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Investors' appetite for money-like assets: The money market fund industry after the 2014 regulatory reform

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Abstract

We document the reaction of money market fund (MMF) investors and portfolio managers to a new SEC regulation that came into effect in October 2016. This regulation forces all prime and municipal MMFs to adopt a system of redemption gates and fees and institutional prime and muni MMFs to also operate under a floating net asset value (NAV). First, we show that in anticipation of the new regulatory framework, investors flowed from prime and muni into government MMFs and especially toward the riskier type of government MMF, agency MMFs, consistent with their likely higher risk appetite profile. Second, the flows from prime and muni MMFs into government MMFs mostly occurred within fund families, supporting the hypothesis that the flows were due to the regulatory changes. This contrasts with past outflows from prime and muni MMFs into government MMFs, such as those seen during the 2008 crisis; in those cases, investors often left not only their prime and muni fund but also the fund family. We relate such differences in investors' behavior to their appetite for money-like assets, whose supply was impacted by the new regulation, as opposed to traditional flight-to-safety motives. Third, the outflow from prime and muni MMFs was stronger for institutional investors, consistent with the fact that these investors are more elastic to industry developments and have been subject to a stricter regulation than retail investors. Finally, as a result of the outflows from prime and muni funds, MMF credit to the private sector has been significantly reduced, whereas credit to government-sponsored enterprises (and in particular Federal Home Loan Banks) has increased substantially.

Key words: money market funds, regulation

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1 Introduction

After the 2008 run on the money market fund (MMF) industry, academics and policy makers have spent much effort to try to understand the sources of fragility in the industry and make it more resilient. These efforts have led the SEC to approve a new regulation in July 2014, which came into effect in October 2016.

U.S. money market funds are open-ended mutual funds that invest in money market instruments. MMFs are pivotal players in the financial markets: as of the end of 2014, they had roughly \$3 trillion in assets under management and held approximately 35% of the global outstanding volume of commercial papers (see ICI, 2015). In particular, they are a critical source of short-term financing for financial institutions: in May 2012, they provided roughly 35% of such funding, with 73% of prime MMF assets consisting of debt instruments issued by large global banks (see Hanson, Scharfstein, and Sunderam, 2015). Similarly to other mutual funds, MMFs are paid fees as a fixed percentage of their assets under management (AUM) and are therefore subject to the tournament-like incentives generated by a positive flow-performance relation (see La Spada, 2017). In contrast to other mutual funds, however, until the new SEC regulation came into effect in October 2016, all MMFs aimed to keep the NAV of their assets at \$1 per share; they have done so by valuing assets at amortized cost and providing daily dividends as securities progress toward their maturity date. Since their deposits are not insured by the government and are daily redeemable, this stable NAV feature makes MMFs susceptible to runs. If a fund “breaks the buck,” i.e., its NAV drops below \$1, investors will likely redeem their investment en masse (i.e., run on the fund) to preserve the value of their capital. This happened on September 16, 2008, when Reserve Primary Fund, the oldest MMF, broke the buck after writing off debt issued by Lehman Brothers.

The interaction between risk-taking incentives and exposure to runs made MMFs a key ingredient of the recent financial crisis. Indeed, in September 2008, the run on Reserve Primary Fund quickly spread to other prime MMFs, triggering investors’ redemptions of more than \$300 billion within a few days after Lehman’s default. This caused a severe shortage of short-term credit to the banking sector (see Kacperczyk and Schnabl, 2013). In the summer of 2011, a “slow-motion run” hit the prime MMF sector as fears about European sovereign debt problems mounted, causing redemptions of more than \$170 billion in approximately two months and disrupting the ability of both European and non-European firms to raise financing in the money

markets (see Chernenko and Sunderam, 2014).

MMFs are regulated under Rule 2a-7 of the Investment Company Act of 1940. This regulation restricts fund holdings to short-term, high-quality debt securities. For example, prime MMFs can only hold commercial papers that carry either the highest or second-highest rating from at least two of the nationally recognized credit rating agencies. During the January 2002-August 2008 period, prime MMFs were not permitted to hold more than 5% of investments in second tier (A2-P2) paper or more than a 5% exposure to any single issuer (other than the U.S. government and agencies). Also, the weighted average maturity of the portfolio was capped to 90 days.¹ The MMF industry is divided in three main sectors based on funds' portfolio composition: 1) prime MMFs mainly invest in private unsecured and secured debt in addition to Treasuries and Agency debt; 2) muni MMFs mainly invest in municipal and local authorities debt; 3) government MMFs mainly invest in Treasuries and Agency debt and can only lend to the private sector through repurchase agreements (repos) collateralized by Treasuries or Agency debt. Government MMFs can be further divided in two subgroups: Treasury MMFs, which can only invest in Treasuries and repos collateralized by Treasuries; and Agency MMFs, which can also invest in Agency debt and repos collateralized by Agency debt. MMFs can also be divided into institutional and retail funds based on the profile of their investors. In September 2008, prime&muni MMFs were at the center of the run on the industry, whereas government MMFs actually experienced an inflow of investors; in particular, within the prime&muni sector, institutional MMFs were most affected, whereas the outflow from the retail ones was smaller and slower.

On July 23, 2014, the SEC approved a new set of rules for MMFs (SEC Release No. IC-31166) focusing on the prime&muni segment of the industry. The main pillar of these rules is that from October 2016, institutional prime&muni MMFs must sell and redeem shares based on the current market-based value of the securities in their underlying portfolios. That is, they have to move away from a stable NAV to

¹In 2010, after the turmoil generated by the collapse of Reserve Primary Fund, the SEC adopted amendments to Rule 2a-7, requiring prime MMFs to invest in even higher-quality assets with shorter maturities. E.g., the weighted average maturity was capped to 60 days (SEC Release No. IC-29132). Funds were also required to have enhanced reserves of cash and readily liquidated securities to meet redemption requests, and could invest only 3% (down from 5%) of total assets in second tier securities. These first regulatory changes, while making MMF portfolios safer, did not alter the "economic" structure of MMFs and, in particular, did not alter their runnability or the money-like quality of a MMF investment. For this reason, the 2010 regulatory changes did not create large outflows of investors from any sector of the MMF industry and are not the subject of this analysis.

a floating NAV. The purpose of this regulatory change is to eliminate (or at least mitigate) the risk of runs by making investments in MMFs less money-like (and more similar to investments in traditional mutual funds). In addition, all prime&muni MMFs will have discretion to impose “gates” on redemptions or charge redemption fees of up to 2% in times of stress.²

The new regulation came into effect in October 2016. In this paper, we study the evolution of the MMF industry ahead of the implementation of the new regulation. We do so by studying MMF portfolio data from MMF regulatory filings with the SEC (form N-MFP). We find that from November 2015 to October 2016, there have been large outflows from prime&muni MMFs to government MMFs. Moreover, the outflows from prime&muni into government MMFs have occurred mostly within fund families: investors have switched from one MMF type to the other but have kept their investment in the same fund complex; this supports the hypothesis that the observed outflows from prime&muni into government MMFs are due to the regulatory changes. These within-industry investors’ flows are quantitatively very significant: in the 12 months we consider, roughly \$1.2 trillion have flowed from the prime&muni segment into the government one; to put this number in perspective, the overall outflow from prime&muni funds during the 2008 crisis was only \$300 billion. This reshuffling of investors within the MMF industry indicates that investors care about the money-likeness of their investment: they flow from funds that are no longer money-like (prime&muni funds, which now operate with a floating NAV and can impose redemption gates and fees) to funds that are still money-like (government funds, which still operate with a fixed NAV and do not have a system of redemption gates and fees).

We also document that investors in prime&muni MMFs have mainly flowed toward the riskier segment of the government MMF sector: agency MMFs. This is consistent with the likely higher risk-appetite profile of investors coming from the prime&muni segment of the industry. Finally, the observed outflows from prime&muni MMFs are stronger for institutional investors, consistent with the fact that they are more elastic with respect to developments in the industry and have also been subject to a stricter version of the regulation.

Section 2 describes the N-MFP form. Section 3 describes investors’ flows within the MMF industry. Section 4 describes the changes in MMF portfolios after the new

²Gates and fees can be imposed when a fund’s liquid assets fall below 30 percent of its total assets.

regulation by looking at private versus public investment. Section 5 describes the changes in MMF portfolios after the new regulation in terms of asset class composition. Section 6 concludes.

2 The N-MFP Form

The Form N-MFP is a publicly available regulatory filing that every MMF is required to submit to the SEC each month. Each filing contains information on a fund's balance sheet, share classes, security-level portfolio holdings, performance, and investor flows. Funds reports all of this information as of the end of the month and submit their filings to the SEC within the first five business days of the next month. The SEC makes all N-MFP submissions publicly available. The form was created in May 2010 along with a set of MMF reforms adopted in the immediate aftermath of the financial crisis.³ The first N-MFP filings were submitted in December 2010 and have continued every month since. Funds occasionally submit their forms late or make small corrections by amending filings from previous months.

We download, parse, and clean information from the Form N-MFP to construct our monthly panel dataset of MMFs. A fund's N-MFP filing specifies whether the fund is a feeder or a master fund, whether it is liquidating or merging with another fund, and whether it is a prime fund, a municipal fund, an agency fund, or a treasury fund. The filing reports the fund's month-end dollar weighted average portfolio maturity, total net assets, and the annualized gross yield for the last seven days of the month. The fund also reports its fixed NAV, at which shares are redeemed and subscribed, and its "shadow price," defined as the NAV calculated using market prices rather than amortized costs and rounded to the fourth decimal place, with and without capital support agreements.

