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Centre for Economic Policy Research
33 Great Sutton Street, London EC1V 0DX, UK
Tel: +44 (0)20 7183 8801
www.cepr.org

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JEL Classification: E41, G23, G28

Keywords: Money-like Assets, information sensitivity, Money market funds, Money Market Funds Reform

Marco Cipriani - marco.cipriani@ny.frb.org
Federal Reserve Bank of New York and CEPR

Gabriele La Spada - gabriele.laspada@ny.frb.org
Federal Reserve Bank of New York

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Investors' Appetite for Money-Like Assets: The MMF Industry after the 2014 Regulatory Reform

Marco Cipriani and Gabriele La Spada*,†

Abstract

This paper uses a quasi-natural experiment to estimate the premium for money-likeness. The 2014 SEC reform of the money market fund (MMF) industry reduced the money-likeness of prime MMFs by increasing their information sensitivity, while leaving government MMFs unaffected. Investors fled from prime to government MMFs, with total outflows exceeding 1 trillion dollars. Using a difference-in-differences design, we estimate the premium for money-likeness to be between 20 and 30 basis points. These premiums are not due to changes in investors' risk tolerance or funds' risk taking. Our results support recent developments in monetary theory identifying information insensitivity as a key feature of money.

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†Corresponding author: Marco Cipriani; Federal Reserve Bank of New York, Research Group, 33 Liberty Street, New York, NY 10045; email: marco.cipriani@ny.frb.org; tel: 212-720 6662.

1 Introduction

Several papers have recently shown that investors are willing to pay a premium to hold money-like assets. Krishnamurthy and Vissing-Jørgensen (2012) and Nagel (2016) show that US Treasuries trade at a premium because of their money-like attributes. Such demand for money-like assets has important macroeconomic and financial stability implications. Del Negro *et al.* (2017a) show that, in the United States, interest rates have been persistently low since the late 1990s because of an increase in the premium for safety and liquidity, two characteristics of money-like assets.[1] Although the literature has mainly focused on money-like assets provided by the public sector, money-like assets can also be provided by the private sector: Sunderam (2015) shows that investors treat shadow-bank debt as a money-like claim, and Greenwood *et al.* (2015 and 2016) show that privately supplied money-like assets increase financial fragility because of run risk and fire-sale externalities. However, although private money-like assets are central to both financial stability and the real economy, investors' demand for such assets and the premium stemming from their liquidity services are much less understood than those of public money-like assets.

In this paper, we use the 2014 SEC reform of the money market fund (MMF) industry as a quasi-natural experiment to study investors' appetite for money-like assets. We make two main contributions. First, we are the first to use a quasi-natural experiment to estimate the premium for money-likeness: in particular, we exploit an exogenous change in the defining feature of money-like assets, information insensitivity. Second, we are the first to estimate the premium for money-likeness on assets supplied by the private sector.[2]

[1]Similarly, Del Negro *et al.* (2017b) show that a shock to the liquidity of private paper has a large effect on both real output and inflation.

[2]In a contemporaneous paper, Kacperczyk *et al.* (2019) measure the safety premium of Euro-denominated certificates of deposit in a non-experimental setting. Our emphasis, in contrast, is specifically on the price of information insensitivity as a key aspect of money-likeness.

Several recent contributions to monetary theory have argued that, for an asset to be used as money (i.e., to be used as a means of payment), it must be immune from adverse selection; that is, it must be information-insensitive (Gorton and Pennacchi, 1990; Holmstrom, 2015; Dang *et al.*, 2015; Lester *et al.*, 2011 and 2012; Hanson *et al.*, 2015a). For this reason, money-like assets are usually debt-like securities with low credit risk and short maturity. US MMF shares are the typical example of privately supplied money-like assets: US MMFs only invest in short-maturity low-risk debt securities, and until recently, like traditional money instruments (e.g., bank deposits), all US MMFs have allowed investors to redeem their shares both on demand and at par.[3]

In 2014, however, in an effort to make the industry more resilient to financial shocks, the SEC approved a new regulation that affects how some MMFs operate. According to the new rule, which came into effect in October 2016, prime MMFs are forced to adopt a system of redemption gates and liquidity fees; in addition, prime MMFs offered to institutional investors are forced to value their shares at market price.[4] Both regulatory changes have made prime MMFs, and in particular institutional ones, more information sensitive and therefore less money-like: investors must now consider the likelihood of fees and gates being imposed and be able to predict the changes in their fund's NAV. In contrast, the rest of the industry, i.e., government MMFs, has not been affected by the regulation. We exploit this differential regulatory treatment within the industry to test the information-based theories of money cited above; we do so by estimating a premium for money-like assets and by associating it to the information sensitivity of the different segments of the MMF industry.[5] Importantly

[3]Indeed, Dang *et al.* (2015) argue that debt-on-debt is the least information-sensitive asset; we can think of MMF shares (before the 2014 SEC reform) as an example of debt backed by other debt (the assets in the fund's portfolio).

[4]As we explain in footnote 19, throughout the paper we use the term prime MMFs to refer to both prime and muni MMFs.

[5]Aldasoro *et al.* (2017) use the SEC reform to estimate the demand schedule for the dollar

for our identification strategy, the reform was a reaction to the contribution of prime MMFs to systemic risk during the 2007-2009 financial crisis and was approved more than two years ahead of its implementation; for these reasons, we argue that the regulatory change is exogenous to investors' demand for money-like assets around its implementation.

Since investors value the money-like features of their MMF shares, one would expect them to react to the reform by leaving the segment of the industry that was impacted by the regulation and by flowing to the segment that was not. Indeed, that is what happened. In anticipation of the new rule, more than one trillion dollars flowed from prime into government MMFs. As a consequence, the share of government MMFs in the industry climbed from 33% to 76%. Consistent with the fact that institutional funds were more impacted by the rule, institutional investors responded more strongly: the share of government MMFs increased by 50 percentage points among institutional share classes and by 36 percentage points among retail ones.

By comparing the intra-industry flows caused by the reform to past MMF runs, we highlight the differences between a response to structural reductions in money-likeness and a flight-to-safety episode. In response to the SEC reform, investors largely remained within the same fund family and moved to the subset of government MMFs with a risk-return profile more similar to that of prime MMFs: agency MMFs. Moreover, the response of retail investors, although weaker than that of institutional investors, was still significant. These features of investors' behavior are very different from what happened during previous runs on prime MMFs—such as the 2008 run caused by the Lehman Brothers default and the 2011 slow-motion run caused by the European debt crisis—which occurred as a reaction to an increase in industry risk.[6]

funding of Japanese banks; Alnahedh and Bhagat (2018) study the effect of the reform on the relative risk taking of institutional and retail prime MMFs.

[6]See Kacperczyk and Schnabl (2013) and Chernenko and Sunderam (2014).

In both runs, a significant share of investors' flows occurred across families, investors mainly flew to the safest type of government MMFs (i.e., treasury MMFs), and the response of retail investors was hardly noticeable.

Using a difference-in-differences design, we estimate the premium investors are willing to pay for money-like assets from the net-yield spread between prime and government MMFs. We find that the premium is large: retail investors demand an average of 20 bps on an annual basis to keep their investment in prime funds, and institutional investors an additional 10 bps.[7] Our estimates are not driven by pre-existing trends in the net yields of prime and government MMFs; they are comparable to the liquidity premium of Treasuries estimated by Krishnamurthy and Vissing-Jørgensen (2012) for the 1926–2008 period (i.e., 46 bps); by Nagel (2016) for the 1991–2011 period (i.e., 24 bps); and by van Binsbergen *et al.* (2018) for the 2004-2018 period (i.e., 40 bps).

In contrast to previous attempts to measure the premium for money-like assets, we directly exploit a regulatory change in a security's information sensitivity. Both Krishnamurhty and Vissing-Jørgensen (2012) and Nagel (2016) compare Treasuries to privately issued securities with a similar credit-risk profile, such as Aaa corporate bonds and Treasury-collateralized repos, and argue that the spread between the two must capture the liquidity services of Treasuries. Since neither Aaa corporate bonds nor Treasury repos are quite as safe as Treasuries, their estimates are actually upper bounds on the liquidity premium of Treasuries.[8] Similarly, the methodology of van Binsbergen *et al.* (2018) identifies the convenience yield on Treasuries as a deviation from a no-arbitrage condition but does not relate it to specific characteristics of

[7]As a term of comparison, consider that the annualized interest rate on 3-month T-bills in October 2016 is 33 bps.

[8]Similarly, Kacperczyk *et al.* (2018) measure the safety premium of Euro-denominated CDs issued by European banks by taking their spread against the Eonia swap rate. Since they are interested in a pure safety premium, they use the Eonia swap rate because, in addition to having very low credit risk, it is also very liquid; as a result, they argue, the spread should not contain any credit risk or liquidity premium. However, this identification strategy is subject to the same measurement challenges faced the papers on the liquidity premium cited above.

the underlying assets. At the cost of being narrower in scope, our quasi-natural experiment provides a more precisely-identified, theory-based estimate of the value investors attach to information insensitivity, which the recent literature predicts should be priced in the premium for money-likeness; indeed, our estimates provide the first empirical evidence supporting recent information-based theories of money, such as Dang *et al.* (2015) and Holmström (2015).[9]

In estimating the premium for money-likeness, we also control for a potentially differential effect of the reform on fund risk taking. Although the 2014 SEC regulation affected only the liquidity of MMF shares, one may argue that the investors who stayed in prime MMFs are relatively more risk tolerant than those who flowed to government MMFs. Such a change in the risk aversion of the investor base could have lead prime funds to take relatively more risk, and the surge in the prime-government yield spread we identify as the premium for money-likeness could just reflect an increase in prime MMF risk-taking relative to government MMFs.

