluding the time-period between July 2014 and October 2016. We exclude this period because it represents the run-up period between the time when the SEC announcement was made and when the regulation went into effect. The intuition behind this "donut" strategy is based on Cookson (2017); Almond & Doyle (2011); Barreca, Guldi, Lindo & Waddell (2011), and it isolates any effects that might be captured during the anticipation and run-up to compliance period. Removing the observations in the period between announcement and compliance alleviates concern that results could be driven by unobservables in the run-up to compliance period, and also allows for a more direct comparison between the pre and post regulatory shock periods. The results in Panel (B) of Table A3 are consistent with those found in Table 6.

5.4 Time-varying trends of individual risk measures

In Figure 8, we illustrated the time-series evolution of aggregate risk index in the MMF industry. As a robustness check, we plot similar graphs using the underlying individual risk measures that make up *Risk Index*.

Figure A1 shows the time series evolution of *Opaque Spread*, which is the holdings of opaque securities in excess of treasuries. Panel (A) compares prime and non-prime funds in their fund holdings opacity, and plots the spread in percentage points, using cross-sectional asset weights. The prime funds have significantly increased the share of opaque securities in recent months. Panel (B) shows that the sharp increase in the opaque holdings spread is driven by institutional funds. Panel (C) shows that bank affiliated funds have consistently had portfolios with the highest opaque holdings spreads in the prime sector. The evidence in this figure is consistent with the argument that prime institutional funds drove the increase in holdings of opaque securities around October 2016, and that bank affiliated funds hold the most opaque portfolios.

Figure A2 plots the time series evolution of MMF portfolio weighted average life maturities (WAL), using cross-sectional asset weights. Panel (A) shows that prime funds have consistently held assets with significantly longer maturities, and Panel (B) shows that institutional prime funds had a sharp increase in maturities immediately around the time

of the SEC regulations enactment in October 2016. Panel (C) shows that bank affiliated prime funds have consistently had portfolios with the longest maturities compared to conglomerate affiliated and other funds.

Figure A3 plots the time series evolution of the percentage of MMF portfolio assets without a guarantee (*Pct Unsecured*), using cross-sectional asset weights. Panel (A) shows that prime funds have consistently held higher proportion of unsecured assets, and Panel (B) shows that institutional prime funds held a larger proportion of unsecured assets compared to retail prime funds. Panel (C) shows that bank affiliated prime funds have mostly held higher proportion of unsecured assets compared to conglomerate affiliated and other funds.

Figure A4 plots the time series evolution of MMF portfolio weighted average security credit ratings, using cross sectional asset weights. Panel (A) shows that prime funds have consistently held assets with a lower credit rating, and Panel (B) shows that institutional prime funds had a decrease in security credit ratings around the time of the SEC regulations enactment in October 2016. Panel (C) shows that bank affiliated prime funds have consistently held portfolios with the lower credit ratings compared to conglomerate affiliated and other funds.

6 Policy implications

MMF assets, while less than their peak of 2008, are increasing; see Figure 4. Policy makers are increasingly concerned about this segment of shadow banking. The evidence above suggests that the SEC regulations implemented in October 2016 have not been effective in discouraging risk-taking by MMFs. To consider effective policies that would discourage excessive risk-taking by MMFs, we would need to consider the incentives of senior managers at the institutions that sponsor the MMFs. Specifically, why do big bank managers sponsor MMFs? In Section 2, we have discussed the legitimate (in the positive NPV sense) business reasons for MMF sponsorship. However, the compensation incentives of senior bank managers is another likely determinant of the decision to sponsor an MMF.

Big bank managers whose incentive compensation has a significant return on equity component would prefer the high leverage of the off-balance sheet vehicles like MMFs, since this would magnify the impact of these vehicles' earnings on the return on equity of the bank. In the past, big bank manager incentive compensation has been based on the bank's return on equity. While the big bank managers could benefit significantly from the off-balance sheet vehicles, it is unclear how the big bank shareholders might

benefit from these off-balance sheet vehicles; shareholders care about projects/strategies that create and sustain long-term shareholder value, not return on equity. Ultimately, as we saw in 2008, these off-balance sheet vehicles impose a significant cost on the big bank shareholders, and ultimately the U.S. taxpayers.

Drawing on the work of Bhagat (2017) and Bhagat et al. (2014), we propose that the incentive compensation of bank executives should consist only of restricted equity (restricted stock and restricted stock option) – restricted in the sense that the individual cannot sell the shares or exercise the options for one to three years after their last day in office. We refer to this as the Restricted Equity proposal.

If a bank CEO is offered incentive compensation contracts consistent with the Restricted Equity proposal, then she would have more high-powered incentives not to invest in the high-risk but unprofitable (over the long-term) projects and trading strategies; MMF sponsorship and the MMF portfolio risk level choice are examples of investment projects under the purview of the bank CEO and bank directors. Not only would the CEO be required to hold these shares and options for the duration of her employment in the bank, but for one to three years subsequent to her retirement or resignation. If the investment project resulted in an unexpected positive cash flow in a certain year prior to their retirement or resignation, the bank's share price would likely go up, the CEO's net worth would go up on paper, but the CEO would not be able to liquidate her stockholdings. The CEO would have to make an assessment of the likelihood of the large negative cash flow outcome during the years she continued to be employed at the bank, plus one to three additional years. After making such an assessment, a CEO would presumably be less likely to authorize or encourage the high-risk but unprofitable (over the long-term) projects in the first place. The long-term feature of the Restricted Equity proposal's compensation package would operate to curb optimistic estimates of a project's long-term profitability by using high-powered financial incentives to prod the executive to attend to, and hence estimate more assiduously, all of a project's cash flows, rather than solely those in the near term. If a bank does not engage in the long-term unprofitable investment project (such as, excessive risk-taking by their sponsored MMFs), then this would, of course, also serve the interests of the long-term shareholders.

There are three important caveats. First, if executives are required to hold restricted shares and options, they would most likely be under-diversified. Second, if executives are required to hold restricted shares and options post-retirement, they may be concerned with lack of liquidity. Third, the proposal could lead to early management departures, as executives seek to convert illiquid shares and options into more liquid assets (after the

one to three year waiting period). These concerns can be addressed by allowing bank managers to liquidate a modest percentage of their holdings every year.

Consistent with and complementary to the above Restricted Equity bank manager incentive compensation proposal is the incentive compensation proposal for bank directors: Specifically, all compensation (including incentive compensation) of bank directors should consist only of restricted equity (restricted stock and restricted stock option) - restricted in the sense that the director cannot sell the shares or exercise the options for one to three years after their last board meeting. With regard to cash compensation – we are recommending bank directors not be paid any retainer fees or other cash compensation.

The Restricted Equity bank manager/director incentive compensation proposal logically leads to a complementary proposal regarding a bank's capital structure: The high leverage implied by debt ratios in the order of 95% (as was the case for many large banks in 2008) will magnify the impact of losses on equity value. As banks' equity values approach zero (as they did for some banks in 2008), equity based incentive programs lose their effectiveness in motivating managers and directors to enhance shareholder value. Second, Bhagat (2017) and Bhagat et al. (2014) document that bank CEOs sell significantly greater amounts of their stock as the bank's equity-to-capital ratio decreases. Third, bank CEOs can make honest business mistakes in the sense that a positive NPV project turns out badly. Hence, for equity based incentive structures to be effective, banks should be financed with considerably more equity than they are being financed currently.

Specifically, our bank capital proposal has two components: First, bank capital should be calibrated to the ratio of tangible common equity to total assets (i.e., to total assets independent of risk). Second, bank capital should be at least 20% of total assets, where total assets include both on-balance sheet and off-balance sheet assets like MMF assets. Our recommendation for significantly greater equity in a bank's capital structure is consistent with the recent recommendations of Admati & Hellwig (2014); Hoenig (2017); Barth & Miller (2017a,b) and with the spirit of the CHOICE Act (passed by the U.S. House of Representatives in June 2017), and the June 2017 report of the U. S. Department of Treasury.[25]

Under the Restricted Equity bank manager/director incentive compensation proposal, and the above bank capital proposal, bank managers can create off-balance sheet vehicles, including MMFs, if they so choose. However; they will not have the incentive to create

[25]This report is available from https://www.treasury.gov/press-center/press-releases/Documents/A%20Financial%20System.pdf

such off-balance sheet vehicles unless these vehicles are value-enhancing (in the positive NPV sense) investment projects that sustain their value in the long-run. The Restricted Equity bank manager incentive compensation proposal, coupled with the above bank capital proposal, provides a powerful disincentive to bank managers and directors from sponsoring MMFs that may generate some short-term profits but are value-destroying (in the negative NPV sense) in the long-run.

7 Conclusion

We analyze the impact of the October 2016 SEC reforms that aim to reduce the systemic risk of MMFs. We find that the reforms are associated with an increase in their portfolio risk. This result is consistent across several proxies for portfolio risk. Bank affiliated funds are consistently associated with more portfolio risk compared to non-bank affiliated funds. This is a cause for concern given that (1) banks are often expected to step in as sponsors to provide financial support to their troubled MMFs; (2) banks do not consolidate their MMF assets on their commercial activity balance sheets; and (3) large banks can transmit economy wide systemic risks by shifting activity to shadow banks through their MMFs.

These findings warrant a more careful look at the October 2016 SEC regulations. By the SEC's own admission, the first set of regulations passed in 2010, which aimed to improve transparency, and decrease risk-taking, failed to yield desired results given the MMFs significant exposures to troubled European banks in 2011. Also, the October 2016 SEC reforms failed to discourage the MMFs' incentives to take excessive risks. We propose a solution to the MMF risk-taking behavior by drawing on the work of AdmatiAdmati & Hellwig (2014), Bhagat et al. (2014) and Bhagat (2017). Specifically, we propose a two pronged solution. First, the sponsoring big bank should have sufficient equity capitalization. Second, the compensation incentives of the big bank managers and directors should be focused on creating and sustaining long-term bank shareholder value. This two pronged solution will provide big bank managers the correct incentives to sponsor (or not) MMFs and encourage/discourage risk-taking by their sponsored MMF.

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8 Figures and Tables

Figure 1: The Global Financial System in 2015

This figure provides a breakdown of the global financial system by asset type in 2015. The underlying data in this figure is from FSB (2017). The total global assets in this graph sums to $321 trillion.