One fund can have multiple share classes, that is, types of shares that differ in terms of fees, minimum investment, and other characteristics. For each of its share classes, the fund reports the net assets, the aggregate monthly redemptions and subscriptions by shareholders, and the annualized net yield for the last seven days of the month. Generally, different share classes are offered to different types of investors, such as institutional or retail investors. In the empirical analysis, where we compare the different behavior of retail and institutional investors, we identify "institutional" and

³See footnote 1.

“retail” share classes based on the classification reported by iMoneyNet (a private provider of MMF data).

Finally, each fund reports detailed information on the securities in its portfolio. For each security, the fund specifies the name of the issuer, the title of the issue and its CUSIP, the general category of the investment (e.g., variable rate demand note, government agency debt, certificate of deposit, asset backed commercial paper), whether the security is a repurchase agreement and, if so, the value and type of its collateral, the maturity date of the security, the principal value of the security, the market value of the security (with and without capital support from the fund’s sponsor), the value of the security at amortized cost, and the share of the fund’s total net assets that are invested in the security. Moreover, for each security in a fund’s portfolio in each month, we obtain (long-term) credit rating information on the issuer from Moody’s, S&P, and Fitch for that month using IHS Markit data; from January 2015 through February 2017, we have credit ratings for more than 84 percent of the total value of all portfolio items.

3 Investors’ Flows

3.1 The Response of MMF Investors to the New Regulation

This section studies the response of MMF investors to the 2014 SEC regulation. Figure 1 and Table 1 show that from January 2015 to February 2017, the total net assets (TNA)⁴ of the whole MMF industry remain roughly constant at around \$3 trillion.

Within the industry, however, the relative size of the MMF categories changes dramatically. The TNA of prime&muni funds decrease by \$1,315 billion (i.e., by approximately 65%), while the TNA of government funds increase by \$1,191 billion (i.e., by more than 115%). As a result, the share of government funds in the MMF industry goes from 33.3% in January 2015 to 75.4% in February 2017. The bulk

⁴A fund’s TNA is the total value of its portfolio of securities minus its debt liabilities. Note that although MMFs can be thought of as deposit-like institutions, from an accounting point of view, their shares are classified as an equity instrument and not included among the liabilities. MMFs usually issue very little debt: indeed, between January 2015 and February 2017, total MMF liabilities were only 1.3% of their total assets. For this reason, the industry’s TNA are very close to the industry’s total assets under management (AUM), which measure the industry size.

of these flows (about 60%) occurs between June and October 2016, that is, before the SEC regulation comes into effect. Indeed, the first major flow from prime&muni into government funds directly attributed to the new SEC regulations occurred in December 2015, when Fidelity converted \$130 billion of its prime MMFs into government MMFs. From November 2016 to February 2017, after the adoption of the new SEC regulation, there has been a very modest net flow back into prime&muni funds.⁵

When looking at flows between the different types of MMFs, we study the changes in their TNA (as opposed to looking at redemptions and subscriptions) because we want to capture those instances in which a fund reclassified itself from prime&muni to government. Such reclassifications have indeed occurred after the SEC regulation came into effect; for instance, as we mentioned above, in December 2015, Fidelity converted a large portion, roughly 34%, of its prime MMFs into government MMFs. A fund reclassification from prime to government will show up in our data as an increase in the family's government TNA and a decrease in the family's prime TNA. In contrast, if we focused on investors' redemptions and subscriptions, we would miss the movement of investors' money from a prime&muni to a government MMF, as the reclassification would not require investors to redeem their shares.⁶

The response of MMF investors to the new regulation can be seen as driven by their desire to hold money-like assets in their portfolio. Indeed, from an investor's perspective, the introduction of redemption gates and liquidity fees and the adoption of a floating NAV makes an investment in a prime&muni MMF less similar to a regular bank deposit. In response to these regulatory changes, investors move their assets into government funds, which instead preserve the money-like features historically associated with the MMF industry.

In our data, we do not directly observe individual investors' flows; we only observe fund TNA at month-end and aggregate redemptions and subscriptions within-month. The growth of government MMFs and the decline of prime&muni MMFs may be unrelated to the SEC regulation. For example, changes in macroeconomic conditions and available investment opportunities might have lead investors in prime&muni funds to leave the MMF industry altogether, while outside investors decide to place

⁵Between November 2016 and February 2017, prime&muni TNA increased by \$24.4 bn, while government TNA decreased by \$7.9 bn, increasing the prime&muni share of the MMF industry from 23.9% to 24.6%.

⁶However, even if we look at redemptions and subscriptions in prime&muni and government MMFs, we obtain similar results to those described above.

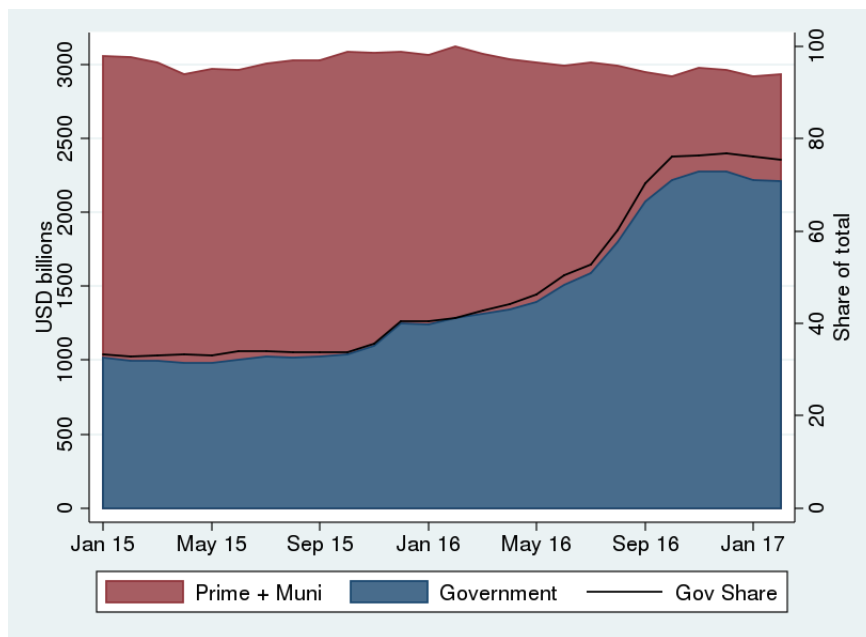


Figure 1. MMF Total Net Assets by Fund Category: Government vs. Prime&Muni. Solid black line: share of government MMFs in percentages (right *y*-axis).

TNA	January 2015	February 2017	Δ
Total	\$3,057 bn	\$2,931 bn	-\$126 bn
Prime&Muni	\$2,037 bn	\$722 bn	-\$1,315 bn
Government	\$1,019 bn	\$2,210 bn	+\$1,191 bn
Government Share	33.3%	75.4%	+42.1 pp

Table 1. Total Net Assets by Fund Category.

their cash into government funds; alternatively, some government funds or fund families specializing in government funds may have had a better advertising strategy than prime&muni funds in 2016. If this were the case, the flows from prime&muni into government MMFs would be equally likely to occur across families as within families: for instance, if families specializing in government MMFs have better advertising strategies, they are likely to attract investors from prime&muni MMFs of other families. In contrast, if the growth of government MMFs comes from the decline of prime&muni MMFs due to the new SEC regulation, our data are more likely to show that the changes in the relative importance of these MMF categories happen through within-family flows; indeed, since fund families have a strong incentive to retain their clients, one would expect that investors desiring to exit prime&muni MMFs and invest in government MMFs would do so by moving their money within the same family.

To test whether flows from prime&muni to government MMFs occurred across or within families, we run the following monthly regression at the family level:

$$\Delta GovtTNA_{it} = \alpha_i + \mu_t + \beta_0 \Delta PrimeTNA_{it} + \beta_1 \Delta PrimeTNA_{it-1} + \varepsilon_{it}, \quad (1)$$

where $\Delta GovtTNA_i$ is the monthly change in the TNA of family i 's government MMFs; $\Delta PrimeTNA_i$ is the monthly change in the TNA of family i 's prime&muni MMFs; and α_i and μ_t are family and month fixed effects. We also include the one-month lagged change in prime&muni TNA to account for the possibility that within-family flows from prime&muni into government MMFs are not contemporaneous. The sample is from November 2015 to October 2016. Standard errors are clustered at the family level. The results of the regression are in Table 2. The estimated slope on contemporaneous outflows from prime&muni MMFs is -0.81, which means that there is almost an exact 1-to-1 relationship between the outflow from prime&muni MMFs and the inflow to government MMFs within each family (indeed, the coefficient is not statistically different from -1); the lagged coefficient on $\Delta PrimeTNA_i$ is statistically insignificant, although slightly negative (-0.02), showing that almost all of the flows from prime&muni into government MMFs are contemporaneous. The results show that before the SEC reform came into effect, investors who did not want to keep their assets in the newly regulated prime&muni MMFs simply shifted their investment to government MMFs within the same family. Note that the relationship between outflows from prime&muni MMFs and inflows to government MMFs is tight. Indeed,

Figures and plot $\Delta GovtTNA$ against $\Delta PrimeTNA$ between November 2015 and October 2016 both in levels and on a logarithmic scale, together with the best-fit regression line;⁷ as the figure shows, almost all the families lie close the regression line.