We tackle this identification issue in three ways. First, we exploit the fact that we also have data on fund portfolios and reestimate the premium explicitly controlling for various forms of risk taking. Adding controls for risk does not change our results; actually, funds affected by the regulation (prime and institutional prime in particular) reduce their risk exposure relative to unaffected funds. Second, we restrict our analysis to those share classes whose size changes by less than 5% in absolute value around the reform implementation, suggesting that their investor base remains roughly the same. Third, we explicitly control for differential effects of investor risk aversion, as proxied by perceived market volatility (VIX), across MMF segments before and after the regulation. In all cases, our estimates of the premium for money-likeness

[9]The only other paper to test theories of money based on information sensitivity is Benmelech and Bergman (2018), who use a bond's moneyness as proxy for information sensitivity and relate it to its liquidity.

are qualitatively and quantitatively close to the baseline results: 20 bps for retail investors who do not want to face the possible introduction of gates and fees, and an additional 10 bps for institutional investors who do not want their MMF share to float its NAV. Finally, another possible confounder of our results is monetary policy, which could affect the net yield spread between of prime and government funds since the two MMF types invest in different asset categories; we control for potential differential effects of monetary policy across MMF segments before and after the reform implementation and show that this does not affect our results.

In the last section of the paper, using an instrumental variables approach, we estimate the demand elasticity of substitution between prime and government MMFs for institutional investors. The structural equation for the demand function is estimated at the MMF-family level. For each family-month, we instrument the net-yield spread between prime and government MMFs with a proxy for family specialization in prime MMF products. The rationale behind the instrument is that families specialize to a different degree in offering either prime or government MMFs, and such specialization, which affects their supply curve, is persistent.[10] We find that prime and government MMFs were close to being perfect substitutes before the regulation came into effect; the reform caused the elasticity of substitution between the two products to drop from 0.51 to 0.11. This decrease confirms that, whereas before the regulation prime and government MMFs were perceived as very similar financial products, such similarity disappeared once shares in prime MMFs became information sensitive and therefore ceased to be perceived as money-like assets.

The paper is organized as follows. Section 2 describes the MMF industry and the data. Section 3 describes investors' reaction to the 2014 SEC reform. Section 4 estimates the money-likeness premium. Section 5 estimates the elasticity of substitution

[10]Our identification strategy does not work for retail investors because of their much lower price-sensitivity. See footnote 47.

between prime and government MMFs before and after the rule change. Section 6 concludes.

2 The money market fund industry

2.1 The MMF industry before and after the 2014 SEC rule

US money market funds are open-ended mutual funds that invest in money market instruments. MMFs are pivotal players in financial markets: as of the end of 2014, they had roughly $3 trillion in assets under management (AUM) and held 35% of the global outstanding volume of commercial papers (Investment Company Institute, 2015). In particular, they are a critical source of short-term financing for other financial institutions: in May 2012, they provided 35% of the short-term, wholesale dollar funding used by large global financial firms (Hanson *et al.*, 2015b).

The MMF industry is divided in three main sectors according to investment strategy: 1) prime MMFs invest in unsecured and secured private debt as well as Treasuries and Agency debt; 2) muni MMFs invest in municipal and local authorities' debt; 3) government MMFs invest in Treasuries, Agency debt, and repurchase agreements (repos) collateralized by Treasuries or Agency debt. Government MMFs can be further divided in two subgroups: treasury MMFs, which invest in Treasuries and repos collateralized by Treasuries, and agency MMFs, which invest in Agency debt and repos collateralized by Agency debt.[11] Finally, based on the profile of their investors, MMF share classes can be divided into institutional and retail.

[11] The fund type is determined by the Names Rule (Rule 35d-1) of the Investment Company Act of 1940, which requires a fund to invest at least 80% of its assets in the type of investment suggested by its name. Furthermore, with the 2014 reform, the SEC has adopted a more stringent definition of government funds: a government money market fund is a fund investing at least 99.5 percent of its total assets in cash, government securities or repos backed by government securities.

Similarly to other mutual funds, all MMFs are paid fees as a fixed percentage of their AUM; as a result, they are subject to the tournament-like incentives generated by the positive flow-performance relation observed in the data (La Spada, 2018). In contrast to other mutual funds, however, until the new SEC regulation came into effect in October 2016, all MMFs were allowed to keep their net asset value (NAV) at $1 per share; they did so by valuing assets at amortized cost and distributing daily dividends as securities progress toward their maturity date. Since MMF shares 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 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 the Reserve Primary Fund, the oldest MMF, broke the buck after writing off Lehman Brothers debt. As discussed in the introduction, the ability to maintain a fixed NAV (i.e., a debt-like payoff structure), along with the callability of MMF shares, made MMFs the typical example of privately provided money-like assets, which underpinned the large expansion of the MMF industry since the 1970s.

The interaction between risk-taking incentives and exposure to runs made MMFs a key ingredient of the 2007–2009 financial crisis. Indeed, in September 2008, the run on the Reserve Primary Fund quickly spread to other prime and muni MMFs, triggering investors' redemptions of more than $300 billion within a few days after Lehman's default. This run caused a severe shortage of short-term credit to the banking sector (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 (Chernenko and Sunderam, 2014). In both episodes, only prime and muni MMFs suffered outflows; government MMFs actually experienced inflows as they were perceived as a safe haven. Moreover, within the prime and muni sector, institutional share classes were the most affected, whereas outflows from retail classes were much smaller and slower. The systemic importance of MMFs highlighted by these episodes led the SEC to adopt changes to their regulation.

MMFs are regulated under Rule 2a-7 of the Investment Company Act of 1940. This regulation restricts their holdings to short-term, high-quality debt securities. For example, prime MMFs can only hold commercial papers with minimal credit risk; from June 1991 to May 2010, prime MMFs were not permitted to hold more than 5% of investments in second tier (A2-P2) paper or have more than a 5% exposure to any single issuer (other than the US government and agencies). Also, in the same period, the weighted average maturity of their portfolios was capped to 90 days. In 2010, after the turmoil generated by the collapse of the Reserve Primary Fund, the SEC adopted amendments to Rule 2a-7, requiring prime MMFs to invest in even higher-quality assets with shorter maturities.[12]

On July 23, 2014, in a further attempt to make the industry more resilient to financial shocks, the SEC approved a new set of rules for prime and muni MMFs (SEC Release No. IC-31166).[13] The purpose of these rules was to eliminate, or at least mitigate, the risk of runs by making prime and muni MMFs less money-like and more similar to investments in traditional mutual funds. The main pillar of this regulatory change is that, starting from October 2016, institutional prime and muni MMFs must sell and redeem shares based on the market value of the securities in their portfolios.

[12]E.g., weighted average maturity was capped to 60 days (SEC Release No. IC-29132). Funds were also required to have enhanced reserves of cash and other liquid 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 money-like features of MMFs and, in particular, did not alter their runnability. For this reason, the 2010 rule did not create large outflows from any sector of the industry and is not the subject of this analysis.

[13]For a detailed discussion of the several reform options under consideration by the SEC, see McCabe *et al.*, 2013.

That is, they have to move from a stable to a floating NAV. Moreover, all prime and muni MMFs will have the discretion to temporarily suspend (or "gate") redemptions for up to 10 business days in a 90-day period or impose a liquidity fee of up to 2%, if the fund's weekly liquid assets fall below 30% of its total assets. Additionally, prime and muni MMFs are required to impose a liquidity fee of 1% on all redemptions if the fund's share of weekly liquid assets falls below 10%, unless the fund's board of directors determines that imposing such a fee would not be in the best interests of the fund's shareholders.

Both the possible introduction of redemption gates and fees and the adoption of a floating NAV make prime and muni MMF shares more information sensitive and hence less money-like. Retail investors must now consider the possibility that the fund management gates redemptions or introduces a redemption fee. In addition, institutional investors have an incentive to acquire private information about the underlying MMF portfolio, since the NAV at which they are able to transact changes as the price of the underlying assets change. Such an incentive to acquire information makes the use of prime and muni MMF shares as a means of payment much more difficult.

Importantly, the impact of the reform on investors' ability to use institutional MMF shares as a means of payments is not due to changes in the legal or accounting treatment of the shares. Indeed, the SEC and the Treasury went to great lengths to make sure that the switch to a floating NAV would be neutral from both a tax-reporting and an accounting perspective.[14,15]This means that, for accounting and

[14]See pages 129-135 and 171-179 of the final rule at `https://www.sec.gov/rules/final/2014/33-9616.pdf`

[15]The new rules issued by the IRS (Prop. Regs. Sec. 1.446-7) allow investors in floating-NAV MMFs to use an aggregate accounting method that computes net capital gain or loss for a year by netting annual redemptions and purchases. Importantly, for shares in floating NAV money market funds, the simplified aggregate method enables investors to determine their annual net taxable gains or losses using information that is currently provided on shareholder account statements and—most important—eliminates any requirement to track individually each share purchase, each

tax-reporting purposes, the treatment of institutional prime MMF shares has not been affected by the reform.

2.2 The data

In our empirical analysis, we use data from two main sources: N-MFP filings with the SEC and iMoneyNet.