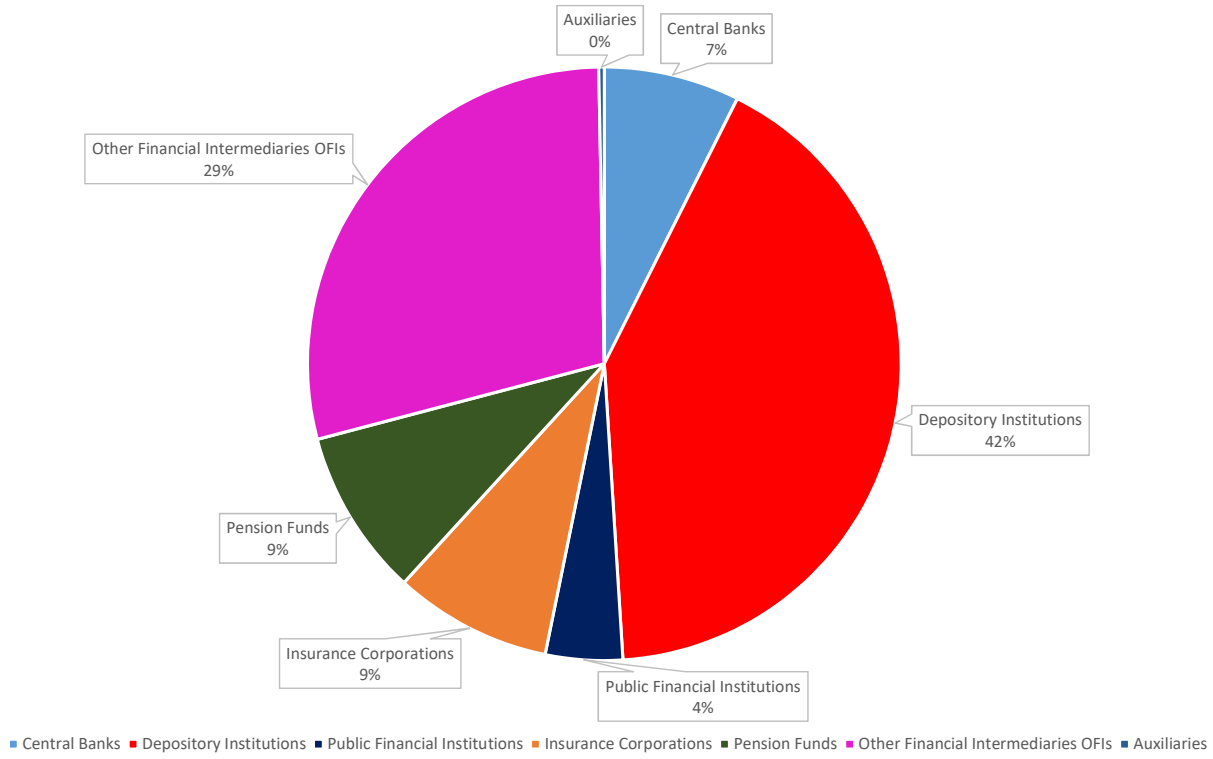


Figure 2: Growth in the Global Financial System

This figure highlights the growth in the global financial system assets, in trillion USD, from 2002 to 2015. The underlying data in this figure is from FSB (2017).

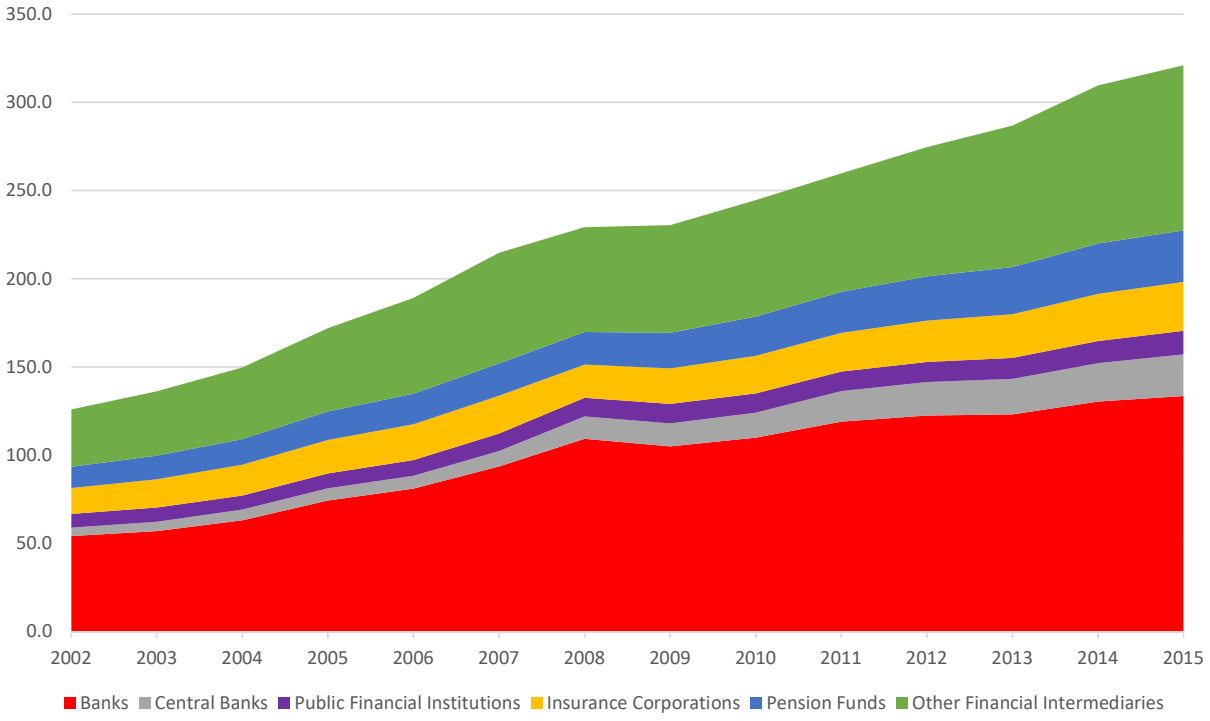


Figure 3: Breakdown of Other Financial Institutions (OFIs) in 2015

This figure provides a breakdown of the institutions that make up the other financial institutions (OFIs) category in 2015. The underlying data in this figure is from FSB (2017). The total assets in this category sums to $92.5 trillion.

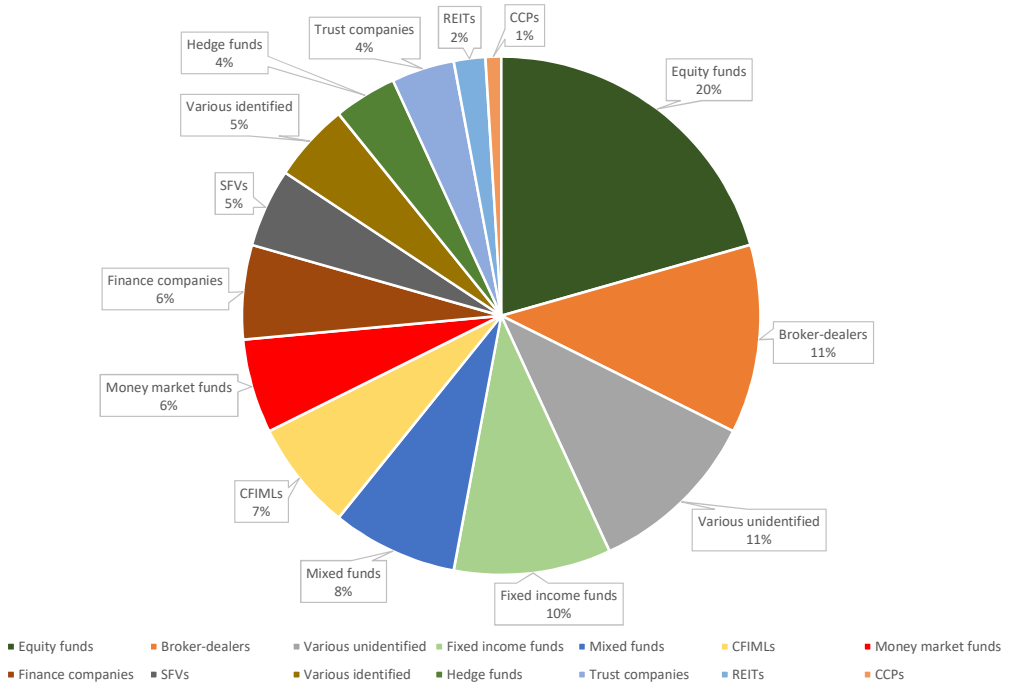


Figure 4: Growth of Global MMF Assets

This figure highlights the growth in the Global MMF assets, in trillion USD, from 2005 to 2015. The underlying data in this figure is from FSB (2017).

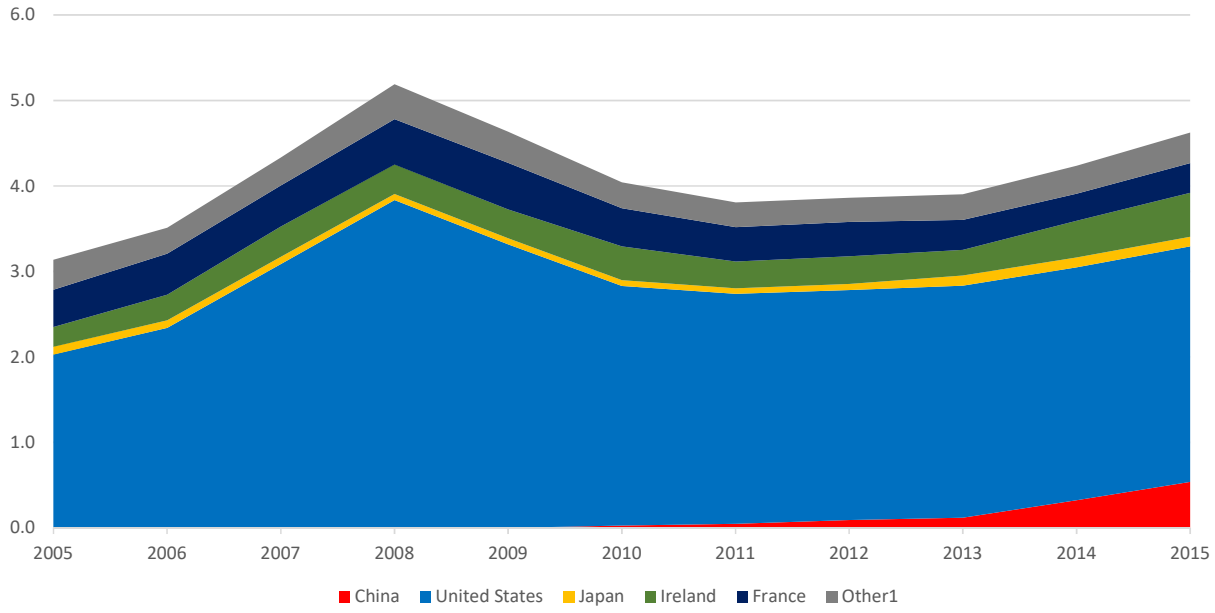


Figure 5: The Shadow Banking System

This figure presents a general outline of the shadow banking system, in the context of MMFs and regulated banks. Financial intermediaries channel the funds between borrowers and lenders, and examples for that include structured investment vehicles (SIVs), limited purpose finance companies (LPFCs), securitization conduits, credit hedge funds, broker dealers, among others.