The regression reported on the first column of Table 2 is run on all family and periods, irrespective of whether in a given month the family experienced an outflow or an inflow from its prime&muni MMFs. The regression results do not substantial change if we run our regression on outflows only (see column (3)). Moreover, if we estimate a separate slope for outflows and inflows to prime& muni MMFs, we observe that the slope for outflows is very similar to that of our original regression (-0.89 vs. -0.81). In contrast, the coefficient on inflows is of the opposite sign (1.00), significant, and statistically indistinguishable from 1. In other words, in those months and families in which prime&muni MMFs increased their TNA, we observe a 1-to-1 increase also in the TNA of government MMFs. This indicates that when there was an inflow into a family's prime&muni MMFs, the family experienced an overall increase in its TNA; in contrast, when there were outflows from its prime&muni MMFs, the family's total TNA did not change as investors flowed from one type of MMF to the other within the family.

It is instructive to have a control sample and compare the regression results described above with those obtained from the same regressions run on November 2014-October 2015 data, that is, more than a year before the SEC regulation came into effect. The results are reported in columns (5)-(8) of Table 2. In the November 2014-October 2015 regressions, the slope coefficient is positive (e.g., in the baseline regression the coefficient is 0.15 and statistically significant), suggesting a positive relationship between a family's government and prime&muni TNA, even after conditioning on month and family effects. In other words, it is only in the year before the regulation came into effect that investors moved their assets from prime&muni to government MMFs within the same family.

One possible concern is that the results described above may be driven by the behavior of outliers. Indeed, as shown in Table 3, there is a lot of heterogeneity across fund families. In particular, although the average TNA across families is \$34 bn, 50

⁷Using a logarithmic scale allows us to visualize more clearly the behavior of all the families in the sample, given than changes in TNA vary greatly across families, ranging from a few dozen million to several hundred billion dollars. In the chart, the prime&muni outflows are given a positive sign to allow us to use logs.

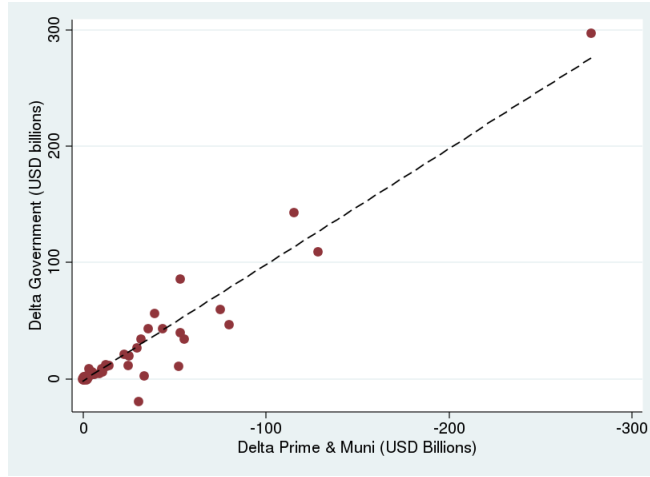


Figure 2. Within-family flows: government vs. prime&muni. Time period: November 2015-October 2016. x -axis: total outflow from a family's prime&muni MMFs; y -axis: total inflow to a family's government MMFs. The dashed line is the regression line of government inflows on prime&muni outflows (slope: 1.00 (0.06), $R^2=0.92$).

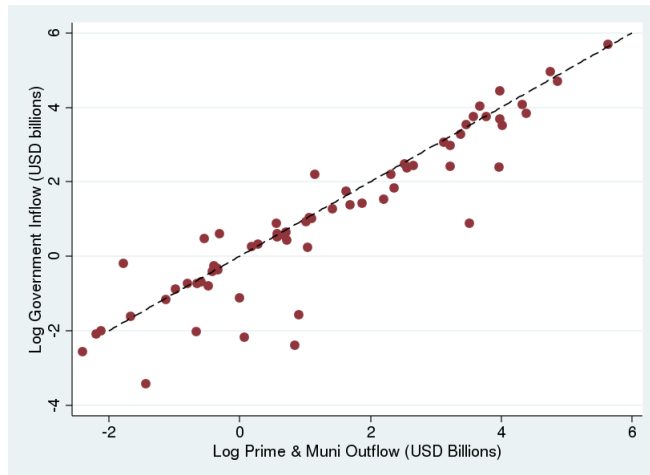


Figure 3. Within-family flows: government vs. prime&muni; log-log scale. Time period: November 2015-October 2016. x -axis: log of total outflow from the family's prime&muni MMFs; y -axis: log of total inflows to the family's government MMFs. The dashed line is the regression line of government inflows on prime&muni outflows (slope: 0.97 (0.05), $R^2=0.85$).

	$\Delta GovTNA_{it}$							
	11/2015–10/2016				11/2014–10/2015			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta PrimeTNA_{it}$	-0.81*** (0.14)	-0.81*** (0.15)			0.15** (0.06)	0.15** (0.06)		
$\Delta PrimeTNA_{it-1}$		-0.02 (0.07)				0.05 (0.08)		
$\Delta PrimeTNA_{it} < 0$			-0.91*** (0.12)	-0.89*** (0.12)			0.07 (0.09)	0.00 (0.07)
$\Delta PrimeTNA_{it} \geq 0$				1.00** (0.40)				0.27* (0.14)
R^2	0.68	0.68	0.79	0.74	0.03	0.03	0.00	0.04
N	1008	1008	466	1008	1140	1140	505	1140

Table 2. Within-family flows: government vs. prime&muni. The sample is a balanced panel of within-family monthly flows (that is, it only includes families that are active in both the prime&muni and the government segment in every month); $\Delta GovTNA_{it}$ is the monthly change in a family's government TNA; $\Delta PrimeTNA_{it}$ is the monthly change in a family's prime&muni TNA; the regressions includes month and family fixed effects; standard errors (in parentheses) are clustered at the family level. Column (1) to (4) are estimated on November 2015-October 2016 data. Columns (1), (2) and (4) are run on all flows; column (3) is run only on month-families with an outflow from prime&muni funds. Columns (5) to (8) report the results of the same regressions using November 2014-October 2015 data. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

	Prime&Muni Funds	Government Funds	Entire Family
Mean TNA	\$24.5 bn	\$18.6 bn	\$34.6 bn
SD TNA	\$46.3 bn	\$38.0 bn	\$80.2 bn
Median TNA	\$3.8 bn	\$2.5 bn	\$2.2 bn
Range TNA	\$258 bn	\$355 bn	\$538 bn
Mean Change	-\$1.0 bn	\$0.6 bn	\$0.5 bn
SD Change	\$4.5 bn	\$3.0 bn	\$25.7 bn

Table 3. Summary statistics of TNA and net flows within fund families between November 2015 and October 2016. Note that the statistics on prime&muni and government funds exclude families with no funds in those categories.

percent of family have TNA of \$2.2 bn or less; indeed, the standard deviation of TNA across families is \$80 bn, and the distribution of family sizes is heavily skewed to the right. These numbers suggest that there are a few families with very large TNA relative to the rest of the industry. In principle, it may be that only very large families have a sufficiently strong franchise value or reputation to retain their prime&muni investors in the transition to government funds. Insofar as these families are those that have exhibited the largest outflows from prime&muni funds, they may also have driven our estimated coefficients.

To address this concern, Table 4 implements robustness checks of the results from Table 2. Columns (1)-(3) replicate the monthly regressions from Table 2 but excluding all those families whose prime&muni outflow in any month is in the top 5% of the cross-sectional distribution. The results largely align with those of Table 2, showing that the impact of changes in prime&muni TNA on changes in government TNA is not driven by the behavior of the largest families.

3.2 Institutional vs. Retail Investors

The new SEC regulation impacts institutional and retail investors in prime&muni MMFs differently. The regulation requires both institutional and retail funds to adopt liquidity fees and redemption gates; only institutional MMFs, however, must switch to a floating NAV. This difference means that an investment in prime&muni MMFs is further away from a money-like investment for institutional investors than for retail investors. Moreover, the experience of the 2008 run on MMFs has shown that, in general, institutional investors are much more responsive (e.g., to economic

	$\Delta GovtTNA$		
	(1)	(2)	(3)
$\Delta PrimeTNA$	-0.74*** (0.06)		
$\Delta PrimeTNA < 0$		-0.93*** (0.06)	-0.85*** (0.05)
$\Delta PrimeTNA \geq 0$			0.59* (0.31)
R^2	0.70	0.82	0.77
N	756	305	756

Table 4. Within-family flows: government vs. prime&muni; robustness checks. Regression in column (1)-(3) replicate regressions in column (1)-(3) of Table 2 excluding all those families whose prime&muni outflow in any month is in the top 5% of the cross-sectional distribution for that month. Time period: November 2015-October 2016. Standard errors (in parentheses) are clustered at the family level. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

news) than retail investors. For both reasons, we should expect that, although both institutional and retail investors transfer their funds from prime&muni MMFs into government MMFs, institutional investors do so to a greater extent. This is indeed what we observe in the data.

Figure 4 and Table 5 show TNA by fund category from January 2015 to February 2017 separately for institutional and retail share classes. The TNA of institutional prime&muni MMFs decrease by roughly 86% (i.e., by \$937 bn), while the TNA of retail prime&muni MMFs decrease by only 43% (i.e., by \$287 bn). As a result, the share of government funds in the institutional segment has increased by over 49 percentage points (pp), from 41.6% to 91.1%, whereas that in the retail segment has increased by only 38.3 pp, from 22.4% to 60.7%.⁸

Indeed, prime&muni MMFs declined from 58.4% of all institutional TNA in January 2015 to 8.9% in February 2017; the decline is more muted for retail TNA, from 77.6% in January 2015 to 39.3% in February 2017. Indeed, in Table 6, we regress the monthly share of prime&muni TNA in a family's institutional and retail share classes⁹ on a time dummy equal to 1 after the regulation came into effect (October

⁸We obtain similar results if we look at net flows into government and out of prime&muni for retail and government share classes separately. See Appendix.