Form N-MFP is a regulatory filing that every MMF is required to submit to the SEC each month. Funds report 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, and it is available since November 2010; in this paper, we use data from N-MFP forms submitted until September 2017 (i.e., one year after the regulation was implemented). We use Form N-MFP to obtain information on a fund's type (prime versus government), its total net assets (TNA), its month-end dollar weighted average portfolio maturity, the securities in its portfolio (the security type, the principal amount, the time to maturity, and the security issuer). 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 share class, Form N-MFP reports its TNA and the aggregate monthly redemptions and subscriptions by shareholders.

Unfortunately, Form N-MFP does not distinguish between institutional and retail share classes. For this reason, we use iMoneyNet to classify share classes into institutional and retail. iMoneyNet is a private provider of MMF data collected through

redemption, and the basis of each share redeemed. Moreover, the Treasury Department and the IRS have introduced a revenue procedure that exempts from the "wash sale" rule dispositions of shares in any floating-NAV MMF. The "wash sale" rule limits tax deductability when shareholders of a mutual fund sell securities at a loss and buy similar securities back within 30 days. Because MMF investors automatically reinvest their dividends (which are often paid monthly), virtually all redemptions would be subject to the wash sale rule.

voluntary filings, and its data have also been used by several recent papers on MMF behavior (Kacperczyk and Schnabl, 2013; Di Maggio and Kacperczyk, 2017; La Spada, 2018). To be consistent with the rest of the literature on MMFs, we also obtain from iMoneyNet information on net and gross yields and on portfolio composition by asset class. Since iMoneyNet only covers a subsample of all funds, any analysis using its data is done on a slightly smaller sample: on average, between November 2010 and September 2017, iMoneyNet data covers 90% of overall MMF TNA as reported in Form N-MFP.[16]

We also match our MMF data with two other databases: Markit and Morningstar. We use the Markit database to construct a measure of portfolio credit risk based on the CDS spreads of the issuers of the securities held by MMFs. We match MMF families with the Morningstar database to retrieve information on the size of their other mutual fund business.

For a more detailed description of the data, see Appendix F.

3 Investors' response to the 2014 SEC reform

3.1 Flows from prime to government MMFs

Figure 1(a) and Table 1 show that, from January 2015 to September 2017, the TNA of the whole MMF industry remain roughly constant at around $3 trillion.[17] Within the industry, however, the relative size of the different MMF types changes dramatically. The TNA of prime MMFs decrease by $1,258 billion (i.e., by 61%), while the TNA

[16] In Appendix C, we also use iMoneyNet data to discuss the behavior of the MMF industry in 2008, before the introduction of the N-MFP form.

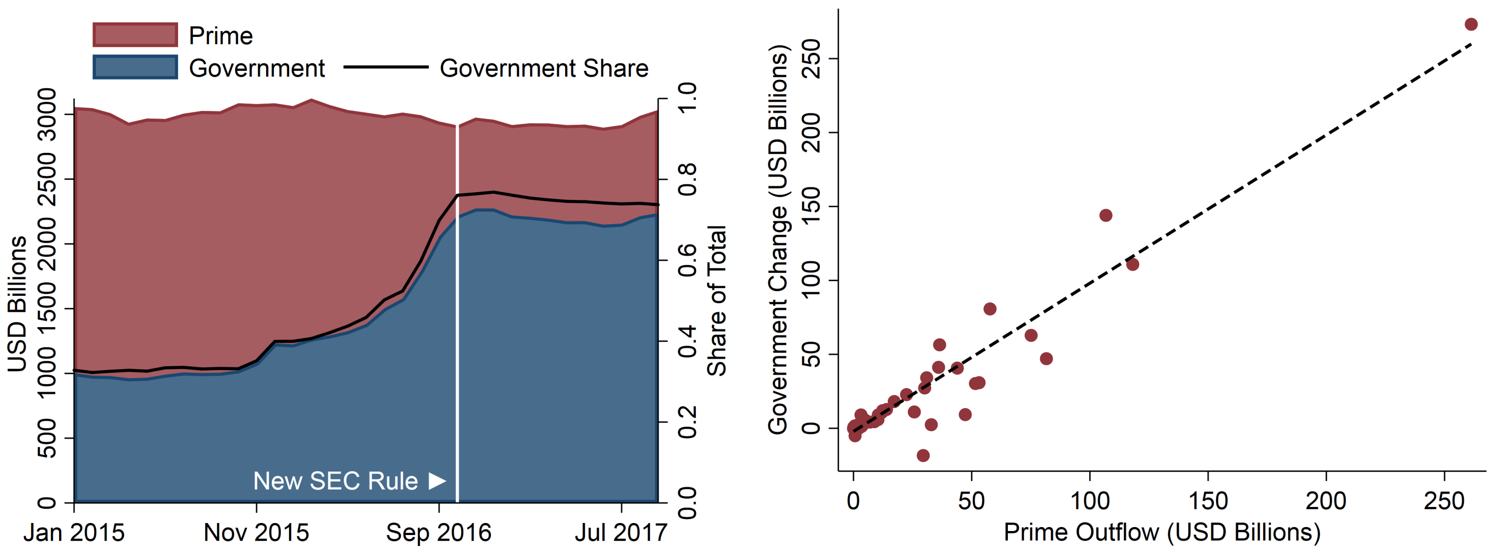
[17] A fund's TNA is the total value of its securities portfolio minus its debt liabilities. MMFs usually issue very little debt: between January 2015 and September 2017, total MMF debt was only 1.1% of the industry's total assets. For this reason, the industry's TNA reported in Form N-MFP are very close to the industry's total assets under management (AUM).

of government funds increase by $1,235 billion (i.e., by 123%).[18,19] As a result, the share of government funds in the MMF industry goes from 33% in January 2015 to 74% in September 2017. The bulk of these flows (about 60%) occurs between June and October 2016, that is, six months before the SEC regulation comes into effect. These changes in the structure of the MMF industry are consistent with investors' desire to hold money-like assets. The introduction of redemption gates and liquidity fees and the adoption of a floating NAV make a prime 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 MMF shares.

In our data, we do not directly observe individual investors' flows. To check that the growth of government MMFs is indeed driven by investors' response to the new SEC rule, we show that flows mainly occurred within families rather than across them. If the growth of the government segment is the result of investors' fleeing the prime segment due to the regulatory change, investors' flows are more likely to occur within families; the reason is threefold: the reform affects all families with prime MMFs equally, fund families have a strong incentive to retain their clients,

[18]We study changes in MMF TNA, as opposed to redemptions and subscriptions, which are also available in Form N-MFP, because we want to capture instances in which a fund reclassified from prime to government. Such reclassifications have indeed occurred before the SEC regulation came into effect. The first major flow from prime into government funds attributable to the new rule occurred in December 2015, when Fidelity converted three of its prime MMFs worth $130 billion (i.e., roughly 34% of its prime-MMF business) into government MMFs, citing the reform as the reason for its conversions. This and subsequent reclassifications show up in our analysis as an increase in the family's government MMF TNA and a decrease in the family's prime MMF TNA. In contrast, if we focused on investors' redemptions and subscriptions, we would miss the change in investors' holdings, since reclassifications do not require investors to redeem their shares. However, even when looking at redemptions and subscriptions, we find a similar pattern of flows from prime to government funds.

[19]The introduction of liquidity gates and fees and the adoption of a floating NAV required by the 2014 SEC reform apply in the same way to prime and muni MMFs; moreover, over our sample, the TNA of the muni sector have only averaged $257bn, less than 15% of the TNA of the prime sector. For these reasons, from now on, we pool these two types of funds together and simply refer to them as prime MMFs.



(a) Total Net Assets (b) Within-family Flows

Figure 1. Panel (a): The sample is all US MMFs from January 2015 to September 2017. The blue area represents the TNA of government MMFs; the red area the TNA of prime MMFs. The solid black line is the share of government MMFs (right y-axis). The vertical white line represents the month of the implementation of the 2014 SEC reform (October 2016). Panel (b): The sample is all MMF families with a reduction in prime MMF TNA between November 2015 and October 2016. The x-axis is the total outflow from a family's prime MMFs; the y-axis is the total change in the TNA of the family's government MMFs. The dashed line is the OLS regression line: the slope is 1.00 (0.05), with $R^2 = 0.92$.

and, ceteris paribus, investors have a strong incentive to remain within the same family, since doing so reduces information acquisition costs.

[billions]	January 2015	October 2016	Δ	September 2017	Δ
Total	$3,057	$2,915	-$142	$3,034	-$23
Prime	$2,054	$698	-$1,356	$796	-$1,258
Government	$1,003	$2,217	+$1,214	$2,238	+$1,235
Government Share	32.8%	76.1%	+43.3pp	73.8%	+41.0pp

Table 1. Total Net Assets by Money Market Fund (MMF) Type. The sample is all US MMFs.

Figure 1(b) plots the change in a family's government MMF TNA against the corresponding change in its prime MMF TNA between November 2015 and October 2016. The relation between outflows from prime MMFs and inflows to government

MMFs appears to be one-to-one over the whole range of family sizes. Moreover, the relation between prime outflows and government inflows is very tight: almost all the families lie close to the unconditional OLS regression line.[20]

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

$$\Delta \text{Government TNA}_{it} = \alpha_i + \mu_t + \beta_0 \Delta \text{Prime TNA}_{it} + \varepsilon_{it}, \quad (1)$$

where ΔGovernment TNA$_{it}$ is the monthly change in the TNA of family i's government MMFs; ΔPrime TNA$_{it}$ is the monthly change in the TNA of family i's prime MMFs; and α_i and μ_t are family and month fixed effects. The regression is estimated on the November 2015–October 2016 period. Standard errors are heteroskedasticity, autocorrelation, and spatial correlation (HACSC) robust to account for correlations both within and across MMF families.[21] The results are in Table 2. The estimated slope on contemporaneous changes in prime MMF TNA is -0.78 (p–value=0.017); that is, for each dollar increase (decrease) in the TNA of a family's prime MMFs, the TNA of the same family's government MMFs decrease (increase) by roughly 80 cents within the same month.