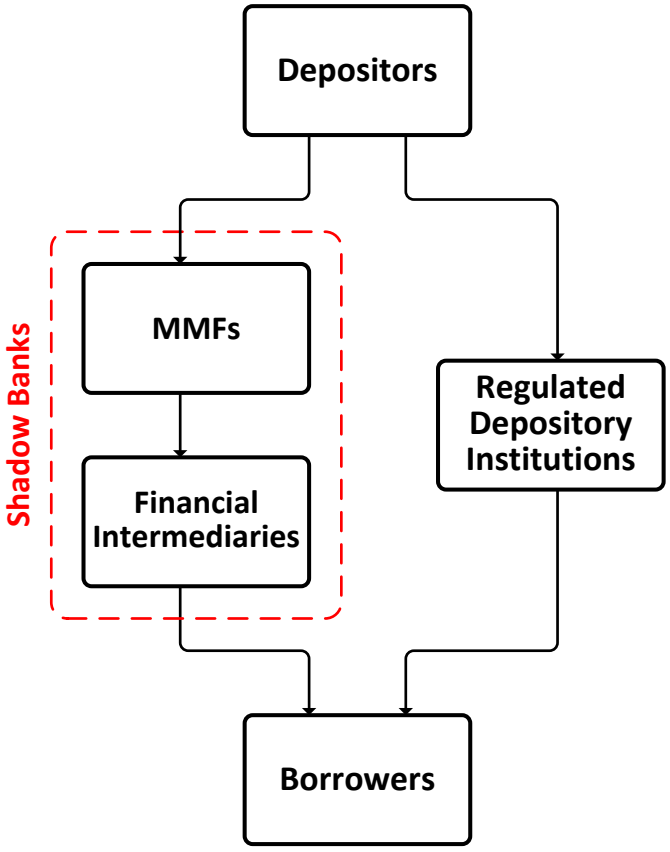


Figure 6: Total Liabilities of Shadow and Traditional Banks

This figure is from Adrian (2014) and it shows the time-series evolution of total liabilities (as a percentage of GDP) by shadow banks, traditional banks, and bank holding companies and broker-dealers. The source of the underlying data comes from the U.S. Flow of Funds by the Board of Governors of the Federal Reserve, and the U.S. National Accounts by the Bureau of Economic Analysis.

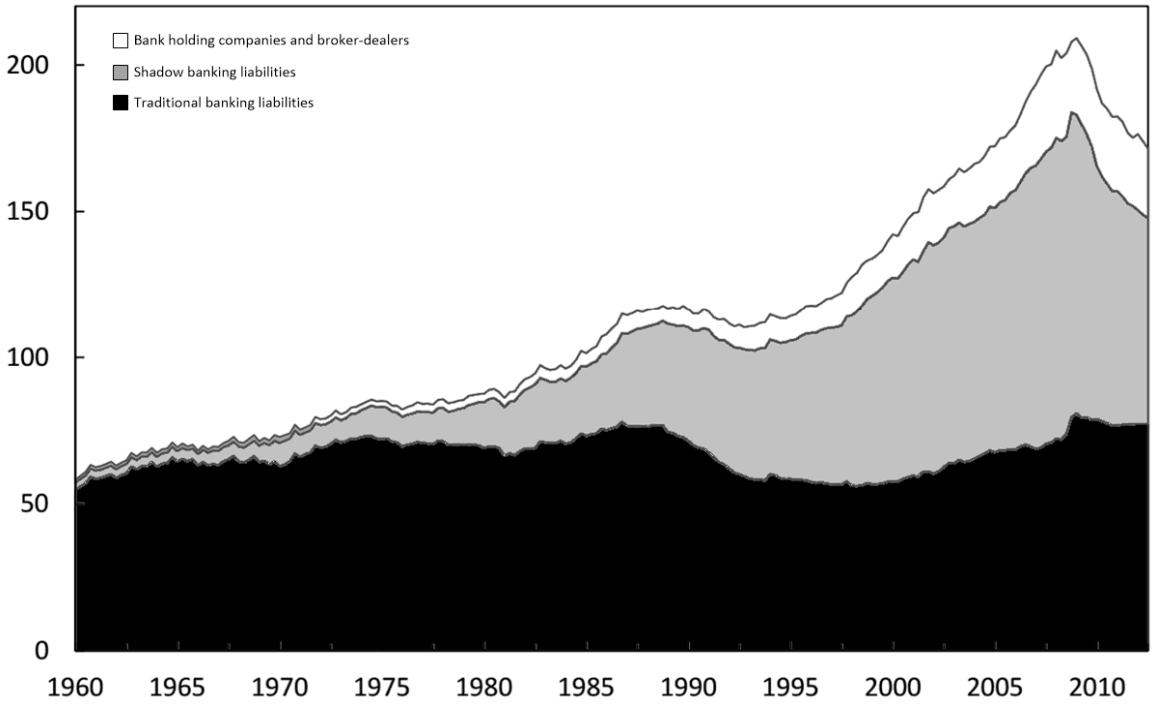
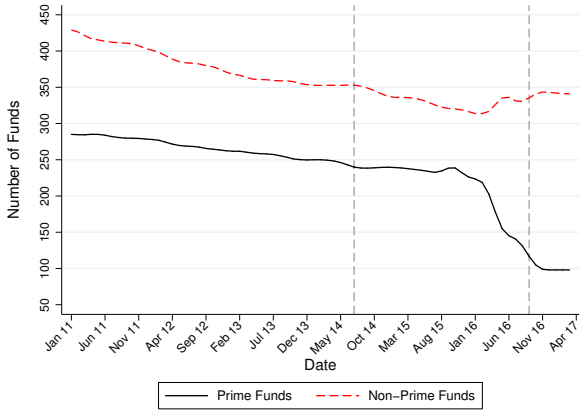
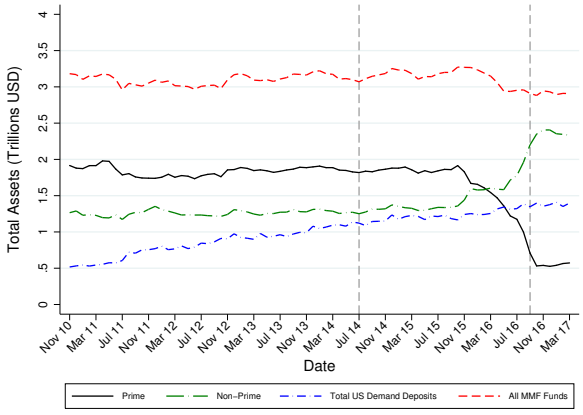


Figure 7: Size of the MMF Industry

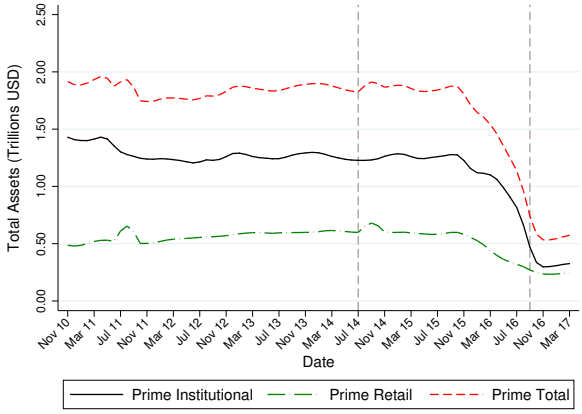
This figure shows the size of the MMF industry during January 2011 through March 2017. The first vertical dashed line marks the announcement of the July 2014 SEC reform, and the second vertical dashed line marks the implementation of that reform in October 2016. Panel (A) plots the number of prime and non-prime funds. Panel (B) plots the total assets held in the MMF industry by prime classification, as well as the total demand deposits held in U.S. depository institutions as reported by FRED. Panel (C) breaks the assets held in the prime sector by clientele classification (i.e. retail vs institutional). Panel (D) plots the total assets held in the MMF industry by fund affiliation classification (i.e. bank, conglomerate, and other). Finally, Panel (E) shows the percentage of assets in the industry that are held in institutional funds.



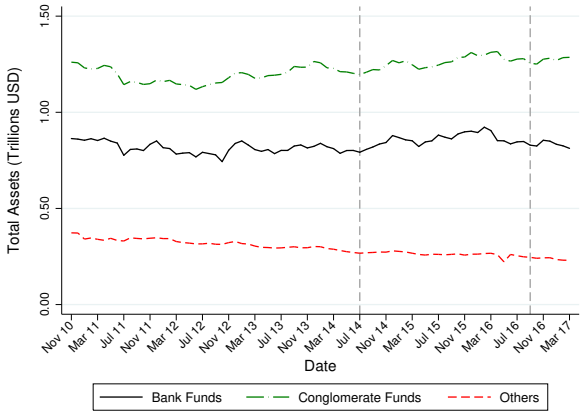
Panel (A)



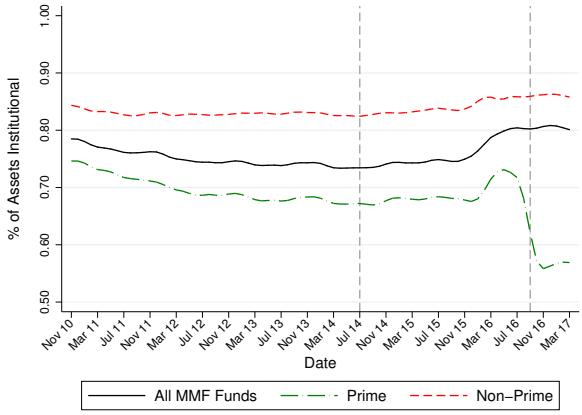
Panel (B)



Panel (C)