⁹In other words, for each family-month, there are two observations: the ratio of prime&muni TNA over all institutional TNA and the ratio of prime&muni TNA over all retail TNA.

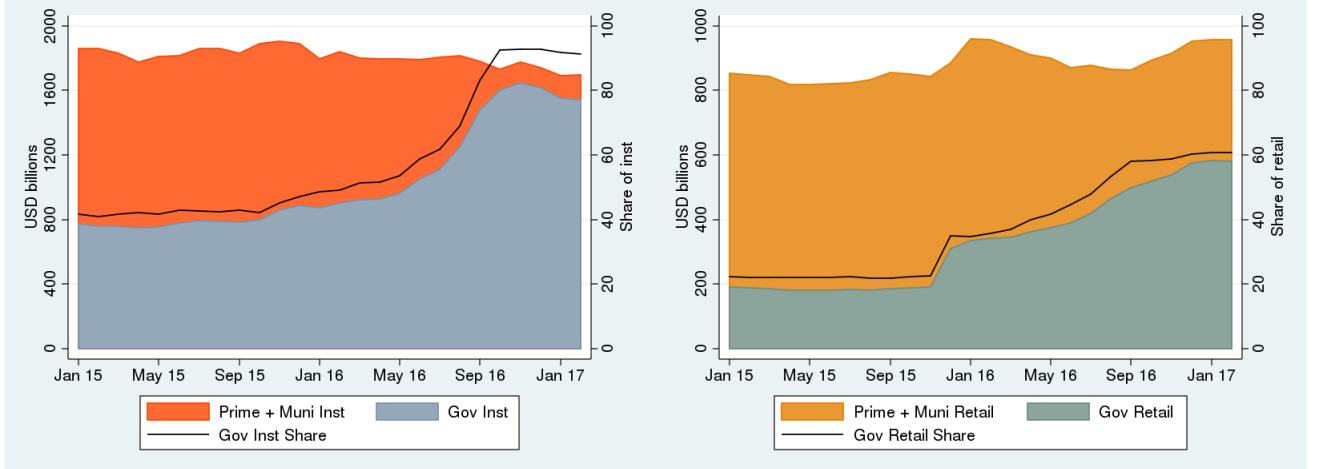


Figure 4. MMF Total Net Assets by Fund Category and Investor Type: Institutional (left) vs. Retail (right). Solid black line: share of government MMFs in percentages (right y -axis).

2016) and its interaction with an institutional dummy equal to 1 for institutional share classes. As controls, we add family-share class type fixed effects. That is, on a balanced panel of families with prime&muni MMFs from October 2015 to February 2017, we run the following regression:

$$Share(Prime\&Muni)_{ikt} = \alpha_{i,k} + \beta_0 Oct_t + \beta_1 Oct_t * Inst_k + \varepsilon_{ikt},$$

where i is the fund family, k is the share class type (institutional or retail), and t is the month. Standard errors are clustered at the family level. The coefficient on the regulation time dummy is negative and significant, indicating that the share of prime&muni funds declined in the retail MMF segment after the regulation; in particular, after controlling for family-share class type fixed effects, the share of prime&muni MMFs among retail share classes decreased by 32 pp after October 2016. However, the interaction coefficient with the institutional dummy is also negative and significant, indicating that such a reduction was even more pronounced for institutional MMFs; in fact, the share of prime&muni MMFs among institutional share classes decreased by an additional 13 pp after October 2016.

	Institutional			Retail		
	Jan. 2015	Feb. 2017	Δ	Jan. 2015	Feb. 2017	Δ
Total	\$1,860 bn	\$1,694 bn	-\$166 bn	\$854 bn	\$957 bn	+\$103 bn
Prime&Muni	\$1087 bn	\$150 bn	-\$937 bn	\$663 bn	\$376 bn	-\$287 bn
Government	\$774 bn	\$1544 bn	+\$770 bn	\$191 bn	\$581 bn	+\$390 bn
Prime&Muni	58.4%	8.9%	-49.5 pp	77.6%	39.3%	-38.3 pp

Table 5. Total Net Assets by Fund Category and Investor Type: Institutional vs. Retail.

	$SharePrime_{ikt}$
Oct_t	-0.32*** (0.04)
$Oct_t * Inst_k$	-0.13*** (0.05)
R^2	0.34
N	1649

Table 6. Institutional vs. Retail: family-level monthly regression. The regression equation is $Share(Prime\&Muni)_{ikt} = \alpha_{i,k} + \beta_0 Oct_t + \beta_1 Oct_t * Inst_k + \varepsilon_{ikt}$, where i is the family, k is the share-class type (institutional or retail), t is the month, and $Share(Prime\&Muni)_{ikt}$ is the share of prime&muni TNA in family i 's share classes of type k in month t , Oct_t is a dummy equal to 1 from October 2016, and $Inst_k$ is a dummy equal to 1 for institutional share classes. $\alpha_{i,k}$ are family-share class type fixed effects. The sample is a balanced panel of families with prime&muni MMFs from October 2015 to February 2017. Standard errors (in parentheses) are clustered at the family level. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

TNA	January 2015	February 2017	Δ
Total	\$3,057 bn	\$2,931 bn	-\$126 bn
Agency	\$546 bn	\$1,605 bn	+\$1059 bn
Treasury	\$473 bn	\$604 bn	+\$131 bn
Agency Share	17.9%	54.8%	+36.9 pp
Treasury Share	15.5%	20.6%	+5.1 pp

Table 7. Total Net Assets by Fund Category: Agency vs. Treasury

3.3 The Risk Appetite of Ultimate Investors

Prime&muni MMFs can hold riskier assets (e.g., commercial papers and certificates of deposit) than government MMFs and therefore offer higher yields to their investors. For example, from 2011 to 2015, the TNA-weighted average gross yield of prime&muni MMFs was 23 basis points, while that of government MMFs was only 11 basis points. Hence, investors that previously invested in prime&muni MMFs have arguably a greater risk-appetite than traditional investors in government MMFs and should be more likely to flow into higher-yield government funds. Namely, we should expect larger inflows to agency MMFs than to treasury MMFs, since agency funds can also buy Agency debt and repos backed by Agency debt. From 2011 to 2015, agency MMFs earned on average 5.5 basis points more than treasury MMFs. As expected, the data show that inflows are concentrated among agency MMFs.

Figure 5 and Table 7 show the TNA of both agency and treasury MMFs from January 2015 to February 2017: agency funds grow by roughly \$1,060 billion (i.e., roughly 194%), while treasury funds grow only by \$131 billion (i.e., less than 28%). The overall surge in the share of government funds in the MMF industry is almost entirely accounted by agency funds, whose share goes from 17.9% in January 2015 to 54.8% in February 2017. In contrast, the share of treasury MMFs increases by only 5 pp, from 15.5% to 20.6%.

To quantify the risk appetite of the investors that previously placed their cash in prime&muni MMFs, we run the following monthly regression at the family level::

$$\Delta GovtTNA_{ikt} = \alpha_{ik} + \mu_t + \beta_1 \Delta PrimeTNA_{it} + \beta_2 Agcy_k * \Delta PrimeTNA_{it} + \varepsilon_{ikt}$$

where k is either “agency” or “treasury;” $Agcy_k$ is a dummy equal to 1 if k is

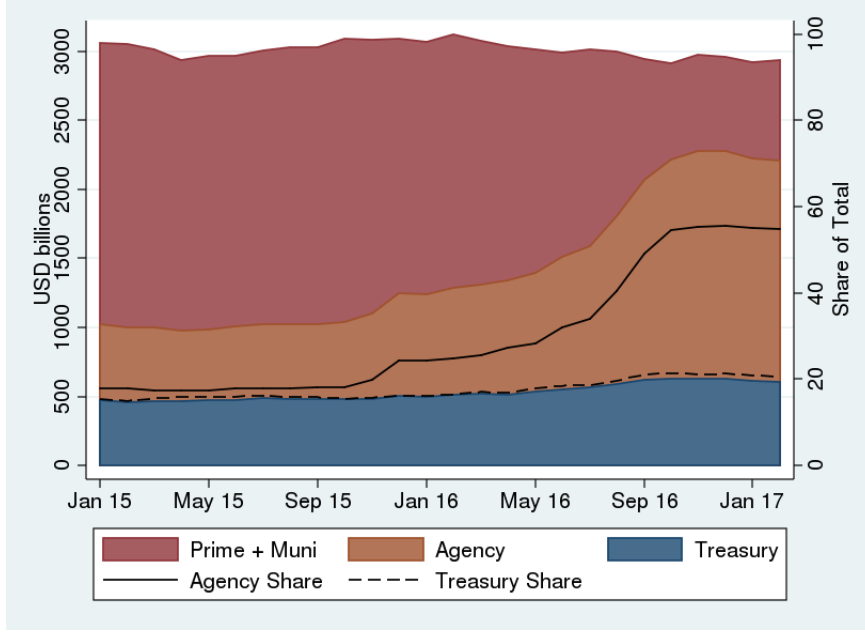


Figure 5. MMF Total Net Assets by Fund Category: Treasury, Agency, and Prime&Muni.