In Column 2, we simultaneously estimate separate slopes for prime-MMF outflows and inflows, the slope for outflows remains similar (-0.86, with p–value=0.003), but the slope for inflows has the opposite sign (1.03, with p–value=0.031). In other

[20]Figure B.1 in Appendix B replicates Figure 1(b) on a log-log scale and confirms that the within-family one-to-one relation between prime-MMF outflows and government-MMF inflows is tight over the whole range of family sizes. Logarithmic scales, in fact, allow us to visualize more clearly the behavior of all the families in the sample, ranging from a few dozen million to several hundred billion dollars of outflows and inflows.

[21]We use Driscoll and Kraay (1998) robust standard errors with 3-month lags. We take the heuristic for the lag selection from the first step of the Newey and West (1994) plug-in procedure, which sets the maximum number of lags up to which residuals may be autocorrelated equal to floor$[4(T/100)^{2/9}]$, where T is the length of the panel. We calculate critical values using the fixed-b asymptotics derived by Vogelsang (2012), which are shown to provide more robust and conservative inference than traditional Normal or Chi-square approximations.

words, family-months with inflows to prime MMFs experience quantitatively similar inflows to government MMFs; this is consistent with the fact that the family itself may have become more attractive to investors. In contrast, when investors flow out of a family's prime MMFs, investors flow into the same family's government MMFs; this is consistent with the fact that investors respond to the loss of money-like features of their prime MMF shares caused by the regulation.

	ΔGovernment TNA_{it}							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ΔPrime TNA_{it}	-0.78**		-0.88***		0.15*		0.15	
	(0.16)		(0.13)		(0.05)		(0.05)	
$\min(\Delta\text{Prime TNA}_{it}, 0)$		-0.86***		-0.96***		0.02		-0.01
		(0.14)		(0.11)		(0.07)		(0.08)
$\max(\Delta\text{Prime TNA}_{it}, 0)$		1.03**		1.31**		0.27		0.28
		(0.25)		(0.31)		(0.11)		(0.11)
Balanced			Yes	Yes			Yes	Yes
Period	Reform	Reform	Reform	Reform	Before	Before	Before	Before
Adj. R^2	0.72	0.76	0.77	0.83	0.01	0.01	0.03	0.03
Adj. Within R^2	0.62	0.68	0.70	0.77	0.03	0.04	0.03	0.03
Observations	792	792	288	288	1003	1003	468	468

Table 2. Within-Family Flows from Prime to Government Money Market Funds (MMFs). The sample is all US MMF families. The regressions are estimated on the November 2015–October 2016 period, that is, one year before the 2014 SEC reform came into effect. ΔGovernment TNA_{it} is the monthly change in a family's government MMF TNA and ΔPrime TNA_{it} is the monthly change in a family's prime MMF TNA. Family-month observations for which the change in prime MMF TNA is zero and the previous month's level of prime MMF TNA is also zero are dropped from the sample. Columns 1 and 2 report the results for the unbalanced panel of families. Columns 3 and 4 report the results for the balanced panel of families. Columns 5-8 replicate Columns 1-4 on the November 2014-October 2015 period. All regressions include month and family fixed-effects. Standard errors (in parentheses) are HACSC robust from Driscoll and Kraay (1998) with 3-month lags. Significance values are computed according to critical values from fixed-b asymptotics derived by Vogelsang (2012). ***, **, and * represent 1%, 5%, and 10% statistical significance.

Columns 3 and 4 report the results of regression (1) for the balanced panel of MMF families that are continuously active in both the prime and government segments from November 2015 to October 2016. Results are similar: there is almost a one-to-one relation between outflows from prime and inflows to government MMFs within the same family-month.

To link investors' behavior to the implementation of the new rules, we use the November 2014–October 2015 period (i.e., two years before the SEC reform came into effect) as a control sample. The results are in Columns 5 and 6: the coefficient on changes in a family's prime-MMF TNA is positive (e.g., in the baseline regression, the coefficient is 0.15 with p–value=0.088), suggesting a positive relation between a family's government and prime TNA. That is, only in the year ahead of the regulatory change investors moved their assets from prime to government MMFs within the same family. Additionally, the relation between prime and government flows is much weaker: the within-R^2 is consistently lower than 0.05, whereas it is between 0.6 and 0.8 in the November 2015–October 2016 regressions.

The intra-family flows during the November 2015–October 2016 period are not solely explained by the conversions of prime into government MMFs that occurred in that period.[22] Table B.2 in Appendix B shows our results after excluding fund conversions from the sample: almost 90 percent of outflows from a family's prime MMF end up into the same family's government MMFs within 6 months.

Our results are not driven by outliers. There is great heterogeneity in the size of MMF families, ranging from a few millions to several hundred billions (see Table B.3 in Appendix B). Because of this, our results could be driven by the fact that only few very large families have sufficient franchise value or reputation to retain their prime investors in the transition to government funds. This is not the case. Table B.4 in Appendix B replicates Columns 1 and 2 of Table 2 in two ways: i) excluding those observations for which the prime outflow in a month is in the top 5% of that month's cross-sectional distribution; and ii) using the Least Absolute Deviation estimator. Results are similar, confirming that the within-family one-

[22]Note that, even if they were, they would still represent investors' response to the regulatory change since, after a conversion, investors are not forced to keep their money in the same fund.

to-one relation between prime-MMF outflows and government-MMF inflows is not driven by the largest families.

Finally, in Appendix B.3, we show that prime MMF investors mainly flew to the riskiest type of government MMFs, agency MMFs. This evidence is consistent with the fact that investors that previously invested in prime MMFs have a greater risk appetite than traditional government-MMF investors and are more likely to flow into higher-yield government funds.

3.2 Institutional versus retail investors

The new SEC rule impacts institutional and retail investors in prime MMFs differently. Both institutional and retail funds must adopt liquidity fees and redemption gates; only institutional funds, however, must switch to a floating NAV. This difference means that an investment in a prime MMF is further away from a money-like investment for institutional investors than for retail investors. Hence, we should expect that, although both institutional and retail investors transfer their funds from prime into government MMFs, institutional investors do so to a greater extent. This is indeed what we observe in the data.

Figure 2 shows TNA by MMF category from January 2015 to September 2017 separately for institutional and retail share classes.[23] The TNA of institutional prime MMFs decrease by roughly 82% (i.e., by $942 bn), while the TNA of retail prime MMFs decrease by only 42% (i.e., by $276 bn). For both institutional and retail investors, the bulk of flows from prime to government MMFs occurred before October 2016, when the new rule came into effect: Table 3 shows that, from January 2015 to October 2016, the share of government funds in the institutional segment increases

[23] For the classification of fund shares into institutional and retail, we used the iMoneyNet dataset because Form N-MFP does not provide that information; remember that the iMoneyNet dataset only covers a subsample of the whole MMF industry (see Section 2).

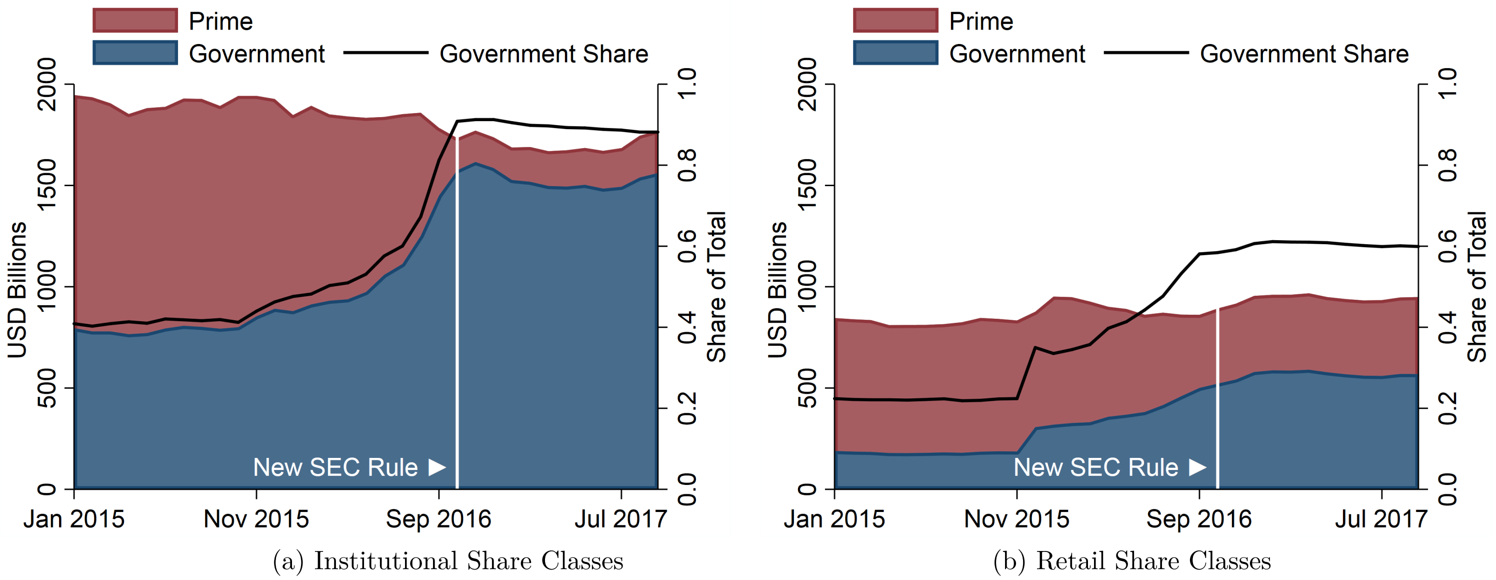


Figure 2. Total Net Assets (TNA) by Money Market Fund (MMF) Type and Investor Type: Institutional (left) vs. Retail (right) Investors. The solid black line is the share of government MMFs in the industry (right y-axis). The vertical white line represents the month of the implementation of the 2014 SEC reform (October 2016). Note that, for the classification of share classes into institutional and retail, we use the iMoneyNet dataset; since the iMoneyNet dataset only covers a subsample of the whole MMF industry (see Section 2), the sums of institutional and retail TNA in these charts are slightly smaller than the totals reported in Figure 1(a).

by 50 percentage points, from 41% to 91%, whereas the share of government funds in the retail segment increases by 36 pp, from 22% to 58%.