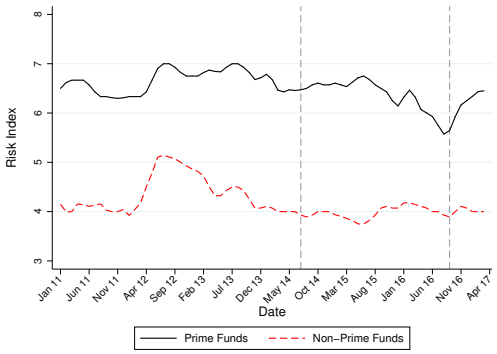
Panel (D)



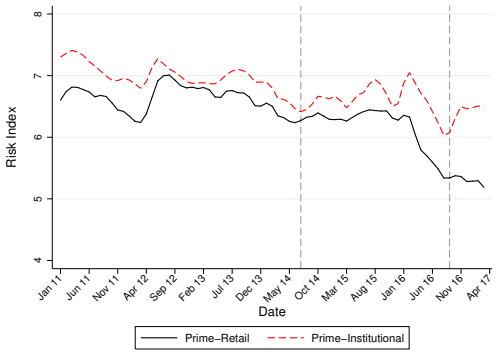
Panel (E)

Figure 8: Risk Index

This figure shows the time-series evolution of portfolio *Risk Index* (asset weighted) in the MMF industry. *Risk Index* is a non-parametric aggregate risk measure for each fund that takes the value between 1 and 10, and constructed by rank ordering five risk measures into deciles. The five risk measures are: WAL, CDS Spread, Opaque Spread, Issue Credit Ratings, and Pct Unsecured. We take the mean of the ranks of the previous measures to construct the risk index, whereby funds with the least portfolio risk assume the value of 1, and funds with the most portfolio risk assume the value of 10. The first vertical dashed line marks the announcement of the July 2014 SEC reform, and the second vertical dashed line marks the implementation of that reform in October 2016. Panel (A) shows the breakdown by fund category (prime vs non-prime). Panel (B) shows the breakdown within the prime sector by clientele category (retail vs institutional). Panel (C) shows the breakdown within the prime sector by affiliation (i.e. bank, conglomerate, and other)



Panel (A)



Panel (B)

Panel (C)

Table 1: Bank and Conglomerate Affiliated MMFs

This table reports the names of the largest investment advisers associated with bank and conglomerate affiliated funds. Covering the time-period between November 2010 and March 2017, this table also highlights the time-series average of assets under management in billions usd held across all funds associated with the asset management firm.

Bank MMFs	Mean Holdings ($B)	Conglomerate MMFs	Mean Holdings ($B)
Bank of America	48.49	BlackRock	208.94
Deutsche Bank	56.36	Charles Schwab	158.42
Goldman Sachs	147.38	Dreyfus	169.39
HSBC	13.53	Fidelity	497.70
JP Morgan	254.22	Franklin	38.27
Morgan Stanley	98.86	Invesco	58.47
PNC	6.20	Legg Mason	139.10
RBC	17.49	Prudential	32.76
UBS	73.01	SSGA	153.89
US Bank	45.30	T Rowe Price	34.81
Wells Fargo	115.57	Vanguard	216.93

Table 2: Summary Statistics

This table reports the summary statistics for the entire sample, covering the time-period between November 2010 and March 2017 with 46,002 observations from 777 unique MMFs that belong to 168 unique asset management firms. *Fund Size* is the total assets, in billions usd, held in a fund. *Fund Family Size* is the total assets, in billions usd, held by an investment management firm across all funds. *Exp Ratio* is the expense ratio of the fund, defined as gross yield minus net yield. *Management Fees* is the dollar value, in millions usd, of management fees defined as the product of a fund's expense ratio by the total assets under management. *Fund Net Flow Ratio* is the fund's net flow of assets for the month divided by assets held under management. *6M Trailing Flow Vol* and *6M Trailing Yield Vol* are the volatilities of fund net flows and gross yields, respectively, over the trailing 6 months. *Issuer CDS Spread* is based on a five-year mid spread in basis points. *Issue Credit Rating* takes the value of 1 for speculative/non-investment grade holdings and up to 5 for high and prime investment-grade holdings. *Pct Unsecured* is the percentage of holdings in a fund without a guarantee. *Opaque Spread* is the percent of opaque holdings minus the percent of safe holdings (treasuries). *Risk Index* is a non-parametric aggregate risk measure for each fund that takes the value between 1 and 10, and constructed by rank ordering five risk measures into deciles. The five risk measures are: WAL, CDS Spread, Opaque Spread, Issue Credit Ratings, and Pct Unsecured. We take the mean of the ranks of the previous measures to construct the risk index, whereby funds with the least portfolio risk assume the value of 1, and funds with the most portfolio risk assume the value of 10.

	Mean	P1	P25	P50	P75	P99	SD
Fund Size ($B)	5.18	0.01	0.24	0.93	4.18	59.29	12.34
Fund Family Size ($B)	117.23	0.08	6.23	78.86	187.21	522.90	129.64
Number of Securities Held	102.79	1.00	32.00	65.00	124.00	659.00	131.52
Gross Yield (BPs)	42.19	0.00	11.00	19.00	29.00	98.00	260.24
Net Yield (BPs)	7.88	0.00	0.00	1.00	3.87	66.00	73.37
Exp Ratio (BPs)	34.31	0.00	9.00	15.64	23.00	73.84	231.31
Management Fees ($M)	15.12	0.00	0.30	1.16	5.50	132.12	308.10
Fund Net Flow Ratio	-0.06	-0.46	-0.04	-0.01	0.02	0.29	2.98
6M Trailing Flow Vol	0.10	0.00	0.02	0.05	0.08	0.66	1.21
6M Trailing Yield Vol	0.15	0.00	0.01	0.04	0.05	3.25	1.19
WAL (Days)	47.78	1.00	26.00	46.00	69.00	111.00	29.80
Issuer CDS Spread (BPs)	70.49	15.92	32.81	54.57	76.59	320.34	165.58
Issue Credit Rating	3.99	3.46	3.78	3.90	4.11	5.00	0.33
Pct Unsecured	27.71	0.00	0.00	6.97	58.80	100.00	31.86
Risk Index	5.03	1.25	3.50	5.00	6.50	8.75	1.81
Pct CP	12.98	0.00	0.00	0.00	22.56	76.42	20.09
Pct Repo	14.38	0.00	0.00	0.00	22.77	90.03	21.88
Pct Municipal	5.33	0.00	0.00	0.00	4.99	40.37	11.04
Pct Treasuries/Gov	23.47	0.00	0.00	4.06	41.49	100.00	32.22
Pct Fin/Ins Securities	10.07	0.00	0.00	0.00	0.14	100.00	28.62
Pct Variable Rate Notes	23.21	0.00	0.00	0.00	59.18	97.92	34.45
Pct Cert. of Deposits	6.87	0.00	0.00	0.00	7.45	50.16	13.21
Pct Other	3.69	0.00	0.00	0.00	3.75	35.30	9.08
Opaque Spread	-19.78	-100.00	-39.71	0.00	0.00	32.00	35.00
Institutional Fund Flag	0.69	0.00	0.00	1.00	1.00	1.00	0.46
Bank Affiliated Flag	0.23	0.00	0.00	0.00	0.00	1.00	0.42
Conglomerate Affiliated Flag	0.38	0.00	0.00	0.00	1.00	1.00	0.49
Prime Fund Flag	0.39	0.00	0.00	0.00	1.00	1.00	0.49

Table 3: Correlations Matrix

This table reports the correlation matrix for key variables using the entire sample, covering the time-period between November 2010 and March 2017 with 46,002 observations from 777 unique MMFs that belong to 168 unique asset management firms.. *Log(Family Size)* is log of all assets held by all funds under the investment management firm. *Net Yield* is the net yield of the fund. *Exp Ratio* is the expense ratio of the fund, defined as gross yield minus net yield. *Log(Management Fees)* is the log of management fees defined as the product of a funds expense ratio by the total assets under management. *Flow Ratio* is the fund's net flow of assets for the month divided by assets held under management. *Flow Vol* and *Yield Vol* are the volatilities of fund net flows and gross yields, respectively, over the trailing 6 months. *CDS Spread* is based on a five-year mid spread (basis points). *Credit Rating* is the issue (security) level weighted average credit rating of the fund, and takes the value of 1 for speculative/non-investment (BB+/Baa1 to B) and up to 5 for high and prime investment-grade holdings (AAA/Aaa to AA-/Aa3). *Pct Unsecured* is the percentage of holdings in a fund without a guarantee. *Opaque Spread* is the percent of opaque holdings minus the percent of safe holdings (treasuries). *Risk Index* is a non-parametric aggregate risk measure for each fund. It ranges in value between 1 and 10, and constructed by rank ordering observations from the five risk measures into ten deciles. The five risk measures are: WAL, CDS Spread, Opaque Spread, Issue Credit Ratings, and Pct Unsecured. We take the mean of the ranks of the previous measures to construct the risk index, whereby funds with the least portfolio risk assume the value of 1, and funds with the most portfolio risk assume the value of 10.

	Log(Family Size)	Net Yield	Exp Ratio	Log(Mgmt Fees)	Flow Ratio	Flow Vol	Yield Vol	WAL	Credit Rating	CDS Spread	Pct Unsecured	Opaque Spread	Risk Index	Bank Funds	Congl. Funds	Prime Funds
Log(Family Size)	1.000															
Net Yield	0.018	1.000														
Exp Ratio	-0.001	0.253	1.000													
Log(Mgmt Fees)	0.224	0.004	0.134	1.000												
Flow Ratio	0.007	0.002	0.000	0.021	1.000											
Flow Vol	-0.003	0.001	0.003	-0.036	-0.961	1.000										
Yield Vol	-0.030	0.080	0.293	0.019	0.000	-0.002	1.000									
WAL	-0.037	0.000	0.006	0.185	0.026	-0.049	0.010	1.000								
Credit Rating	-0.405	0.002	0.015	-0.069	0.058	-0.059	0.037	0.256	1.000							
CDS Spread	0.150	-0.007	0.009	-0.020	-0.007	0.004	-0.008	-0.307	-0.213	1.000						
Pct Unsecured	0.019	0.058	0.033	0.098	-0.032	0.008	0.024	0.053	-0.354	0.426	1.000					
Opaque Spread	0.137	0.037	0.022	-0.001	-0.014	0.019	0.011	-0.416	-0.470	0.482	0.631	1.000				
Risk Index	0.046	0.026	0.019	0.105	0.006	-0.018	0.012	0.308	-0.618	0.516	0.845	0.542	1.000			
Bank Funds	0.187	-0.003	-0.035	0.104	-0.012	0.027	-0.040	-0.022	-0.068	0.020	0.003	0.024	-0.025	1.000		
Congl. Funds	0.577	0.008	-0.011	0.006	0.011	-0.013	-0.015	-0.077	-0.412	0.077	-0.007	0.071	0.005	-0.426	1.000	
Prime Funds	-0.208	0.046	0.003	0.032	0.009	-0.013	0.014	0.167	-0.261	0.059	0.783	0.319	0.528	-0.061	-0.097	1.000