“agency;” $\Delta GovtTNA_{ikt}$ is the change in the TNA of family i ’s type- k government MMFs; $\Delta PrimeTNA_{it}$ is the corresponding change in the TNA of family i ’s prime&muni MMFs; α_{ik} are family-fund type fixed effects; and μ_t are month fixed effects. The coefficients of interest are β_1 and β_2 : β_1 represents the fraction of outflows from prime&muni MMFs that flows into treasury MMFs, and $\beta_1 + \beta_2$ represents the fraction of outflows from prime&muni MMFs that flows into agency MMFs. The results of the regression are in column (1) of Table 8: a one-dollar outflow from a family’s prime&muni funds generates a 78 cent inflow to the family’s agency funds (significant at the 1% level) and only a 3 cent inflow to the family’s treasury funds (statistically insignificant). Figure 6 plots $\Delta GovtTNA_{ik}$ against $\Delta PrimeTNA_i$ separating inflows to agency MMFs from inflows to treasury MMFs, together with the regression lines of treasuries and agency inflows on prime&muni outflows. For both agencies and treasuries inflows, the relationship with prime&muni outflows is very tight: all points in the chart lie close their regression lines; however, the predicted inflow into a family’s government MMFs following an outflow from the family’s prime&muni MMFs is much larger for the agency segment of government MMFs.

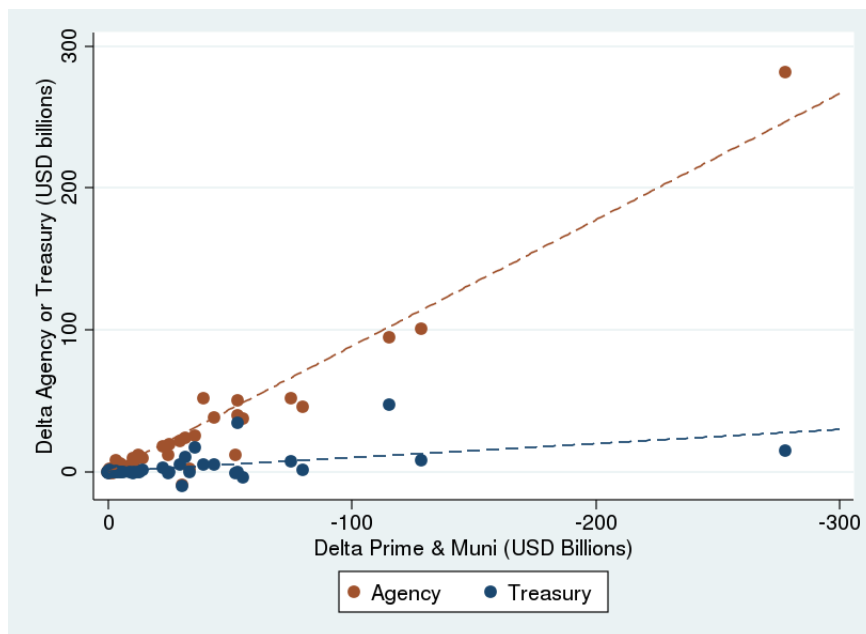


Figure 6. Within-family flows: agency vs. prime&muni, and treasury vs. prime&muni. Time period: November 2015-October 2016. x -axis: total outflow from the family's prime&muni MMFs; y -axis: total inflows to the family's agency and treasury MMFs (separately). The dashed lines are the regression lines from the regression of inflows on outflows allowing a different slope for inflows in agency and treasury MMFs (blue line: slope: 0.10 (0.04), $R^2 = 0.28$; red line: slope: 0.90 (0.08), $R^2 = 0.94$).

	$\Delta GovTNA_{ikt}$		
	(1)	(2)	(3)
$Agcy_k * \Delta PrimeTNA_{it}$	-0.75*** (0.17)		
$\Delta PrimeTNA_{it}$	-0.03 (0.02)		
$Agcy_k * \Delta PrimeTNA_{it} < 0$		-0.85*** (0.15)	-0.81*** (0.16)
$\Delta PrimeTNA < 0$		-0.03 (0.02)	-0.04 (0.03)
$Agcy_k * \Delta PrimeTNA_{it} \geq 0$			0.61** (0.30)
$\Delta PrimeTNA_{it} \geq 0$			0.20* (0.11)
R^2	0.67	0.77	0.72
N	2016	932	2016

Table 8. Within-family flows: agency vs. prime&muni, and treasury vs. prime&muni. The sample is a balanced panel of within-family monthly flows (that is, it only includes families that are active in every month) from November 2015 to October 2016; k is either “agency” or “treasury;” $Agcy_k$ is a dummy equal to 1 if k is “agency;” $\Delta GovTNA_{ikt}$ is the monthly change in a family’s type- k government TNA; $\Delta PrimeTNA_{it}$ is the monthly change in a family’s prime&muni TNA; the regressions includes month and family fixed effects; standard errors (in parentheses) are clustered at the family level. Columns (1) and (3) are run on all flows; column (2) is run on month-families with an outflow from prime&muni funds. ***, **, * represent 1%, 5%, and 10% statistical significance, respectively.

3.4 Past Episodes of Outflows from Prime&Muni MMFs

It is instructive to compare portfolio flows after the SEC regulation came into effect in October 2016 with what happened during two past episodes of turmoil in the MMF industry: the period around September 2008 after the Primary Reserve Fund broke the buck (the so-called “2008 MMF Run”), and the second half of 2011 at the height of the European debt crisis (the so-called “Silent Run”). Whereas portfolio flows over the 2015-2016 were the results of new regulation, both the 2008 MMF Run and the Silent Run were driven by investors’ concerns over the safety of prime&muni MMFs (after Lehman’s bankruptcy and after the European debt crisis respectively).

Figure 7 and Table 9 show MMF TNA from January 2008 to January 2011. From August 2008 to October 2008, investors redeemed \$464 bn from prime&muni MMFs and invested \$486 bn in government MMFs. Outflows from prime&muni into government funds subsided after October 2008: the share of government MMF assets jumped to 38% at the end of September 2008, reached a peak of 40% in October, and very gradually reverted to its pre-run level over the following three years. Moreover, institutional investors accounted for almost all of the net outflows from prime&muni MMFs. We detect a similar pattern if we look at the Silent Run of 2011. Figure 8 and Table 10 show MMF TNA from January 2011 to January 2013. From May to December 2011, when investors were most skeptical of the viability of European debt, investors only redeemed \$228 bn from prime&muni MMFs and invested \$190 bn in government MMFs. The share of government MMF assets jumped by only a couple of percentage points during the Summer of 2011 and remained stable afterwards.

These numbers pale with respect to what we observed in anticipation to the new SEC regulation becoming effective in October 2016. As we described in Section 3.1, between January 2015 and February 2017, investors roughly moved \$1tn from the prime&muni MMF sector to the government MMF sector. As we discuss in Section 3.1.1, although outflows from prime&muni funds were more pronounced for institutional asset classes, both institutional and retail classes were significantly affected. As a result, the overall share of government MMFs jumped from 33% to 75%. The contrast between recent investors’ behavior and that in 2008 and 2011 is even more surprising given that, for example, the 2008 MMF run happened in the midst of the financial crisis and after Lehman bankruptcy; in contrast, the recent outflows from prime&muni MMFs occurred in a time of relative calm in financial markets.

A possible interpretation of the much larger impact of the SEC regulation on MMF

flows is that the new rule affected investors' desire to hold prime&muni MMF in a more fundamental way than credit-risk concerns. By altering the system of floating NAV and by imposing a system of gates and fees, the new regulation made prime&muni MMF less similar to money instruments. Since one of the main reasons to invest in MMF is the similarity of the MMF investment to money, the new regulation made the typical MMF investor to switch his or her investment toward government funds. The interpretation given above is consistent with the fact that, as documented in Section 3.1, between 2015 and 2017, flows from prime&muni into government MMFs were mainly intra-family flows: if the reason behind such flows is investors' desire to preserve the money feature of their investment, there is no reason for them to move to a different family of funds (and disrupt the investor-sponsor relationship).

In contrast, when flows from prime&muni funds into government funds are due to credit-risk concerns (as was the case in 2008 and 2011), there is less reason for investors to remaining within the same family: the preservation of the investor-sponsor relationship should be weighted against the fact that MMF families may differ in their riskiness. Accordingly, we observe that, both during the 2008 MMF Run and the 2011 Silent Run, the within-family relationship between prime&muni outflows and government inflows was weaker.