	Institutional				Retail			
[billions]	Jan. 2015	Oct. 2016	Sept. 2017	Δ	Jan. 2015	Oct. 2016	Sept. 2017	Δ
Prime	\$1,151	\$159	\$209	-\$942	\$656	\$371	\$380	-\$276
Government	\$796	\$1,575	\$1562	+\$766	\$189	\$522	\$569	+\$380
Government Share	40.9%	90.8%	88.2%	+47.3pp	22.4%	58.4%	59.9%	+37.5

Table 3. Total Net Assets (TNA) by Money Market Fund (MMF) Type and Investor Type: Institutional vs. Retail Investors. Note that, for the classification of share classes into institutional and retail, we use the iMoneyNet dataset; since the iMoneyNet dataset only covers a subsample of the whole MMF industry (see Section 2), the sums of institutional and retail TNA in this table are slightly smaller than the totals reported in Table 1.

3.3 Comparison with flight-to-safety episodes

Investors' response to the increased information sensitivity of prime MMFs caused by the 2014 SEC reform is very different from how they react to concerns over the safety of prime MMFs. In Appendix C, we repeat the same analyses of investors' flows we carried out for the 2014 SEC reform on two recent MMF runs: the 2008 MMF Run and the 2011 Silent Run. During both runs, there were significant intra-industry flows from the prime to the government segment. The characteristics of these flows, however, contrast starkly with the response to the 2014 reform: a significant share of investors' flows occurred across families, investors mainly flew to the safest type of government MMFs (i.e., treasury MMFs), and the response of retail investors was hardly noticeable. Moreover, the industry share of prime MMFs reverted close to its original level within a year after the run, and the overall size of the intra-industry flows pales compared to the $1.2 trillion flows occurred in response to the 2014 reform: overall flows from prime to government MMFs were only about $500 billion for the 2008 Run and $200 billion for the 2011 Run. This is very surprising given that these flight to safety episodes occurred at the heights of the worst financial crisis since the Great Depression.

The comparison between investors' behavior around the regulatory change and their behavior during runs highlights that changes in the information sensitivity of an asset may have profound, structural effects that go beyond what happens as a result of changes in risk perceptions.[24]

[24]Runnability is a key characteristic of all private money-like assets due to their debt-like payoff (Holmstrom, 2015; Gorton, 2019). Recently, Goldstein et al. (2017) show that bond mutual funds' flow-performance relation is stronger for bad performance, which they interpret as evidence of runnability: higher sensitivity to bad performance gives a stronger first-mover advantage and hence an incentive to run. In Appendix A, we estimate the flow-performance relation of institutional prime MMFs before and after the reform implementation. We show that flow sensitivity to bad performance decreased after the reform, consistently with the fact that they became less money-like (see Table A.1).

4 The Premium for money-like assets

4.1 Baseline specification

How much are investors willing to pay to preserve the money-likeness of their investment? In other words, what is the premium for money-likeness? As Figure 3 shows, the difference between the net yield of prime and government MMFs widens substantially in the months before and after the implementation of the new SEC rule. The net-yield spread between the two MMF types averages under 8 bps through November 2015, jumps to 25 bps in October 2016, and remains above 14 bps since then; this evidence suggests that prime MMF investors require a higher spread to keep their money in prime MMFs as compensation for the fact that the regulation has made prime MMF shares less money-like.

Fluctuations in the net yield spread between prime and government MMFs, however, can be due to factors other than the 2014 SEC reform and its effect on the money-likeness of prime MMFs. For example, an increase in risk aversion or market volatility could lead prime MMF investors to require a higher yield relative to government MMFs since prime MMFs are riskier. Similarly, a higher yield spread could be caused by a relative increase in risk-taking by prime MMFs. Also, a tightening of monetary policy, by raising short-term interest rates, increases the opportunity cost of holding money and may drive up the premium for money-like assets (Nagel, 2016 and Drechsler *et al.*, 2017 and 2018). In this section, we isolate the impact of the SEC reform on the prime-government yield spread through a difference-in-differences approach. Our regression design allows us to estimate the premium investors attach to the money-likeness of MMF shares and relate this premium to the information insensitivity generated by the absence of redemption gates or fees and by the presence of a stable NAV.

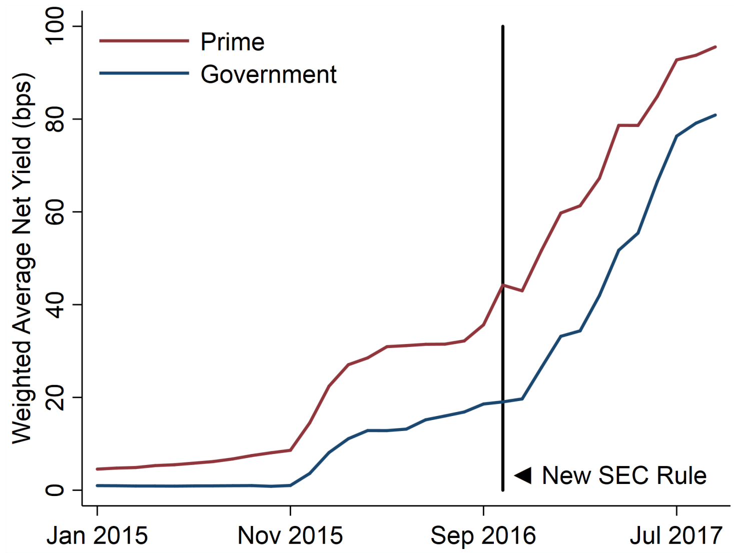


Figure 3. Weighted Average Net Yield by Money Market Fund (MMF) Type. The sample is all US MMFs from January 2015 to September 2017. The red line is the weighted average net yield of prime MMFs; the blue line is the weighted average net yield of government MMFs. The yield is expressed in basis points. The black vertical line represents the month in which the 2014 SEC reform came into effect (October 2016).

To estimate the premium for money-likeness, we run the family-level regression:

$$y_{ijkt} = \alpha_{ijk} + \mu_{jt} + \gamma_1 \times \text{Prime}_k \times 1_{t \geq \text{Nov. 2015}} + \gamma_2 \times \text{Prime}_k \times 1_{t \geq \text{Oct. 2016}} +$$
$$\gamma_3 \times \text{Inst}_j \times \text{Prime}_k \times 1_{t \geq \text{Nov. 2015}} + \gamma_4 \times \text{Inst}_j \times \text{Prime}_k \times 1_{t \geq \text{Oct. 2016}} + \varepsilon_{ijkt}, \quad (2)$$

where y_{ijkt} is the weighted average net yield of MMFs of type $k \in \{\text{prime, government}\}$, for share classes of type $j \in \{\text{institutional, retail}\}$, in family i, in month t.[25] Prime_k is a dummy for prime MMFs; Inst_j is a dummy for institutional share classes; $1_{t \geq \text{Nov. 2015}}$ is a dummy for November 2015—when MMF investors started to react to the new regulation—onwards; and $1_{t \geq \text{Oct. 2016}}$ is a dummy for October 2016—when the new regulation came into effect—onwards. The coefficients γ_1 and γ_2 measure how the prime-government yield spread of retail share classes responds to the reform; γ_3 and

[25]Since the regressions are at the family level, we average share class observations using TNA as weights.

γ_4 measure the additional effect for institutional classes. In other words, we interpret $\gamma_1 + \gamma_2$ as the premium for money-likeness paid by retail investors, and $\gamma_3 + \gamma_4$ as the additional premium paid by institutional ones.[26]

To control for other factors that could affect the net-yield spread between prime and government MMFs and differentially impact institutional and retail share classes, we saturate regression (2) with fixed effects: α_{ijk} are fixed effects for the interaction of family, MMF-type, and investor-type, which control for heterogeneity across families in their ability to offer better yields on different MMF products (institutional prime, retail prime, institutional government and retail government); μ_{jt} are fixed effects for the interaction of investor-type and time, which control for time-varying factors that affect the net yields of institutional and retail share classes differently.