Table 4: Yields and Fund Characteristics

This table reports OLS regression results showing the effects of fund characteristics on yields, covering the time-period between November 2010 and March 2017. Panel (A) shows results where the dependent variable is *Gross Yield Spread*$_{i(t+1)}$. Panel (B) shows results where the dependent variable is *Net Yield Spread*$_{i(t+1)}$. All covariates are as defined in Table 2. T-stats are reported in parentheses. Standard errors are double clustered at the month and fund levels. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

Panel (A) - Gross Yield Spreads

	(Gross Yield Spread)$_{i(t+1)}$				
	(1)	(2)	(3)	(4)	(5)
Risk Index	1.8496***	0.7623*	2.1228***	0.9743**	2.0724***
	(6.71)	(1.98)	(7.79)	(2.65)	(6.67)
Log(Fund Size)	-0.0404	-0.5081*	0.0061	-0.4539	0.1617
	(-0.14)	(-1.67)	(0.02)	(-1.58)	(0.51)
Log(Family Size)	-0.9897**		-0.9602**		1.2582
	(-2.63)		(-2.56)		(0.67)
Exp Ratio	0.3369***	0.3364**	0.3332***	0.3324**	0.3132**
	(2.74)	(2.57)	(2.68)	(2.45)	(2.52)
Fund Net Flow Ratio	0.3408	0.3836	0.3512	0.3630	0.2599
	(0.56)	(0.65)	(0.61)	(0.65)	(0.49)
6M Trailing Flow Vol	2.1947**	1.8927*	1.0823	0.5891	1.0569
	(2.03)	(1.84)	(1.24)	(0.78)	(1.36)
6M Trailing Yield Vol	1.3355	1.2965	1.4641	1.4179	-0.0167
	(1.07)	(1.02)	(1.00)	(0.96)	(-0.01)
Log(Management Fees)	0.6761**	0.6750**	0.5496*	0.5260*	0.5709*
	(2.17)	(2.12)	(1.98)	(1.84)	(1.79)
Institutional Flag		1.3768		1.7656	
		(0.78)		(1.06)	
Bank Affiliated Flag		-3.1871**		-2.5798**	
		(-2.41)		(-2.21)	
Conglomerate Affiliated Flag		-3.0269**		-2.8357*	
		(-2.02)		(-1.98)	
Prime Fund Flag		7.0876**		7.8757**	
		(2.07)		(2.56)	
Prime X Bank		0.1996		-0.5703	
		(0.06)		(-0.20)	
Prime X Conglomerate		0.9996		0.5686	
		(0.27)		(0.16)	
Obs.	41,282	41,282	41,282	41,282	41,282
R-Sq	0.110	0.111	0.117	0.118	0.134
Fund FE					X
Month FE			X	X	X

Panel (B) - Net Yield Spreads

	(Net Yield Spread)$_{i(t+1)}$				
	(1)	(2)	(3)	(4)	(5)
Risk Index	0.7804***	0.1674	0.8251***	0.2749	0.9122***
	(3.71)	(0.80)	(3.94)	(1.35)	(4.28)
Log(Fund Size)	1.5533***	1.3000***	1.5116***	1.2707***	1.4706***
	(4.68)	(3.87)	(4.56)	(3.73)	(4.20)
Log(Family Size)	-0.1534		-0.1723		0.0488
	(-1.01)		(-1.07)		(0.05)
Exp Ratio	0.0073	0.0071	0.0102	0.0099	0.0105
	(0.51)	(0.49)	(0.74)	(0.72)	(0.70)
Fund Net Flow Ratio	0.0840	0.0749	0.4322	0.4126	0.3174
	(0.22)	(0.21)	(1.08)	(1.15)	(0.90)
6M Trailing Flow Vol	1.3412	1.0002	2.1140	1.7202	1.8784
	(0.96)	(0.73)	(1.58)	(1.33)	(1.47)
6M Trailing Yield Vol	0.5792*	0.5864*	0.3336	0.3421	0.1278
	(1.92)	(1.93)	(1.06)	(1.10)	(1.40)
Log(Management Fees)	-0.6914***	-0.6872***	-0.6028**	-0.6059**	-0.5433**
	(-2.81)	(-3.04)	(-2.42)	(-2.63)	(-2.03)
Institutional Flag		1.3263		1.1451	
		(1.49)		(1.30)	
Bank Affiliated Flag		0.5184		0.3611	
		(0.66)		(0.46)	
Conglomerate Affiliated Flag		-0.1256		-0.2462	
		(-0.20)		(-0.36)	
Prime Fund Flag		3.9097***		3.2953***	
		(3.19)		(2.98)	
Prime X Bank		1.9497*		2.1286**	
		(1.95)		(2.17)	
Prime X Conglomerate		0.4364		0.6455	
		(0.27)		(0.41)	
Obs.	41,282	41,282	41,282	41,282	41,282
R-Sq	0.018	0.024	0.070	0.075	0.104
Fund FE					X
Month FE			X	X	X

Table 5: Portfolio Risk Index and Fund Characteristics

This table reports OLS regression results showing the effects of fund characteristics on the portfolio risk index, covering the time-period between November 2010 and March 2017. The dependent variable is the asset weighted portfolio risk index *Risk Index*, which is a non-parametric aggregate risk measure for each fund. It ranges in value between 1 and 10, and constructed by rank ordering observations from the five risk measures into ten deciles. The five risk measures are: WAL, CDS Spread, Opaque Spread, Issue Credit Ratings, and Pct Unsecured. We take the mean of the ranks of the previous measures to construct the risk index, whereby funds with the least portfolio risk assume the value of 1, and funds with the most portfolio risk assume the value of 10. All covariates are as defined in Table 2. T-stats are reported in parentheses. Standard errors are double clustered at the month and fund levels. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(Portfolio Risk Index)$_{i(t+1)}$			
	(1)	(2)	(3)	(4)
Log(Fund Size)	-0.0226	-0.0752***	-0.0230	-0.0732***
	(-0.49)	(-9.57)	(-0.50)	(-9.44)
Log(Family Size)	0.0267		0.0278	
	(0.71)		(0.73)	
Net Yield Spread	0.0093**	0.0005	0.0107*	0.0018*
	(2.17)	(0.42)	(1.99)	(1.69)
Exp Ratio	0.0003	0.0003*	0.0003	0.0002
	(0.72)	(1.70)	(0.74)	(1.24)
Fund Net Flow Ratio	-0.0653	-0.0401	-0.0711	-0.0482
	(-1.29)	(-1.41)	(-1.41)	(-1.65)
6M Trailing Flow Vol	-0.2195	-0.1984***	-0.1862	-0.2001***
	(-1.52)	(-2.97)	(-1.28)	(-2.99)
6M Trailing Yield Vol	-0.0093	-0.0033	-0.0035	0.0022
	(-0.52)	(-0.28)	(-0.16)	(0.14)
Log(Management Fees)	0.0583**	0.0557***	0.0597**	0.0546***
	(2.01)	(17.19)	(2.07)	(17.25)
Institutional Flag		0.0839***		0.0796***
		(4.04)		(3.95)
Bank Affiliated Flag		0.1445***		0.1437***
		(5.31)		(5.16)
Conglomerate Affiliated Flag		0.4294***		0.4333***
		(20.20)		(19.69)
Prime Fund Flag		2.0140***		2.0024***
		(68.75)		(62.53)
Prime X Bank		0.2361***		0.2342***
		(7.94)		(7.93)
Prime X Conglomerate		-0.2396***		-0.2443***
		(-8.76)		(-8.81)
Obs.	41,282	41,282	41,282	41,282
R-Sq	0.021	0.287	0.046	0.306
Fund FE				
Month FE			X	X

Table 6: Prime MMFs Difference-in-Differences Regressions

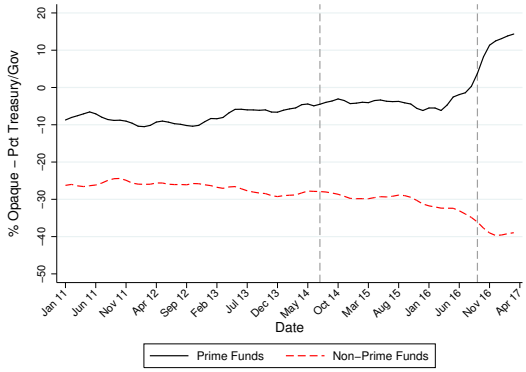
This table reports difference-in-differences regression results showing the impact of SEC regulations on prime institutional funds. The sample in this table covers the time-period November 2010 through March 2017, except for the specification in column (8), where the sample period is May 2012 through March 2017. The variable *Prime-Inst X Post* is the key difference-in-differences covariate which measures the causal impact of the SEC regulation on the dependent variable. *Post* takes the value of 1 starting from October 2016 when the regulation was to be complied with. T-stats are reported in parentheses. Standard errors are double clustered at the month and fund levels. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	Gross Yield	Net Yield	Risk Index	Log(Mgmt Fees)	Opaque Spread	WAL	Pct Unsecured	Credit Rating	CDS Spread
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Prime-Inst X Post	10.0290***	14.3067***	0.7172***	1.5362*	11.0273**	11.5721**	7.9524*	-0.0197*	4.0559***
	(4.21)	(3.71)	(2.85)	(1.76)	(2.58)	(2.38)	(1.98)	(-1.81)	(13.13)
Log(Family Size)	1.7813	0.8566	0.1615	-0.4874*	-0.9177	1.9525	-4.9741	-0.0621***	2.8824***
	(0.80)	(0.55)	(1.24)	(-1.72)	(-0.42)	(0.74)	(-1.52)	(-3.54)	(20.27)
Log(Fund Size)	0.4485	1.7523***	0.0688	0.6596***	1.2916	0.9390	-0.1319	0.0079	-0.2105
	(1.06)	(2.77)	(0.87)	(4.20)	(1.39)	(0.65)	(-0.16)	(0.69)	(-1.38)
Exp Ratio	0.4952***	0.0212	0.0001	0.0027***	-0.0001	0.0019	-0.0023*	-0.0000***	0.0044*
	(4.33)	(0.51)	(0.34)	(3.95)	(-0.09)	(0.58)	(-1.87)	(-2.83)	(1.91)
Fund Net Flow Ratio	2.1767	0.4827	0.0356	-0.1478*	1.9152	-0.5992	-0.4521	0.0010	-0.6587**
	(1.36)	(1.37)	(0.62)	(-1.80)	(1.62)	(-0.62)	(-0.37)	(0.22)	(-2.53)
6M Trailing Flow Vol	-0.2210	0.3225	-0.1996*	-0.3370*	-1.5863	-6.4690***	-0.2125	-0.0187**	-0.0102
	(-0.16)	(0.25)	(-1.68)	(-1.78)	(-0.50)	(-3.42)	(-0.41)	(-2.47)	(-0.05)
6M Trailing Yield Vol	-3.7783	-0.4619*	0.0180	-0.0857	-0.0476	0.7514	0.1845	0.0057	-0.5298**
	(-1.44)	(-1.72)	(0.85)	(-1.19)	(-0.23)	(1.61)	(0.92)	(1.12)	(-2.16)
Log(Management Fees)	0.3351	-0.6284**	-0.0204		0.5737*	-0.2876	0.9241**	0.0074	0.6760***
	(1.33)	(-2.53)	(-0.39)		(1.75)	(-0.39)	(2.45)	(1.60)	(18.70)
Obs.	16,141	16,141	16,141	16,140	16,109	16,141	14,023	1,782	7,740
R-Sq	0.279	0.135	0.476	0.349	0.612	0.480	0.637	0.844	0.419
Fund FE	X	X	X	X	X	X	X	X	X
Month FE	X	X	X	X	X	X	X	X	X