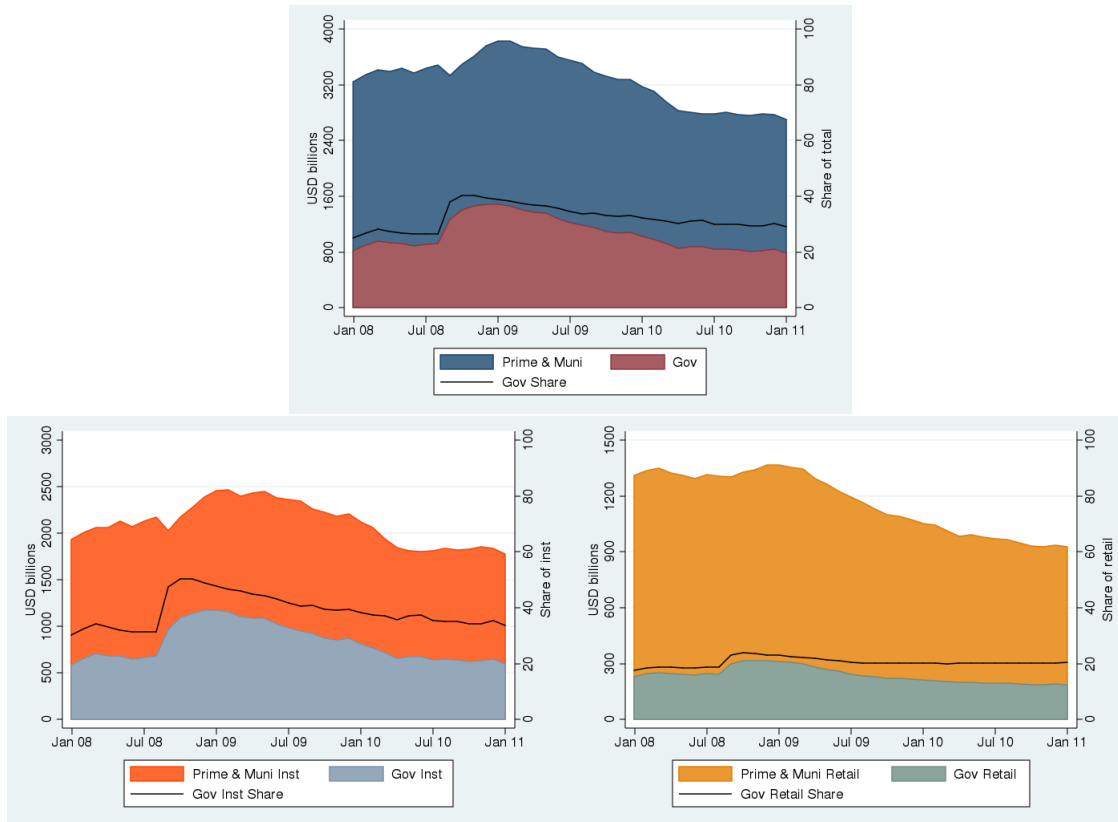


Figure 7. The 2008 MMF Run. (Above) MMF Total Net Assets by Fund Category: Government vs. Prime&Muni. (Below) MMF Total Net Assets by Fund Category and Investor Type: Institutional (left) vs. Retail (right). Solid black line: share of government MMFs in percentages (right y -axis).

	Aug. '08	Sep. '08	Oct. '08	Nov. '08	Dec '08	Jan '09	Jan '11
Total	\$3,478 bn	\$3,331 bn	\$3,501 bn	\$3,615 bn	\$3,754 bn	\$3,825 bn	\$2,700 bn
Prime&Muni	\$2,556 bn	\$2,067 bn	\$2,092 bn	\$2,157 bn	\$2,269 bn	\$2,341 bn	\$1,916 bn
Government	\$923 bn	\$1,264 bn	\$1,409 bn	\$1,458 bn	\$1,458	\$1,484	\$784 bn
Gov. Share	26.5%	37.9%	40.2%	40.3%	39.6%	38.8%	29.0%

Table 9. MMF Total Net Assets Around the 2008 Financial Crisis: Prime&Muni Vs. Government.

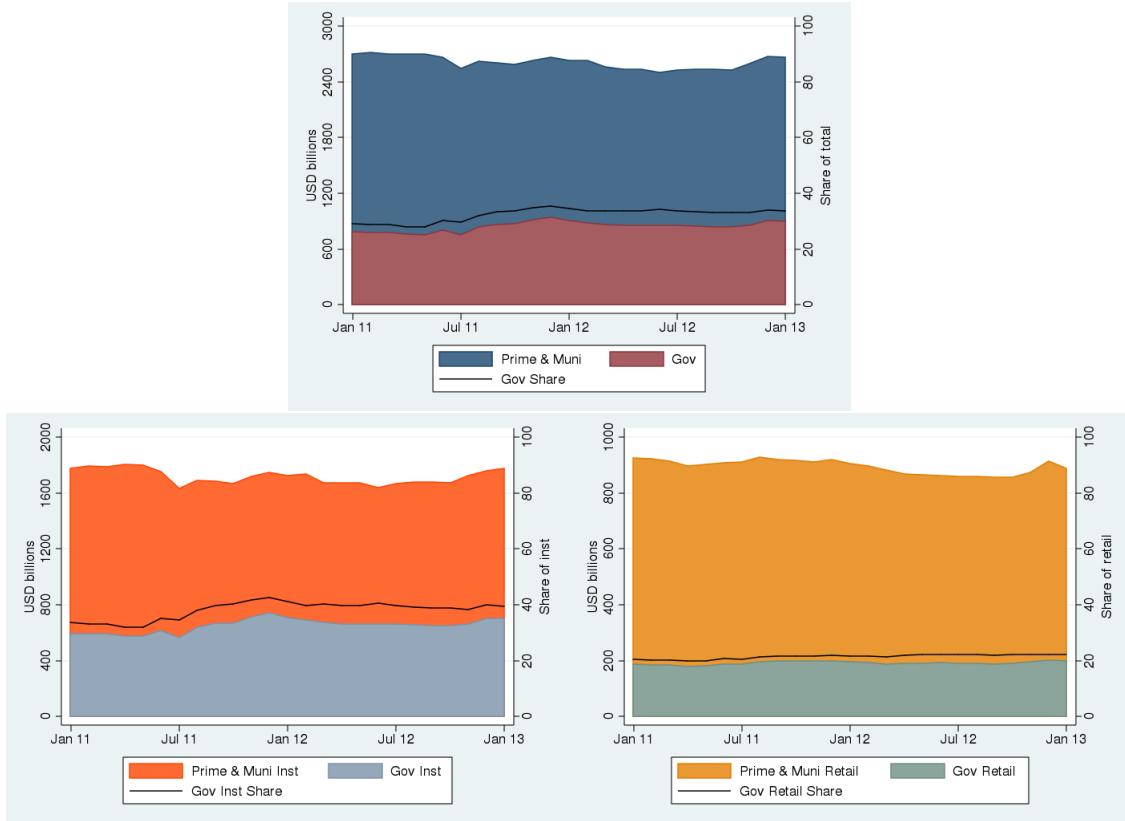


Figure 8. The 2011 Silent Run. (Above) MMF Total Net Assets by Fund Category: Government vs. Prime&Muni. (Below) MMF Total Net Assets by Fund Category and Investor Type: Institutional (left) vs. Retail (right). Solid black line: share of government MMFs in percentages (right y-axis).

	May '11	Jun. '11	Jul. '11	Aug. '11	Sep. '11	Oct. '11	Jan '13
Total	\$2,702 bn	\$2,661 bn	\$2,541 bn	\$2,618 bn	\$2,604 bn	\$2,583 bn	\$2,666 bn
Prime&Muni	\$1,947 bn	\$1,856 bn	\$1,790 bn	\$1,780 bn	\$1,738 bn	\$1,714 bn	\$1,765 bn
Government	\$755 bn	\$805 bn	\$751 bn	\$838 bn	\$866	\$869	\$901 bn
Gov. Share	28.0%	30.2%	29.6%	32.0%	33.3%	33.7%	33.8%

Table 10. MMF Total Net Assets Around the 2011 European Debt Crisis: Prime&Muni Vs. Government.

As figure 9 shows, in 2008, the slope of the best-fit line of within-family flows into government MMFs versus outflows from prime&muni MMFs is only 0.53; this contrasts with the almost 1-to-1 relation we observed around the SEC regulation (see Figure 2). Furthermore, as Figure 10 shows, there is little difference between agency and treasury MMFs; the best-fit line coefficients are 0.17 and 0.37 respectively. If

anything, during the 2008 MMF Run, the relationship between prime&muni outflows and government inflows is stronger for treasury MMFs than agency MMFs; this is consistent with the fact that prime investors were “flying to safety” rather than seeking to preserve the money-likeness of their investment. Similar results are obtained when looking at the Silent Run of 2011 (see Figures 11 and 12), for which the slopes of the best-fit lines are 0.35 for treasury MMFs and 0.25 for agency MMFs.

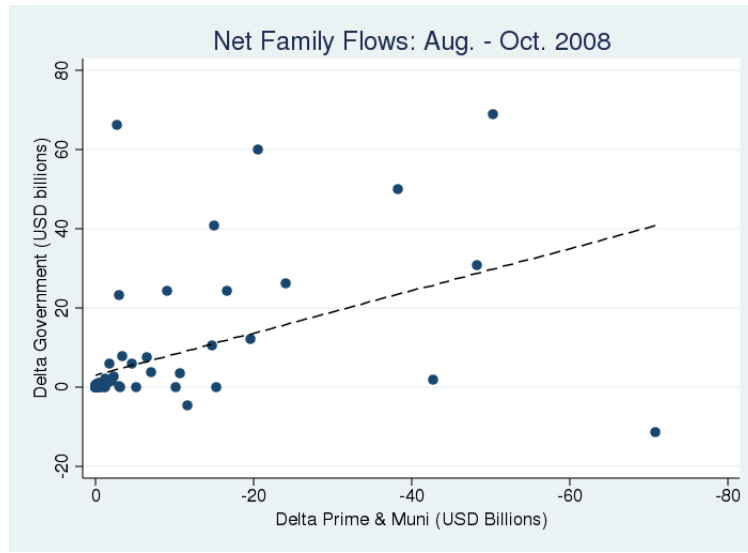


Figure 9. Within-family flows: government vs. prime&muni. Time period: August 2008-October 2008. x -axis: total outflow from the family’s prime&muni MMFs; y -axis: total inflows to the family’s government MMFs. The dashed line is the regression line of government inflows on prime&muni outflows (slope: 0.53, $p = 0.09$, $R^2 = 0.21$).