Results of regression (2) are in Table 4. Standard errors are heteroskedasticity, autocorrelation, and spatial correlation (HACSC) robust to account for correlations within and across fund families.[27] Column 1 reports the estimates for our baseline sample, the unbalanced panel of MMF families active in any month from January 2015 to September 2017. For retail investors, the net-yield spread between prime and government MMFs does not change significantly ahead of the regulatory change but increases sharply after the regulation comes into place. After October 2016, the yield paid by retail prime funds in excess of that paid by retail government funds increases by 20 bps (p–value = 0.000); such rise reflects the higher information sensitivity of prime MMF investments due to the introduction of gates and fees and the resulting

[26]In our diff-in-diff specification, we use as control the yield on government MMF. This is a natural choice given the flow from prime to government funds documented in Section 3. Ultra-short government bond (USGB) funds are a type of mutual fund that invests in similar asset classes as MMFs; as government MMFs, USGB funds have not been affected by any regulation during our period of analysis and, therefore, can be used as control group in our diff-in-diff analyses. In Appendix D, we estimate the premium for money-likeness by comparing the net yield of prime MMFs to that of USGB funds. The results are similar to those reported in this section.

[27]As in Section 3, we use Driscoll and Kraay (1998) standard errors with 3-month lags.

reduction in their money-likeness.[28] For institutional investors, whose prime MMF shares must also operate with a floating NAV, the response to the regulation is faster and stronger. The yield spread between institutional prime and institutional government funds widens by around 5 bps (p–value = 0.001) in the year ahead of the regulatory change and by an additional 22 bps (p–value = 0.000) after the regulation comes into effect.[29] The overall increase in the net-yield spread for institutional investors is 28 bps and is significantly greater, by 8 bps, than that for retail investors (p–value = 0.001).[30]

The earlier and stronger reaction of institutional investors is consistent both with the fact that they are more sophisticated and attentive to changes in their investments' characteristics and with the fact that, through the additional requirement of a floating NAV, the reform has made institutional prime funds even less money-like than retail ones. Overall, the results of regression (2) indicate that investors are willing to pay a high premium for the money-likeness of their MMF shares, ranging from 20 bps for retail investors to 28 bps for institutional investors. These estimates of the premium for money-likeness estimated on privately supplied assets are comparable to those of Krishnamurthy and Vissing-Jorgensen (2012) and Nagel (2016) estimated on US Treasuries, 46 and 24 bps; in other words, the premium attached to the information insensitivity of a MMF share with fixed NAV and no gates or fees is comparable to the premium attached to the information insensitivity of US Treasuries.

[28]The effect is the sum of the two coefficients $\gamma_1 + \gamma_2 = 0.55 + 19.07 = 19.62$.

[29]The first effect is the sum of the two coefficients $\gamma_1 + \gamma_3 = 0.55 + 4.64 = 5.19$; the second is the sum of the two coefficients $\gamma_2 + \gamma_4 = 19.07 + 3.25 = 22.32$.

[30]Our estimates suggest that the increase in spread attributable to gates and fees (20 bps) is larger than that attributable to the adoption of the floating NAV (8 bps); this contrasts with the general wisdom at the time of the reform enactment, when most practitioners were concerned about the impact on the industry of the floating NAV (e.g., ICI, 2010 and ICI, 2013).

	Net Yield$_{ijkt}$		
	(1)	(2)	(3)
Prime$_k$ × $1_{t\geq \text{Nov. 2015}}$	0.55	2.00	0.87
	(0.75)	(1.18)	(0.75)
Prime$_k$ × $1_{t\geq \text{Oct. 2016}}$	19.07***	17.99***	19.59***
	(2.10)	(2.24)	(2.02)
Inst$_j$ × Prime$_k$ × $1_{t\geq \text{Nov. 2015}}$	4.64***	9.18***	4.17***
	(0.87)	(1.85)	(0.87)
Inst$_j$ × Prime$_k$ × $1_{t\geq \text{Oct. 2016}}$	3.25	1.01	4.33***
	(1.78)	(1.78)	(1.33)
Prime$_k$ × $\sum_s 1_{t\geq s}$	19.62***	19.99***	20.46***
Inst$_j$ × Prime$_k$ × $\sum_s 1_{t\geq s}$	7.90***	10.19***	8.50***
Balanced		Yes	
Nov. 2010 - Sep. 2017			Yes
Adj. R^2	0.92	0.91	0.90
Adj. Within R^2	0.26	0.29	0.26
Observations	5257	3333	15723

Table 4. The Premium for Money-likeness: Regression Analysis. Net Yield$_{ijkt}$ is the weighted average net yield of family i's share classes of type j (institutional or retail) in MMFs of type k (prime or government) in month t. Prime$_k$ is a dummy for k =“prime.” Inst$_j$ is a dummy for j =“institutional.” $1_{t\geq \text{Nov. 2015}}$ is a dummy for November 2015 onward and $1_{t\geq \text{Oct. 2016}}$ is a dummy for October 2016 onward. All regressions include fixed effects for the interaction of family, MMF-type, and class-type; and fixed effects for the interaction of class-type and time. Column 1 reports the results for the unbalanced panel of MMF families active in any month from January 2015 to September 2017. Column 2 reports the results for the balanced panel of families continuously active from January 2015 to September 2017. Column 3 reports the results for the unbalanced panel of MMF families active in any month from November 2010 to September 2017. Standard errors (in parentheses) are HACSC robust from Driscoll and Kraay (1998) with 3-month lags. Significance values are computed according to critical values from fixed-b asymptotics derived by Vogelsang (2012). ***, **, and * represent 1%, 5%, and 10% statistical significance.

Our first robustness check is to make sure that our diff-in-diff specification satisfies the parallel trend assumption. To have enough statistical power to detect possible pre-regulation trends, we extend the sample back to January 2014 and estimate the following regression:

$$y_{ijkt} = \alpha_{ijk} + \mu_{jt} + \sum_{s \neq 2015Q1} \gamma_{1,s} \times \text{Prime}_k \times \text{Quarter}_t^{(s)} + \sum_{s \neq 2015Q1} \gamma_{2,s} \times \text{Inst}_j \times \text{Prime}_k \times \text{Quarter}_t^{(s)} + \varepsilon_{ijkt}. \quad (3)$$

$\text{Quarter}_t^{(s)}$ is a dummy equal to one if month t belongs to quarter s; the other variables are defined as in regression (2). The coefficients of interest are the γ's, which measure the evolution of the prime-government yield spread in retail share classes (γ_1) and institutional ones ($\gamma_1 + \gamma_2$) over time relative to an omitted quarter, 2015Q1, in the "pre-treatment" period. If there were non-parallel trends in net yields before the industry started to respond to the 2014 SEC reform, the γ's should be increasing (or decreasing) significantly before November 2015. Results of this non-parametric test are in Figure 4; for both retail and institutional share classes, there is not such a trend: the net yields of prime run parallel to those of government MMFs throughout 2014 and the first half of 2015. Specifically, $\gamma_{1,s}$ are flat and practically indistinguishable from zero until 2016Q3, while $\gamma_{1,s} + \gamma_{2,s}$ start to pick up in 2015Q3 and increase significantly during the transition period.[31]

We run several other robustness checks. Column 2 of Table 4 replicates the results of Column 1 estimating regression (2) on the balanced panel of MMF family-product (e.g., Fidelity-institutional-prime) active each month from January 2015 to September 2017. Results are qualitatively and quantitatively similar: the premium for money-likeness paid by retail investors is 20 bps and the additional premium paid by institutional investors is 10 bps. Column 3 reports the results of regression (2) for a much longer sample, namely, the unbalanced panel of MMF families active in

[31] A further robustness check of the parallel trend assumption is in Appendix D, where we reestimate regression (2) allowing for group-specific linear time trends; results are qualitatively and quantitatively similar to the baseline ones.

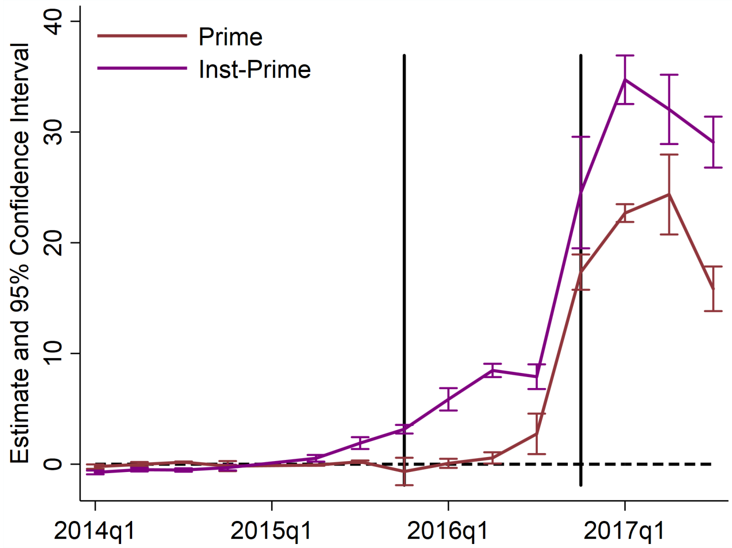


Figure 4. Nonparametric Test of Parallel Trend Assumption; Premium for Money-likeness over Time. Red points are estimates of γ_1 from regression (3), and purple points are estimates of $\gamma_1 + \gamma_2$; the regression is estimated on the unbalanced panel of MMF family-products from January 2014 until September 2017. Vertical bars are HACSC robust standard errors from Driscoll and Kraay (1998) with 3-month lags. The black vertical lines correspond to November 2015 and October 2016.

any month from November 2010 (i.e., the first available date for N-MFP data) until September 2017. Again, the estimates are very close to those in Columns 1 and 2. Also, the within R^2 of all regressions in Table 4 is between 25 and 30%, indicating that our baseline specification has good explanatory power.[32]