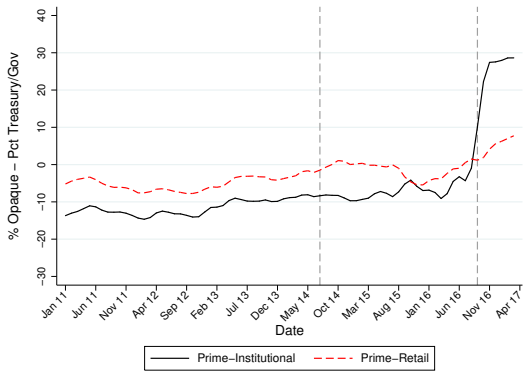
A Appendix - robustness figures and tables

Figure A1: Opaque Spread

This figure shows the time-series evolution of *Opaque Spread* (asset weighted) in the MMF industry. The first vertical dashed line marks the announcement of the July 2014 SEC reform, and the second vertical dashed line marks the implementation of that reform in Oct. 2016. Panel (A) shows the breakdown by fund category (prime vs non-prime). Panel (B) shows the breakdown within the prime sector by clientele category (retail vs institutional). Panel (C) shows the breakdown within the prime sector by affiliation (i.e. bank, conglomerate, and other)



Panel (A)

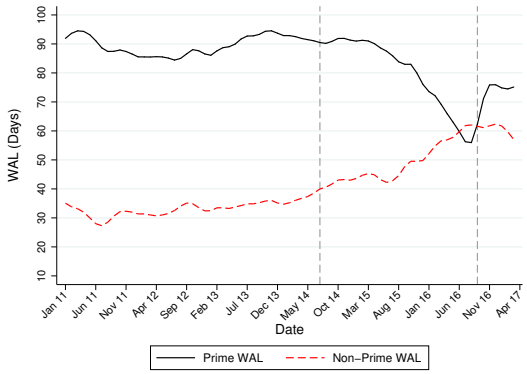


Panel (B)

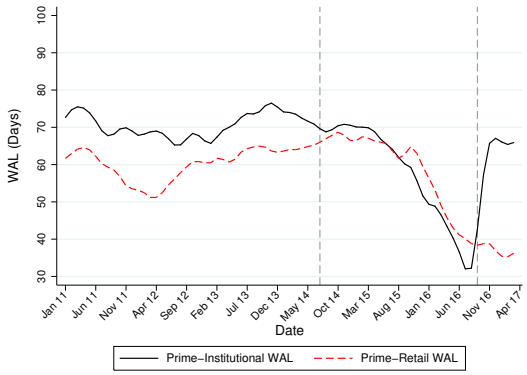
Panel (C)

Figure A2: Portfolio Weighted Average Life Maturity (WAL)

This figure shows the time-series evolution of *WAL* in fund portfolios (asset weighted) in the MMF industry. The first vertical dashed line marks the announcement of the July 2014 SEC reform, and the second vertical dashed line marks the implementation of that reform in Oct. 2016. Panel (A) shows the breakdown by fund category (prime vs non-prime). Panel (B) shows the breakdown within the prime sector by clientele category (retail vs institutional). Panel (C) shows the breakdown within the prime sector by affiliation (i.e. bank, conglomerate, and other)



Panel (A)

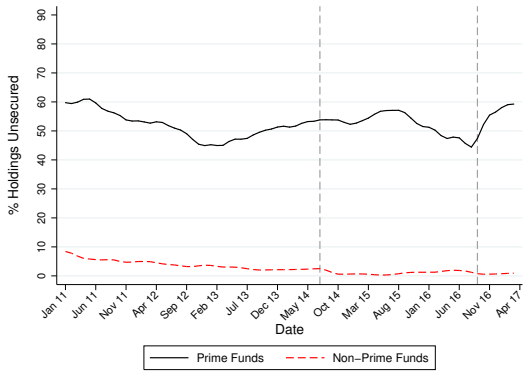


Panel (B)

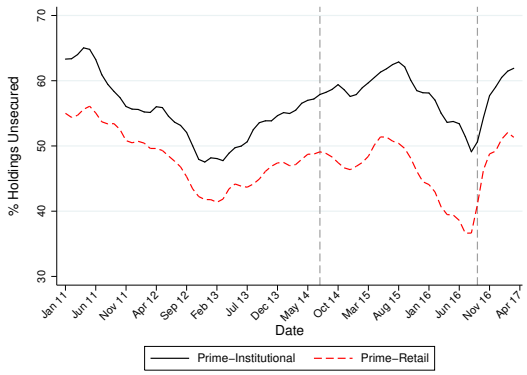
Panel (C)

Figure A3: Pct Unsecured

This figure shows the time-series evolution of *Pct Unsecured* in fund portfolios (asset weighted) in the MMF industry. The first vertical dashed line marks the announcement of the July 2014 SEC reform, and the second vertical dashed line marks the implementation of that reform in Oct. 2016. Panel (A) shows the breakdown by fund category (prime vs non-prime). Panel (B) shows the breakdown within the prime sector by clientele category (retail vs institutional). Panel (C) shows the breakdown within the prime sector by affiliation (i.e. bank, conglomerate, and other)



Panel (A)

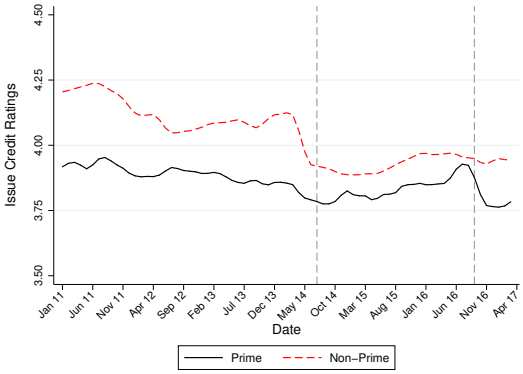


Panel (B)

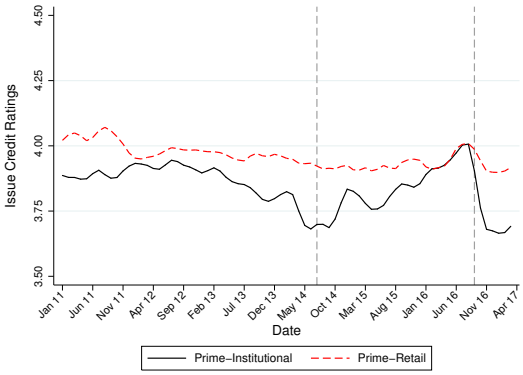
Panel (C)

Figure A4: Credit Ratings

This figure shows the time-series evolution of *Issue-level Credit Ratings* in fund portfolios (asset weighted) in the MMF industry. The variable takes the value of 1 for speculative/non-investment grade holdings (BB+/Baa1 to B) and up to 5 for high and prime investment-grade holdings (AAA/Aaa to AA-/Aa3). The first vertical dashed line marks the announcement of the July 2014 SEC reform, and the second vertical dashed line marks the implementation of that reform in Oct. 2016. Panel (A) shows the breakdown by fund category (prime vs non-prime). Panel (B) shows the breakdown within the prime sector by clientele category (retail vs institutional). Panel (C) shows the breakdown within the prime sector by affiliation (i.e. bank, conglomerate, and other)



Panel (A)



Panel (B)

Panel (C)

Table A1: Prime MMFs Difference-in-Differences Regressions - Placebo Tests

This table reports difference-in-differences regression results showing the impact of SEC regulations on prime institutional funds. As a robustness check, Panel (A) executes a placebo test using the time period between January 2014 and February 2015, and defining the shock as the announcement month of the regulation in July 2014 in lieu of the compliance month of October 2016. Panel (B) assigns a randomly generated month between January 2014 and March 2017 as the regulatory shock. The variable *Prime-Inst X Post* is the key difference-in-differences covariate which measures the causal impact of the SEC regulation on the dependent variable. *Post* takes the value of 1 starting from July 2014 when the regulation was announced (for the placebo test in Panel (B) it takes the value of 1 using a randomly generated month between January 2014 and March 2017). T-stats are reported in parentheses. Standard errors are double clustered at the month and fund levels. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

Panel (A) - Using Announcement in July 2014 as DID Shock (Data From Jan 2014 to Feb 2015)