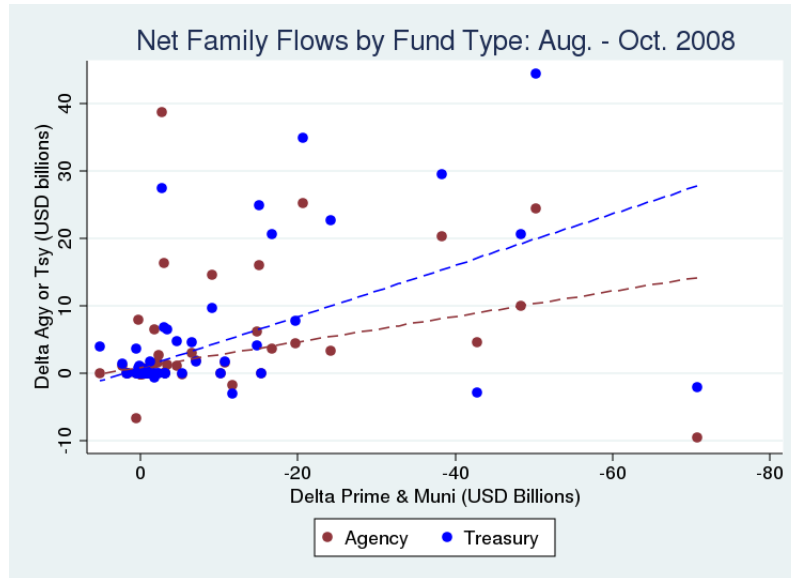


Figure 10. Within-family flows: agency vs. prime&muni, and treasury vs. prime&muni. Time period: August 2008-October 2008. x -axis: total outflow from the family’s prime&muni MMFs; y -axis: total inflows to the family’s agency and treasury MMFs (separately). The dashed lines are the regression lines of inflows on outflows allowing a different slope for inflows in agency and treasury MMFs (blue line: slope: 0.37, $p = 0.05$, $R^2 = 0.29$; red line: slope: 0.17, $p = 0.21$, $R^2 = 0.10$).

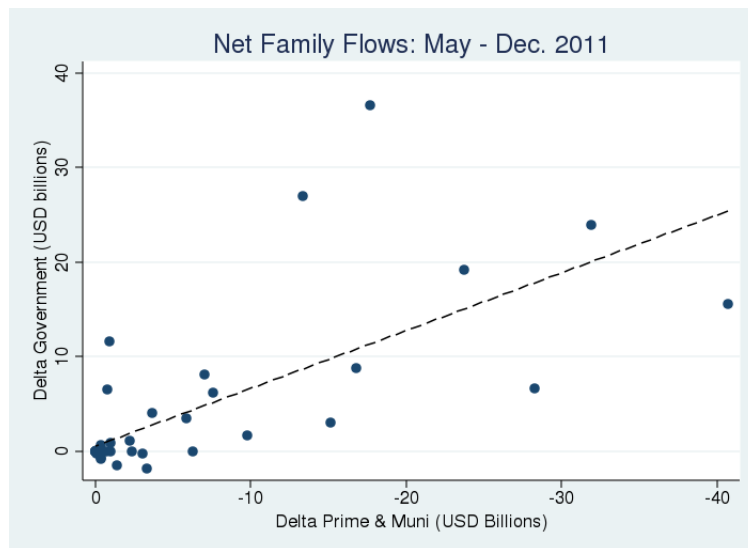


Figure 11. Within-family flows: government vs. prime&muni. Time period: May 2011-December 2011. x -axis: total outflow from the family’s prime&muni MMFs; y -axis: total inflows to the family’s government MMFs. The dashed line is the regression line of government inflows on prime&muni outflows (slope: 0.61, $p = 0.00$, $R^2 = 0.51$).

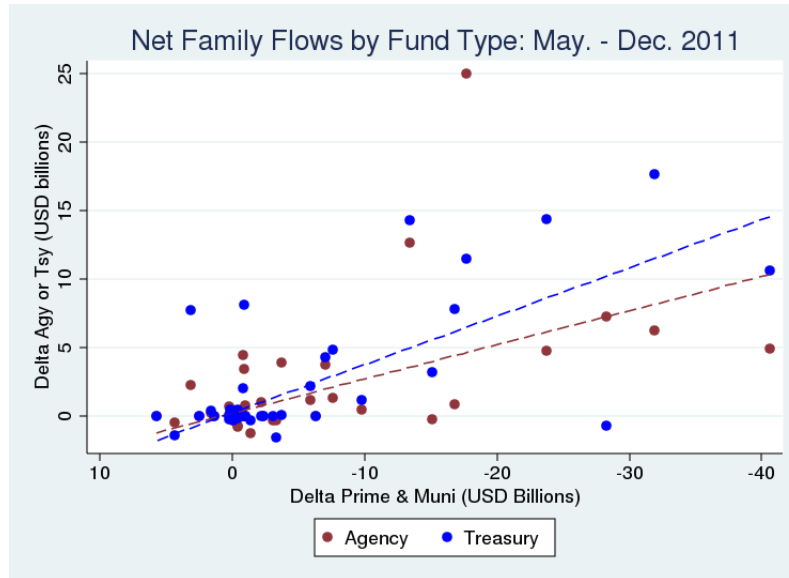


Figure 12. Within-family flows: agency vs. prime&muni, and treasury vs. prime&muni. Time period: May 2011-December 2011. x -axis: total outflow from the family’s prime&muni MMFs; y -axis: total inflows to the family’s agency and treasury MMFs (separately). The dashed lines are the regression lines of inflows on outflows allowing a different slope for inflows in agency and treasury MMFs (blue line: slope: 0.36, $p = 0.00$, $R^2 = 0.57$; red line: slope: 0.25, $p = 0.01$, $R^2 = 0.30$).

4 The Impact on MMF Portfolios: Lending to Public vs. Private Borrowers

Has the SEC regulation changed the volume of MMF lending by borrower type? Borrowers from US MMFs can be divided in four main categories: the US government, government agencies, the NY Fed via the RRP program, and private borrowers.¹⁰ It is interesting to study whether the new regulation reduced the credit flowing to the private sector from the MMF industry. Note that this does not immediately follow from the fact that after the regulation was implemented, the size of the prime segment shrank: indeed, agency and treasury MMFs can supply credit to the private sector through repos collateralized by treasuries and agency debt. This financing however is limited by the availability of eligible collateral and by the fact that not all private institutions have the capability of entering into repo agreements (e.g., non

¹⁰For the purpose of this section, we include lending to local authorities by muni MMFs as private lending. Since lending to local authorities is a very small fraction of overall MMF lending, our choice does not materially impact the results of this section.

financial corporations).

Figure 13 shows the 3-month backward moving average of MMF portfolio composition by borrower type from January 2015 to February 2017.¹¹ Tables 11 and 12 shows the shares and dollar volumes in January and November 2016. In the whole industry, lending to private borrowers decreases from roughly 64% of overall MMF lending in January 2015 to roughly 40% in February 2017; in dollar value, this decline corresponds to a reduction of roughly \$700 bn, from approximately \$1,900 bn to approximately \$1,200 bn. In contrast, treasuries, agency debt, and repos with the NY Fed increase by roughly \$300 bn, \$250 bn, and \$20bn, respectively; as a fraction of the whole industry’s portfolio, treasuries increase from 14% to 27%, agency debt from 18% to 24%, and repos with the NY Fed from 3.4% to 5.9%.

These changes in the composition of the industry portfolio reflect investors’ migration from prime&muni into government funds. Government MMFs are much more restricted in their investment opportunities than prime MMFs: they can only buy private debt in the form of repurchase agreements. This restriction limits their ability to absorb the credit previously provided by prime MMFs to the private sector via CDs, CPs, and ABCPs, as well as via repos. When we look at the portfolio composition of each MMF category separately, we observe patterns that differ from that of the industry’s portfolio. The portfolio composition of both treasury and prime MMFs has remained fairly stable from January to November 2016: both categories have slightly reduced the fraction of private debt in their portfolios and increased the fraction of treasuries and repos with the NY Fed. In contrast, the portfolio composition of agency funds has changed significantly. Even though agency MMFs have increased their dollar holdings of both treasuries and agency debt, they have done so in a very unequal way: the percentage of their portfolio invested in treasuries has increased by more than 12 pp, from 5% to almost 18%, while that invested in agency debt has decreased by 14 pp, from 56% to 42%. On the other hand, the fraction of their portfolios invested in private debt has remained fairly stable at around 30%. These changes in the portfolio composition of agency MMFs are driven by the combination of two factors: the increase in the size of this segment of the MMF industry and the limited supply of agency debt relative to treasuries. In fact, the decrease in

¹¹We take a 3-month moving average because European banks, when trying to meet their regulatory requirements, heavily cut their borrowing from US MMFs at quarter-ends (Munyan, 2015); this generates a strong exogenous cyclicity in the borrower-composition of MMF portfolios. Since in this paper we are not interested in capturing this regulation-driven behavior at quarter-ends, we smooth the data over 3-month rolling windows.