Finally, in Appendix D, we control for all time-varying factors that affect the yields of prime and government MMFs differentially and focus on the additional spread within institutional share classes. We do so by adding fixed effects for the interaction of MMF-type and time to regression (2). This specification comes at the cost of losing identification of the premium for money-likeness paid by retail investors but provides a more robust estimate of the additional premium paid by institutional investors. The

[32]A possible concern is that, in Table 4, we compare the yield of prime MMFs to that of all government MMFs, including both treasury and agency funds, whereas most of the prime MMF outflows caused by the reform went to the agency MMF subsegment (see Appendix B.3). For robustness, we estimate regression (2) excluding treasury MMFs from the sample. Results are in Table D.6 of Appendix D and are similar to those in Table 4.

results are very close to those of the baseline specification: the additional premium paid by institutional investors because of the new regulation is between 8 and 10 bps (with p–values ranging from 0.000 to 0.001).[33]

4.2 Controlling for fund risk taking, investors' risk aversion, and monetary policy

A potential concern about our identification strategy is that the regulation changed the investor base of different MMF products and therefore may have impacted their risk-taking. Although the 2014 SEC regulation affected only the liquidity of MMF shares, one might argue that the investors who remained in prime MMFs are relatively more risk tolerant than those who flowed to government MMFs; such change in the relative risk aversion of the funds' investor base may have lead prime funds to take relatively more risk, therefore increasing the prime-government yield spread.[34]

In this section, we tackle this identification issue in four ways: by showing that the risk taking of prime relative to government MMFs did not increase in response to the regulation; by explicitly controlling for fund risk-taking; by focusing only on those share classes that did not experience significant outflows or inflows; and by controlling

[33]After the reform, anecdotally, many fund families no longer allowed investors to use prime MMFs to settle their trades. We interpret this fact as evidence that investors stopped considering prime MMFs as money-like instruments (because of the possible imposition of gates and fees), and, as a result, MMF families stopped offering them as settlement accounts. One could argue, however, that fund families' decision to stop using prime MMFs as settlement account is a direct effect of the reform (although, the reform did not impact their ability to do so), and the higher yield paid by prime MMF reflects the loss of their settlement value. Information on which family stopped using prime MMFs as a settlement account is not available, so we cannot address the concern directly with our econometric analysis. As an alternative empirical strategy, in Appendix D, we rerun our premium regression including the interactions of the prime-MMF and regulatory dummies with the family share or non-MMF mutual fund business. The rationale is that investors in fund families that offer a large selection of other mutual-fund products should value the settlement feature more than investors in families that only or almost only offer MMF products. As Table D.10 in Appendix D shows, our premium estimates are unaffected.

[34]Note, however, that it is actually unclear whether such intra-industry changes in investor base would push the net-yield spread up or down since the risk tolerance of government MMF investors may also have increased due to inflows of former prime MMF investors.

for differential effects of perceived market volatility across MMF segments before and after the regulation.

First, we exploit the fact that we have security-level data on MMF portfolios and construct the following four proxies for fund risk-taking: weighted average portfolio maturity, weighted average portfolio CDS spread, difference in the portfolio shares of risky and safe asset classes, and portfolio share of safe asset classes. These proxies are commonly used in the literature on MMF risk-taking (Kacperczyk and Schnabl, 2013; La Spada, 2018). A fund's weighted average portfolio maturity measures its exposure to interest rate risk; the other three proxies measure its exposure to credit risk. To compute the weighted average CDS spread of a fund's portfolio, we match every security in the fund's portfolio with its issuer's 5-year CDS spread from Markit. Following La Spada (2018), safe asset classes are Treasuries, Agency debt, and repos, that is, the asset classes available to government funds. To identify risky asset classes, we follow Kacperczyk and Schnabl (2013) and regress a fund's future gross yield on its current portfolio composition by asset class, controlling for time-varying fund characteristics and fixed effects.[35] For prime funds, consistent with Kacperczyk and Schnabl (2013) and La Spada (2018), the riskiest investment category is bank obligations; for muni funds, it is general market notes; for government funds, we set the share of risky assets to zero.[36]

After having constructed the proxies for fund risk taking, for each risk-taking measure, we run the same regression as Equation (2) with the risk-taking measure as the dependent variable (instead of the net yield). The results are in Table 5 and show that the risk-taking of prime MMFs relative to government MMFs did not go up in

[35]Note that, in a departure from our general empirical strategy, these regressions consider muni and prime funds as two separate fund types; the reason is that prime and muni MMFs invest in different type of assets, and, therefore, the risky investments available to the two types of funds are different.

[36]A more detailed description of our risk-taking proxies can be found in Appendix D.

response to the 2014 SEC reform and actually decreased for retail share classes. This is true all our four measures of risk-taking.[37]

	(1) WAM_{ijkt}	(2) CDS_{ijkt}	(3) Net_{ijkt}	(4) Safe_{ijkt}
$\text{Prime}_k \times 1_{t\geq\text{Nov. 2015}}$	-4.90*	1.12	-11.33***	8.57***
	(2.13)	(2.00)	(2.13)	(1.54)
$\text{Prime}_k \times 1_{t\geq\text{Oct. 2016}}$	-3.12	-7.21***	4.12***	-5.98***
	(2.38)	(2.13)	(1.15)	(1.09)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t\geq\text{Nov. 2015}}$	-1.45	1.15	2.90	-2.90
	(0.96)	(1.10)	(2.30)	(1.45)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t\geq\text{Oct. 2016}}$	1.69	-0.49	-6.10	3.49
	(1.25)	(1.27)	(3.23)	(2.16)
$\text{Prime}_k \times \sum_s 1_{t\geq s}$	-8.02***	-6.09***	-7.20***	2.59*
$\text{Inst}_j \times \text{Prime}_k \times \sum_s 1_{t\geq s}$	0.24	0.66	-3.20	0.59
Adj. R^2	0.66	0.81	0.96	0.96
Adj. Within R^2	0.04	0.04	0.05	0.04
Observations	5257	5199	5257	5257

Table 5. Money Market Fund (MMF) Risk Taking by Fund Type. WAM_{ijkt} is the weighted average portfolio maturity in days of family i's share classes of type j (institutional or retail) in MMFs of type k in month t. CDS_{ijkt} is the weighted average portfolio CDS spread in percentage points of family i's share classes of type j (institutional or retail) in MMFs of type k in month t. Net_{ijkt} is the difference between the portfolio shares of risky and safe asset classes in percentage points of family i's share classes of type j (institutional or retail) in MMFs of type k in month t. Safe_{ijkt} is the portfolio share of safe asset classes in percentage points of family i's share classes of type j (institutional or retail) in MMFs of type k in month t. Risky asset classes are bank obligations for prime funds and general market notes for muni funds. Safe asset classes are Treasuries, Agency debt, and repos. Inst_j is a dummy for $j =$"institutional." $1_{t\geq\text{Nov. 2015}}$ is a dummy for November 2015 onward and $1_{t\geq\text{Oct. 2016}}$ is a dummy for October 2016 onward. All regressions include fixed effects for the interaction of family and class-type. The sample is the unbalanced panel of MMF families active in any month from January 2015 to September 2017. Standard errors (in parentheses) are HACSC robust from Driscoll and Kraay (1998) with 3-month lags. Significance values are computed according to critical values from fixed-b asymptotics derived by Vogelsang (2012). ***, **, and * represent 1%, 5%, and 10% statistical significance.

Next, we reestimate the premium for money-likeness adding all our risk-taking controls, lagged by one month, to regression (2).[38] Results are in Table 6. Across all

[37]In contrast to our focus on prime versus government funds, Alnahedh and Bhagat (2018) look at the effect of the reform on the relative risk taking of institutional versus retail share classes within the prime MMF segment.

[38]Since the regression is at the family, MMF-type, investor-type level, we aggregate class-level

samples, our estimates are qualitatively and quantitatively similar to those in Table 4: the premium for the information insensitivity due to the absence of gates or fees is between 20 and 22 bps, and the additional premium for a stable NAV is between 9 and 12 bps.[39]

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risk-taking in the same way that we aggregate net yields. That is, given a risk-taking variable x in the underlying securities portfolio, x_{ijkt} is month t's weighted average of x across share classes of type j in MMFs of type k within family i, using class TNA as weights.

[39]In Appendix D, we rerun regression (2) controlling for one risk-taking proxy at the time (see Table D.8); results are unchanged.