	Gross Yield	Net Yield	Risk Index	Log(Mgmt Fees)	Opaque Spread	WAL	Pct Unsecured	Credit Rating	CDS Spread
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Prime-Inst X Post	3.0661	0.1914	-0.1492	1.7110***	1.8792	-3.1697	2.2913	0.0140	0.1600
	(1.34)	(0.26)	(-0.72)	(7.44)	(1.60)	(-0.75)	(1.72)	(0.53)	(0.48)
Log(Family Size)	-14.1489	0.0960	-0.2874	-0.0510	0.5729	-6.3142*	-0.0939	0.0687	2.1646***
	(-1.23)	(0.18)	(-1.55)	(-0.19)	(0.16)	(-1.99)	(-0.04)	(0.72)	(16.16)
Log(Fund Size)	0.8611	1.1795*	0.0392	0.5724***	0.6315	0.9721	0.3535	0.1114	-0.0598
	(1.51)	(1.81)	(0.47)	(27.51)	(0.63)	(0.54)	(0.74)	(1.28)	(-0.49)
Exp Ratio	0.7394**	-0.0144	0.0010**	0.0055***	0.0006	0.0265**	0.0892	0.0110*	0.2253***
	(2.27)	(-1.10)	(2.24)	(4.62)	(0.79)	(2.76)	(1.18)	(1.79)	(4.09)
Fund Net Flow Ratio	7.3325	1.9846**	-0.1023	-1.2717***	-0.2295	-2.3039	-0.8000	-0.0636**	-2.2697
	(1.31)	(2.25)	(-0.56)	(-4.72)	(-0.12)	(-0.88)	(-0.56)	(-2.28)	(-1.05)
6M Trailing Flow Vol	14.1143*	11.0978**	-1.8196**	-2.1078**	-3.1624	-39.0378***	6.0613	0.0715	12.5759***
	(1.84)	(2.34)	(-2.21)	(-2.81)	(-0.85)	(-3.19)	(0.87)	(0.66)	(4.78)
6M Trailing Yield Vol	5.0697	2.0243	-0.3120***	-0.4231**	0.0370	-8.0560***	-23.8735	0.1726	-54.6495***
	(1.34)	(1.19)	(-7.16)	(-2.38)	(0.23)	(-9.93)	(-1.30)	(1.20)	(-4.28)
Log(Management Fees)	-0.1702	-0.3261*	-0.0289		-0.0152	-0.5653	0.2117*	-0.0801	0.2879***
	(-0.43)	(-2.05)	(-0.54)		(-0.28)	(-0.71)	(1.79)	(-0.95)	(3.81)
Obs.	3,137	3,137	3,137	3,137	3,123	3,137	2,742	270	2,768
R-Sq	0.519	0.332	0.555	0.405	0.899	0.536	0.897	0.910	0.322
Fund FE	X	X	X	X	X	X	X	X	X
Month FE	X	X	X	X	X	X	X	X	X

Panel (B) - Placebo Test Using a Randomly Generated Month Between Jan 2014 and March 2017 as the Shock

	Gross Yield	Net Yield	Risk Index	Log(Mgmt Fees)	Opaque Spread	WAL	Pct Unsecured	Credit Rating	CDS Spread
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Prime-Inst X Post	0.4529	1.2162	-0.0189	0.8930*	2.8295***	-2.3031	0.7555	0.0017	-0.3106
	(0.26)	(1.45)	(-0.15)	(1.95)	(2.94)	(-1.24)	(1.47)	(0.30)	(-0.50)
Log(Family Size)	1.7682	0.8345	0.1609	-0.4901	-0.9420	1.9537	-3.5432*	-0.0626***	-0.0625
	(0.80)	(0.54)	(1.26)	(-1.36)	(-0.43)	(0.75)	(-1.98)	(-3.26)	(-0.03)
Log(Fund Size)	0.4159	1.7080***	0.0663	0.6511***	1.2649	0.8905	0.7627	0.0085	-0.6627
	(1.00)	(2.70)	(0.84)	(4.22)	(1.37)	(0.62)	(0.89)	(0.87)	(-0.59)
Exp Ratio	0.4952***	0.0210	0.0000	0.0026***	-0.0002	0.0018	-0.0020***	-0.0000**	0.0026
	(4.33)	(0.60)	(0.30)	(3.58)	(-0.15)	(0.56)	(-3.12)	(-2.19)	(0.99)
Fund Net Flow Ratio	2.3033	0.6612*	0.0448	-0.1286*	2.0461*	-0.4435	-1.2879	0.0006	0.4100
	(1.46)	(1.69)	(0.84)	(-1.69)	(1.79)	(-0.51)	(-1.03)	(0.13)	(1.24)
6M Trailing Flow Vol	0.2071	0.9085	-0.1668	-0.3045*	-1.2169	-5.8527***	1.1827	-0.0186**	0.5375
	(0.15)	(0.69)	(-1.52)	(-1.68)	(-0.40)	(-3.33)	(1.63)	(-2.35)	(1.26)
6M Trailing Yield Vol	-3.7753	-0.4563*	0.0181	-0.0829	-0.0390	0.7484	0.2830*	0.0057**	-0.7871
	(-1.44)	(-1.70)	(0.84)	(-1.14)	(-0.19)	(1.60)	(1.82)	(2.59)	(-1.13)
Log(Management Fees)	0.3351	-0.6354**	-0.0198		0.5451	-0.2528	0.1591*	0.0074	0.0702
	(1.39)	(-2.63)	(-0.38)		(1.67)	(-0.34)	(1.84)	(1.48)	(0.89)
Obs.	16,141	16,141	16,141	16,140	16,109	16,141	14,017	1,782	11,137
R-Sq	0.279	0.134	0.475	0.356	0.613	0.480	0.741	0.844	0.502
Fund FE	X	X	X	X	X	X	X	X	X
Month FE	X	X	X	X	X	X	X	X	X

Table A2: Municipal MMFs Difference-in-Differences Regressions

This table reports difference-in-differences regression results showing the impact of SEC regulations on municipal institutional funds. The sample in this table cover the time-period between November 2010 and March 2017, except for the specification in column (8), where the sample period begins in May 2012 and ends in March 2017. The variable *Muni-Inst X Post* is the key difference-in-differences covariate which measures the causal impact of the SEC regulation on the dependent variable. *Post* takes the value of 1 starting from October 2016 when the regulation was enacted. T-stats are reported in parentheses. Standard errors are double clustered at the month and fund levels. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	Gross Yield	Net Yield	Risk Index	Log(Mgmt Fees)	Opaque Spread	WAL	Pct Unsecured	Credit Rating	CDS Spread
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Muni-Inst X Post	5.3578***	6.6417***	0.8321***	0.0401	0.5293	9.5216**	0.2687*	-0.0336**	9.4510***
	(4.52)	(3.40)	(3.55)	(0.44)	(0.10)	(2.28)	(1.82)	(-2.56)	(3.16)
Log(Family Size)	4.2741**	6.2626**	-0.0615	0.0262	1.9909	-2.3105	-0.8091	-0.0826***	-14.9455***
	(2.08)	(2.73)	(-0.25)	(0.08)	(0.54)	(-0.88)	(-0.59)	(-14.52)	(-3.79)
Log(Fund Size)	-0.5508	-0.9255**	0.0481	1.0036***	0.5552	0.7295	0.6145***	-0.0494***	19.2918*
	(-1.50)	(-2.26)	(0.53)	(86.58)	(1.43)	(0.75)	(4.03)	(-5.78)	(1.99)
Exp Ratio	0.3981***	-0.4524***	0.0039	0.0356***	0.0088	0.2658***	0.0030	-0.0054***	-0.4012
	(3.38)	(-3.34)	(0.50)	(5.12)	(0.17)	(3.10)	(0.34)	(-6.33)	(-0.73)
Fund Net Flow Ratio	-0.3718	0.0397	-0.0147**	0.0032	0.0204	-0.2071**	1.9101	0.0464*	-0.0636
	(-1.05)	(0.12)	(-2.32)	(0.28)	(0.58)	(-2.38)	(0.93)	(1.95)	(-0.13)
6M Trailing Flow Vol	-0.6342**	-0.5891***	-0.0811	0.0140	-0.8576***	-1.0804	-2.4692	0.0086***	2.7250*
	(-2.54)	(-3.48)	(-1.51)	(0.60)	(-3.53)	(-1.53)	(-0.69)	(2.87)	(1.97)
6M Trailing Yield Vol	0.1899***	0.0930	0.0088	-0.0069*	-0.0096	0.1622***	0.1237***	0.0046	-91.3876
	(3.20)	(1.62)	(1.36)	(-1.76)	(-0.20)	(5.52)	(6.37)	(1.63)	(-1.21)
Log(Management Fees)	0.4101	0.7826**	-0.0007		-0.2181	0.9433	-0.0396	0.0239***	-15.2439
	(1.39)	(2.49)	(-0.02)		(-0.90)	(1.39)	(-0.48)	(5.54)	(-1.52)
Obs.	6,690	6,690	6,690	6,688	6,688	6,690	1,385	941	5,164
R-Sq	0.847	0.745	0.410	0.778	0.428	0.486	0.872	0.612	0.207
Fund FE	X	X	X	X	X	X	X	X	X
Month FE	X	X	X	X	X	X	X	X	X

Table A3: Prime MMFs Difference-in-Differences Regressions - Robustness to Subsamples

This table reports difference-in-differences regression results showing the impact of SEC regulations on prime institutional funds. As a robustness check, the sample in this table covers a shorter time period compared to the main analysis in Table 6. The sample period is shortened to examine the effects of the regulation by only looking at the six months before and after the SEC reform. Panel (A) shows the results using the data for the time-period between May 2016 and March 2017, and Panel (B) uses data from January 2014 to March 2017, excluding the time period between July 2014 and October 2016. The excluded period in Panel (B) represents the time frame when the announcement was made by the SEC until the point the regulation went into effect, and it is excluded to isolate any effects that might be captured during the anticipation and run-up to compliance period. Panel (C) executes a placebo test using the time period between January 2014 and February 2015, and defining the shock as the announcement month of the regulation in July 2014 in lieu of the compliance month of October 2016. The variable *Prime-Inst X Post* is the key difference-in-differences covariate which measures the causal impact of the SEC regulation on the dependent variable. *Post* takes the value of 1 starting from October 2016 when the regulation was enacted (for the placebo test in Panel (C) it takes the value of 1 starting July 2014). T-stats are reported in parentheses. Standard errors are double clustered at the month and fund levels. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