	Fed Repos	Treasuries	Non-FHLB Agy	FHLB Agy	Private
All MMFs					
Jan. 2015	5.7%	14.7%	6.5%	9.1%	64.1%
Feb. 2017	6.6%	26.6%	6.5%	18.1%	42.3%
Δ	+0.9 pp	+11.9 pp	+0.0 pp	+9.0 pp	-21.8 pp
Prime&Muni					
Jan. 2015	2.8%	4.8%	2.8%	4.8%	84.7%
Feb. 2017	5.1%	5.8%	0.9%	1.8%	86.5%
Δ	+2.3 pp	+1.0 pp	-1.9 pp	-3.0 pp	+1.8 pp
Agency					
Jan. 2015	10.5%	5.1%	25.7%	32.6%	26.2%
Feb. 2017	7.0%	18.1%	11.4%	32.2%	31.4%
Δ	-3.5 pp	+13.0 pp	-14.3 pp	-0.4 pp	+5.2 pp
Treasury					
Jan. 2015	12.6%	68.7%	0.5%	0.1%	18.1%
Feb. 2017	7.4%	73.3%	0.0%	0.0%	19.3%
Δ	-5.2 pp	+4.6 pp	-0.5 pp	-0.1 pp	+1.2 pp

Table 11. MMF Portfolio by Borrower Type and Fund Category: Percentage Composition.

the relative weight of agency debt and the increase in that of treasuries starts around August 2016, when the issuance of treasuries increases relatively more than that of agency debt.

It is interesting to remark that in an effort to maintain their yield while facing inflows from the prime&muni sector (and given the limited supply of non-FHLB agency debt), agency MMFs have increased their lending to FHLB. Indeed, as Figure 14 shows, their lending to FHLB as a share of overall agency lending has increased steadily since the beginning of 2015, from roughly 60 percent to over 75 percent. From a policy perspective, such a sizable increase in MMF lending to FHLBs is particularly important: FHLBs can lend to U.S. commercial banks and thrifts and hence work as a bypass for MMF credit to some U.S. private borrowers that cannot meet their funding by borrowing directly from the (now much smaller) prime&muni MMF segment.

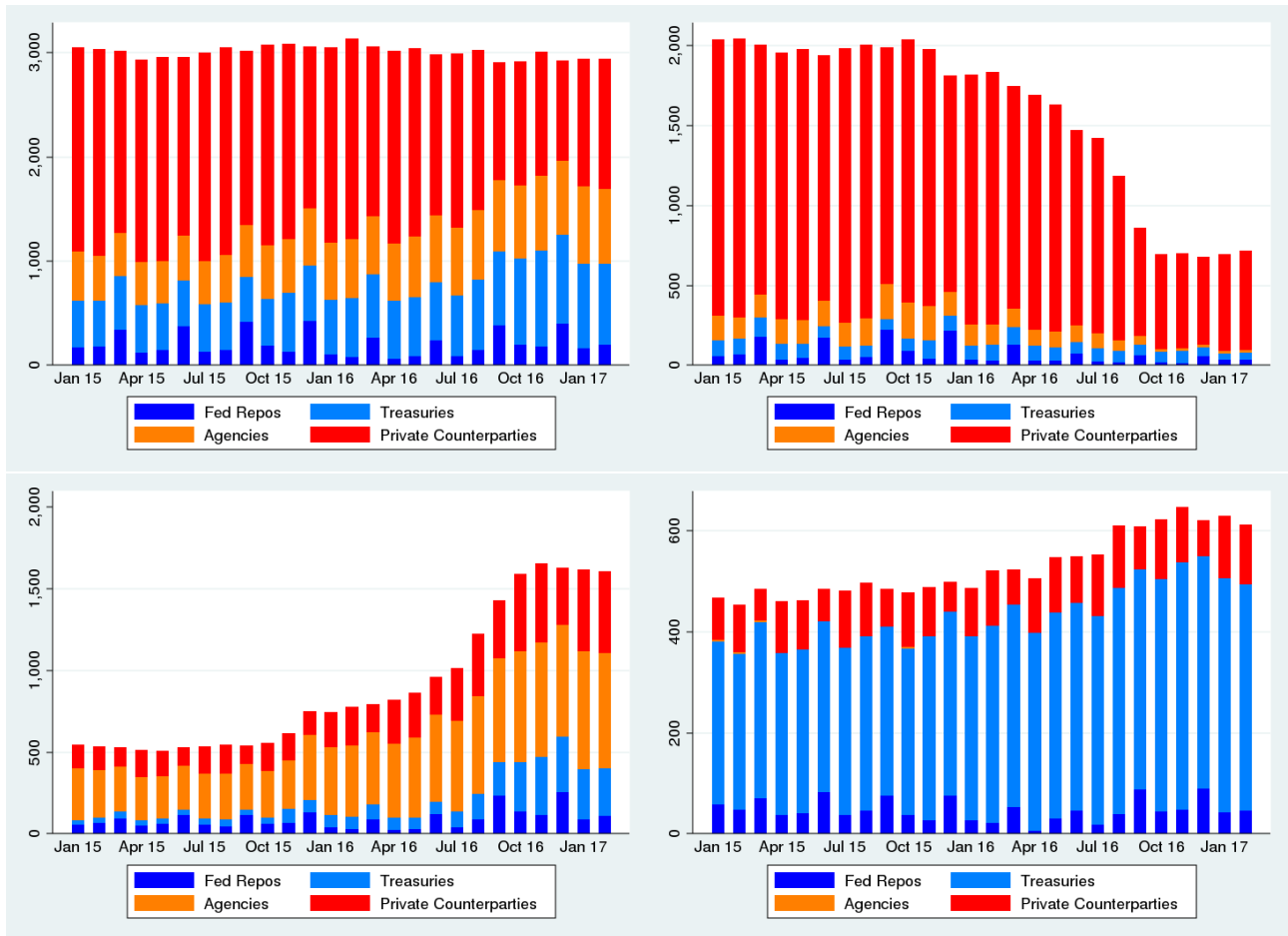


Figure 13. MMF portfolio composition in percentages by borrower type and fund category. Top left: all MMFs; top right: prime&muni MMFs; bottom left: agency MMFs; bottom right: treasury MMFs.

	Fed Repos	Treasuries	Non-FHLB Agy	FHLB Agy	Private
All MMFs					
Jan. 2015	\$173 bn	\$447 bn	\$198 bn	\$278 bn	\$1957 bn
Feb. 2017	\$194 bn	\$781 bn	\$190 bn	\$531 bn	\$1244 bn
Δ	+\$21 bn	+\$334 bn	-\$8 bn	+\$253 bn	-\$713 bn
Prime&Muni					
Jan. 2015	\$57 bn	\$98 bn	\$58 bn	\$98 bn	\$1,730 bn
Feb. 2017	\$36 bn	\$42 bn	\$6 bn	\$13 bn	\$622 bn
Δ	-\$21 bn	-\$56 bn	-\$52 bn	-\$85 bn	-\$1,108 bn
Agency					
Jan. 2015	\$57 bn	\$28 bn	\$140 bn	\$177 bn	\$142 bn
Feb. 2017	\$112 bn	\$291 bn	\$183 bn	\$518 bn	\$505 bn
Δ	+\$55 bn	+\$263 bn	+\$43 bn	+\$341 bn	+\$363 bn
Treasury					
Jan. 2015	\$59 bn	\$321 bn	\$1 bn	\$2 bn	\$85 bn
Feb. 2017	\$46 bn	\$449 bn	\$0 bn	\$0 bn	\$118 bn
Δ	-\$13 bn	+\$128 bn	-\$1 bn	-\$2 bn	+\$33 bn

Table 12. MMF Portfolio by Borrower Type and Fund Category: Dollar Values.

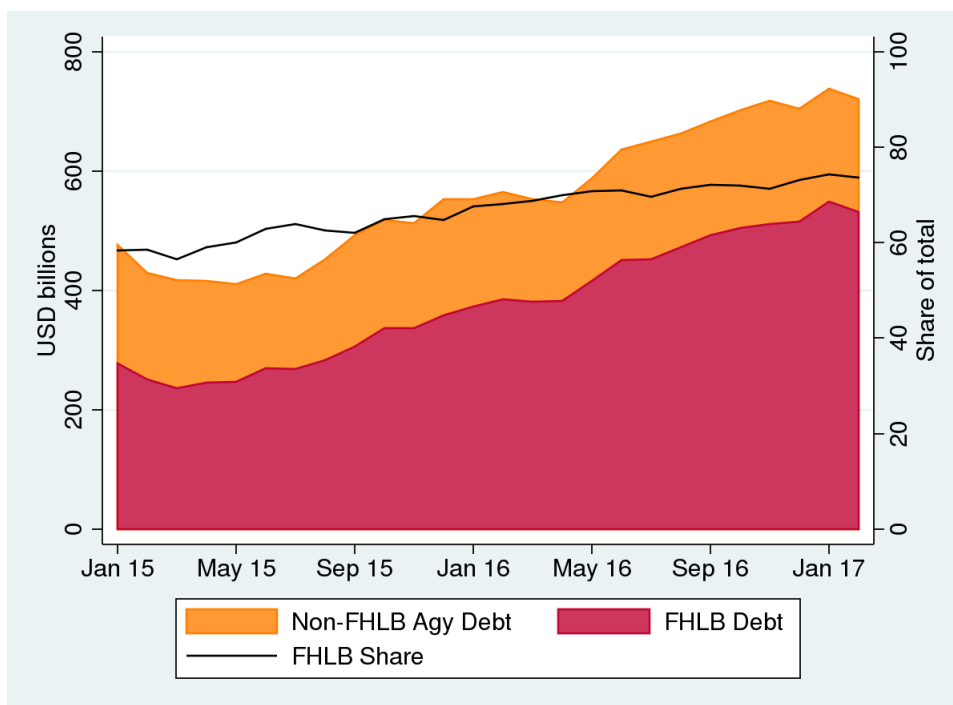


Figure 14. Non-FHLB and FHLB Agency Debt (USD billions) held by the MMF industry. The solid line (FHLB Share) shows the share of FHLB debt as a fraction of all Agency debt.

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