Panel (A) - Using Data From May 2016 to March 2017

	Gross Yield	Net Yield	Risk Index	Log(Mgmt Fees)	Opaque Spread	WAL	Pct Unsecured	Credit Rating	CDS Spread
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Prime-Inst X Post	7.0093**	7.0262***	0.6503**	2.7212***	5.8355***	14.0543***	3.9696**	0.0065	2.8508***
	(3.34)	(3.62)	(2.61)	(7.53)	(3.93)	(3.56)	(2.40)	(0.70)	(6.39)
Log(Family Size)	-2.5991	0.3533	-0.1570	0.4032	-3.9974	-5.0983	5.0051	-0.0040	3.7526***
	(-0.57)	(0.08)	(-0.35)	(0.90)	(-1.44)	(-0.64)	(1.67)	(-0.04)	(10.54)
Log(Fund Size)	-0.0736	-0.2340	-0.0232	0.9443***	2.5854***	-0.8537	-1.0639	0.0029	-1.0957***
	(-0.08)	(-0.25)	(-0.46)	(27.07)	(5.22)	(-0.68)	(-1.68)	(0.18)	(-4.76)
Exp Ratio	0.1080	-0.8801***	0.0077	0.0733***	0.0206	0.2313**	0.0114	-0.0009	0.0814***
	(1.78)	(-14.57)	(1.30)	(8.28)	(0.42)	(2.42)	(0.28)	(-1.41)	(5.27)
Fund Net Flow Ratio	0.9162	0.5628	0.1085**	-0.3089***	1.8477**	0.5786	0.7571	0.0037	-0.6418***
	(1.44)	(0.82)	(3.10)	(-4.21)	(2.55)	(1.26)	(0.44)	(0.45)	(-5.64)
6M Trailing Flow Vol	-1.5803	-2.4309**	-0.0972	-0.0510	0.5746	-3.6532***	0.2699	-0.0143**	-0.4457**
	(-1.54)	(-2.54)	(-1.51)	(-1.30)	(0.58)	(-8.26)	(0.38)	(-3.15)	(-2.92)
6M Trailing Yield Vol	10.6654	12.5283	0.6230	-2.3407	4.3985	10.7971	7.4677***	0.0068	-0.9356***
	(1.12)	(1.19)	(1.53)	(-1.27)	(1.39)	(0.99)	(5.83)	(0.47)	(-5.96)
Log(Management Fees)	0.6940*	0.7275**	0.0468*		0.6965**	0.8670**	0.4131*	-0.0015***	0.7846***
	(2.27)	(2.52)	(2.22)		(3.33)	(2.78)	(1.93)	(-4.23)	(5.66)
Obs.	932	932	932	931	932	932	697	286	713
R-Sq	0.736	0.787	0.679	0.541	0.853	0.708	0.667	0.932	0.378
Fund FE	X	X	X	X	X	X	X	X	X
Month FE	X	X	X	X	X	X	X	X	X

Panel (B) - Using Data From Jan 2014 to March 2017, Excluding July 2014 to October 2016

	Gross Yield	Net Yield	Risk Index	Log(Mgmt Fees)	Opaque Spread	WAL	Pct Unsecured	Credit Rating	CDS Spread
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Prime-Inst X Post	5.4445*	15.9553**	0.5632**	2.6451***	6.0411***	12.3932**	3.5764**	-0.0273	4.4925***
	(1.93)	(3.21)	(2.44)	(11.74)	(4.20)	(3.04)	(2.43)	(-1.78)	(3.79)
Log(Family Size)	-6.9119	-1.9549	0.5021	-2.7731***	-1.5034	-5.5303	5.3088*	-0.0606	2.7803***
	(-1.75)	(-0.40)	(1.40)	(-15.39)	(-0.90)	(-1.03)	(1.99)	(-0.77)	(17.35)
Log(Fund Size)	1.0123	1.5509*	0.0383	0.7109***	0.5394	1.5187	-0.4814**	0.0092	-0.5979**
	(0.79)	(2.28)	(0.56)	(11.90)	(1.51)	(1.13)	(-2.82)	(0.98)	(-3.22)
Exp Ratio	-0.0024	-0.0561	0.0005	0.0079	-0.0026	0.0130	0.0405	0.0009**	0.1440**
	(-0.69)	(-0.98)	(0.89)	(1.55)	(-0.56)	(1.15)	(0.86)	(3.08)	(3.39)
Fund Net Flow Ratio	15.2295***	4.6674	0.4158	-0.3234	14.0694*	1.7242	3.9113	-0.0386***	-6.6216
	(5.71)	(1.72)	(1.80)	(-0.91)	(2.30)	(0.48)	(0.72)	(-5.02)	(-1.12)
6M Trailing Flow Vol	-1.3453	-0.6913	-0.1619	-0.0929*	-0.6392	-4.8684**	-0.6521	-0.0165***	-0.2078
	(-1.34)	(-0.61)	(-1.82)	(-2.27)	(-0.67)	(-3.33)	(-1.37)	(-5.79)	(-1.03)
6M Trailing Yield Vol	-3.2973**	5.4611	-0.3532***	-0.6165	0.8044	-9.1902***	33.8578	0.4404***	23.0144
	(-3.07)	(1.05)	(-10.66)	(-1.39)	(1.50)	(-10.02)	(1.51)	(4.22)	(0.88)
Log(Management Fees)	0.8705***	-0.7124**	-0.0100		0.6948***	0.0948	0.8302***	0.0007	0.4287***
	(7.40)	(-3.30)	(-0.20)		(4.67)	(0.12)	(3.66)	(0.99)	(11.54)
Obs.	1,363	1,363	1,363	1,364	1,358	1,363	1,138	243	1,157
R-Sq	0.114	0.545	0.579	0.378	0.786	0.605	0.738	0.941	0.379
Fund FE	X	X	X	X	X	X	X	X	X
Month FE	X	X	X	X	X	X	X	X	X

B Appendix - opacity of portfolio securities

Asset categories, portfolio opacity, and fund returns

To motivate our measure for fund opacity, we test whether certain categories of fund holdings (e.g., asset classes) can explain gross and net yield spreads. We argue that the proportion of opaque holdings in a fund proxies for risk. If this measure captures portfolio risk, then we would expect it to be associated with higher fund returns. The following equation describes the regression specification employed in this test.

$$\begin{aligned} Y_{i(t+1)} &= \beta_1 \% Opaque_{it} + \beta_2 \% CP_{it} + \beta_3 \% Municipal_{it} + \beta_4 \% Repo_{it} \\ &\quad + \beta_5 \% Fin/Ins_{it} + \beta_6 \% VRN_{it} + M_t + F_i + \epsilon_{it} \end{aligned} \tag{B1}$$

where $Y_{i(t+1)}$ is an outcome variable that is either gross or net fund yield spread (annualized) above the risk free rate. The main independent variable of interest is *% Opaque*, a unique risk proxy defined as the percentage of assets in a portfolio that are categorized as "Other" when a fund files to the SEC. *%CP* is the percentage of Commercial Paper securities held by the fund, and it includes financial company CP, Other CP, and asset backed CP. *%Municipal* is the percentage of municipal bond securities held by the fund. *%Repo* is the percentage of repurchase agreement securities held by the fund, and it includes government agency repo, treasury repo, and other repo. *%Fin/Ins Securities* is the percentage securities in the portfolio issued by financial and insurance firms. *%VRN* is the percentage of variable rate demand notes held by the fund. The omitted category in this regression is treasury and government securities. M_t is the month fixed effects, and controls for common trends shared by all MMFs in the cross-section. F_i is the fund fixed effects, which control for time invariant unobservables for each MMF in the time-series. Regression standard errors are double clustered at the fund and month levels.

Table B1 shows the OLS results of this test. In columns (1)-(3), the dependent variable is the fund's next period annualized gross yield spread above the risk free rate, denoted *(Gross Yield Spread)*$_{i(t+1)}$. The dependent variable in columns (4)-(6) is *(Net Yield Spread)*$_{i(t+1)}$.[26] The independent variables are the percentage holdings of each security category at the fund level. The omitted category is treasury and government securities. Across different specifications of fixed effects, *Pct Opaque* is consistently positive and statistically significant with the largest coefficient magnitude. These results indicate that a one percentage point increase in *Pct Opaque* is associated with a 0.35 basis points increase in gross-yield spreads, and 0.14 basis points increase in net-yield spreads. With the largest coefficient compared to other asset class covariates, this result is consistent with the hypothesis that opaque holdings are associated with higher portfolio risk. The percentage of commercial paper holdings, denoted *Pct CP*, is also positive and significant across all specifications. A one percentage point increase in *Pct CP* is associated with a 0.22 basis points increase in gross-yield spreads, and 0.09 basis points increase in net-yield spreads.

[26] The spread in gross and net yields is relative to the risk free rate, defined here as the one month treasury bill return. The yields are annualized.

Table B1: Yields and Security Holdings

This table reports OLS regression results showing the effects of security holdings on fund yields, covering the time-period between November 2010 and March 2017. The dependent variable is *Net Yield Spread*$_{i(t+1)}$. *Pct Opaque* is the percentage of assets, relative to total assets, held under management in which the security is categorized as 'other' in the SEC filing. *Pct CP* is the percentage of Commercial Paper securities held by the fund, and it includes financial company CP, Other CP, and asset backed CP. *Pct Municipal* is the percentage of municipal bond securities held by the fund. *Pct Repo* is the percentage of repurchase agreement securities held in the fund, and it includes government agency repo, treasury repo, and other repo. *Pct Fin/Ins Securities* is the percentage of financial and insurance company securities held by the fund. *Pct Variable Rate Notes* is the percentage of variable rate demand notes held by the fund. The omitted category is treasury and government securities. T-stats are reported in parentheses. Standard errors are double clustered at the month and fund levels. * denotes $p < 0.1$, ** denotes $p < 0.05$, and *** denotes $p < 0.01$.

	(Gross Yield Spread)$_{i(t+1)}$			(Net Yield Spread)$_{i(t+1)}$		
	(1)	(2)	(3)	(4)	(5)	(6)
Pct Opaque	0.3532***	0.2776***	0.3491*	0.1965***	0.2169***	0.1418**
	(3.82)	(2.92)	(1.92)	(5.30)	(5.51)	(2.06)
Pct CP	0.1947**	0.2383***	0.2162***	0.0472**	0.0335*	0.0942***
	(2.47)	(3.37)	(3.24)	(2.22)	(1.90)	(3.73)
Pct Municipal	0.0303	0.0688	0.0828	0.0254	0.0161	-0.0078
	(0.62)	(1.45)	(1.39)	(0.90)	(0.61)	(-0.21)
Pct Repo	0.0073	0.0133	-0.0431	0.0322**	0.0305**	0.0277**
	(0.25)	(0.47)	(-0.99)	(2.08)	(2.14)	(2.14)
Pct Fin/Ins Securities	0.0582	0.0607*	0.0588	0.0304***	0.0302***	0.0366***
	(1.58)	(1.67)	(1.62)	(2.81)	(2.78)	(3.77)
Pct Variable Rate Notes	0.0350	0.0391	0.0200	0.0015	-0.0010	0.0044
	(1.18)	(1.59)	(0.90)	(0.14)	(-0.10)	(0.43)
Obs.	45,070	45,070	45,069	45,070	45,070	45,069
R-Sq	0.002	0.016	0.044	0.006	0.048	0.077
Fund FE			X			X
Month FE		X	X		X	X