	Net Yield$_{ijkt}$		
	(1)	(2)	(3)
Prime$_k$ × $1_{t \geq \text{Nov. 2015}}$	1.99	3.54*	1.15
	(1.03)	(1.48)	(0.80)
Prime$_k$ × $1_{t \geq \text{Oct. 2016}}$	19.48***	18.66***	19.32***
	(2.04)	(2.27)	(1.97)
Inst$_j$ × Prime$_k$ × $1_{t \geq \text{Nov. 2015}}$	4.15***	8.19***	4.11***
	(0.68)	(1.42)	(0.83)
Inst$_j$ × Prime$_k$ × $1_{t \geq \text{Oct. 2016}}$	4.42**	3.45**	4.52***
	(1.44)	(1.31)	(1.16)
WAM$_{i,j,k,t-1}$	0.07**	0.10***	-0.01
	(0.02)	(0.02)	(0.01)
CDS$_{i,j,k,t-1}$	0.04	0.03	0.00
	(0.03)	(0.04)	(0.01)
Net$_{i,j,k,t-1}$	0.18**	0.24***	0.05**
	(0.06)	(0.06)	(0.02)
Safe$_{i,j,k,t-1}$	0.06	0.09	0.00
	(0.07)	(0.10)	(0.02)
Prime$_k$ × $\sum_s 1_{t \geq s}$	21.48***	22.20***	20.47***
Inst$_j$ × Prime$_k$ × $\sum_s 1_{t \geq s}$	8.57***	11.63***	8.63***
Balanced		Yes	
Nov. 2010 - Sep. 2017			Yes
Adj. R^2	0.92	0.92	0.90
Adj. Within R^2	0.27	0.31	0.26
Observations	4978	3192	15325

Table 6. The Premium for Money-likeness: Controlling for Portfolio Characteristics. Net Yield$_{ijkt}$ is the weighted average net yield of family i's share classes of type j (institutional or retail) in MMFs of type k (prime or government) in month t. Prime$_k$ is a dummy for k =“prime.” Inst$_j$ is a dummy for j =“institutional.” $1_{t \geq \text{Nov. 2015}}$ is a dummy for November 2015 onward and $1_{t \geq \text{Oct. 2016}}$ is a dummy for October 2016 onward. WAM$_{ijkt}$ is the weighted average portfolio maturity in days, CDS$_{ijkt}$ is the weighted average portfolio CDS spread in percentage points, Net$_{ijkt}$ is the difference between the portfolio shares of risky and safe assets in percentages, Safe$_{ijkt}$ is the share of safe asset classes in percentages. For each security in a fund's portfolio, the CDS spread is the 5-year CDS spread of the issuer from Markit. Risky asset classes are bank obligations for prime funds and general market notes for muni funds; safe asset classes are Treasuries, Agency debt, and repos. All regressions include fixed effects for the interaction of family, MMF-type, and class-type; and fixed effects for the interaction of class-type and time. Column 1 reports the results for the unbalanced panel of MMF families active in any month from January 2015 to September 2017. Column 2 reports the results for the balanced panel of families continuously active from January 2015 to September 2017. Column 3 reports the results for the unbalanced panel of MMF families active in any month from November 2010 to September 2017. Standard errors (in parentheses) are HACSC robust from Driscoll and Kraay (1998) with 3-month lags. Significance values are computed according to critical values from fixed-b asymptotics derived by Vogelsang (2012). ***, **, and * represent 1%, 5%, and 10% statistical significance.

Our second robustness check restricts the sample to those share classes whose TNA did not change by more than 5% in absolute value between November 2015 and October 2016. The rationale is that these share classes are less likely to have experienced significant reshuffling of their investor base around the reform implementation. We estimate regression (2) on this subsample of the industry; given the nature of this robustness check, the regression is run at the share class level.[40] Results are in Table 7 and again are very close to our baseline estimates: for instance, looking at the balanced panel in Column 2, the premium paid by retail investors is 16 bps, and the additional premium paid by institutional investors is 11 bps.

[40]Family, MMF-type, investor-type fixed effects are replaced with class, MMF-type, investor-type fixed effects. Note that such fixed effects are appropriate since, in our sample, several share classes have changed both fund type and investor type over time.

	Net Yield_{ijkt}		
	(1)	(2)	(3)
$\text{Prime}_k \times 1_{t \geq \text{Nov. 2015}}$	0.73	2.11	0.44
	(1.29)	(1.77)	(1.29)
$\text{Prime}_k \times 1_{t \geq \text{Oct. 2016}}$	14.63***	14.31***	15.05***
	(2.48)	(2.77)	(2.36)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t \geq \text{Nov. 2015}}$	7.54*	11.32***	8.71**
	(3.07)	(1.91)	(3.35)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t \geq \text{Oct. 2016}}$	4.18	-0.04	5.33
	(4.07)	(3.83)	(4.38)
$\text{Prime}_k \times \sum_s 1_{t \geq s}$	15.35***	16.42***	15.49***
$\text{Inst}_j \times \text{Prime}_k \times \sum_s 1_{t \geq s}$	11.72**	11.28***	14.03***
Balanced		Yes	
Nov. 2010 - Sep. 2017			Yes
Adj. R^2	0.83	0.85	0.82
Adj. Within R^2	0.11	0.13	0.13
Observations	3356	1848	8249

Table 7. The Premium for Money-likeness: Share-class Level Regression. Net Yield_{ijkt} is the net yield of share class i, which is of type j (institutional or retail) in a MMF of type k (prime or government), in month t. Prime_k is a dummy for $k =$"prime." Inst_j is a dummy for $j =$"institutional." $1_{t \geq \text{Nov. 2015}}$ is a dummy for November 2015 onward and $1_{t \geq \text{Oct. 2016}}$ is a dummy for October 2016 onward. All regressions include fixed effects for the interaction of class, MMF-type, and class-type; and fixed effects for the interaction of class-type and time. The sample is all MMF share classes whose TNA did not change by more than 5% in absolute value between November 2015 and October 2016. Column 1 reports the results for the unbalanced panel of share classes in the sample active in any month from January 2015 to September 2017. Column 2 reports the results for the balanced panel of classes in the sample continuously active from January 2015 to September 2017 and that did not change MMF type or investor type during this period. Column 3 reports the results for the unbalanced panel of classes in the sample active in any month from November 2010 to September 2017. Standard errors (in parentheses) are HACSC robust from Driscoll and Kraay (1998) with 3-month lags. Significance values are computed according to critical values from fixed-b asymptotics derived by Vogelsang (2012). ***, **, and * represent 1%, 5%, and 10% statistical significance.

Our third robustness check is to estimate regression (2) adding as controls the interactions of the VIX with Prime_k, $\text{Inst}_j \times \text{Prime}_k$, and their own interactions with the regulation dummies. This regression aims to control for differential effects of investors' time-varying risk aversion, as proxied by perceived market volatility, on the different segments of the MMF industry before and after the rule implementation.

Results are in Columns 1 to 3 of Table 8 and are quantitatively and qualitatively similar to our baseline estimates of the premium for money-likeness in Table 4.

	Net Yield$_{ijkt}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{Prime}_k \times 1_{t\geq\text{Nov. 2015}}$	5.22	9.65*	5.99*	-1.83	-2.36*	-1.95**
	(3.18)	(4.32)	(3.14)	(0.91)	(1.14)	(0.83)
$\text{Prime}_k \times 1_{t\geq\text{Oct. 2016}}$	17.09	7.35	17.17	22.60***	25.99***	23.41***
	(9.98)	(10.57)	(9.78)	(3.35)	(3.30)	(3.27)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t\geq\text{Nov. 2015}}$	4.37	2.18	5.68*	7.01***	12.16***	4.69***
	(2.67)	(5.91)	(2.75)	(1.52)	(2.78)	(1.20)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t\geq\text{Oct. 2016}}$	9.74	20.11**	9.47	1.29	-1.44	2.76
	(5.98)	(7.64)	(5.65)	(3.50)	(4.07)	(3.04)
$\text{Prime}_k \times \sum_s 1_{t\geq s}$	22.31*	17.00	23.16**	20.77***	23.64***	21.46***
$\text{Inst}_j \times \text{Prime}_k \times \sum_s 1_{t\geq s}$	14.12**	22.28***	15.16***	8.30**	10.72**	7.46**
Balanced		Yes			Yes	
Nov. 2010 - Sep. 2017			Yes			Yes
Control	VIX	VIX	VIX	EFFR	EFFR	EFFR
Adj. R^2	0.92	0.91	0.90	0.92	0.92	0.90
Adj. Within R^2	0.26	0.29	0.26	0.26	0.29	0.26
Observations	5257	3333	15723	5257	3333	15723

Table 8. The Premium for Money-likeness: Regression Analysis with Controls for Time-varying Macro Factors. Net Yield$_{ijkt}$ is the weighted average net yield of family i's share classes of type j (institutional or retail) in MMFs of type k (prime or government) in month t. Prime_k is a dummy for $k =$"prime." Inst_j is a dummy for $j =$"institutional." $1_{t\geq\text{Nov. 2015}}$ is a dummy for November 2015 onward and $1_{t\geq\text{Oct. 2016}}$ is a dummy for October 2016 onward. All regressions include fixed effects for the interaction of family, MMF-type, and class-type; and fixed effects for the interaction of class-type and time. Columns 1 and 2 report the results for the unbalanced panel of MMF families active in any month from January 2015 to September 2017. Columns 2 and 5 report the results for the balanced panel of families continuously active from January 2015 to September 2017. Columns 3 and 6 report the results for the unbalanced panel of MMF families active in any month from November 2010 to September 2017. Columns 1 to 3 (4 to 6) include the interactions of the last month's VIX (effective federal funds rate) with Prime_k and with $\text{Inst}_j \times \text{Prime}_k$, and their own interactions with the regulation dummies. Standard errors (in parentheses) are HACSC robust from Driscoll and Kraay (1998) with 3-month lags. Significance values are computed according to critical values from fixed-b asymptotics derived by Vogelsang (2012). ***, **, and * represent 1%, 5%, and 10% statistical significance.

The net-yield spread between prime and government MMFs may also depend on the monetary policy stance, as the two types of funds invest in different asset classes.

To control for this, we re-estimate regression (2) adding as independent variables the interactions of the effective federal funds rate with Prime_k, $\text{Inst}_j \times \text{Prime}_k$, and their own interactions with the regulation dummies. Results are in Columns 4 to 6 of Table 8 and are very close to those of our baseline specification: the money-likeness premium is between 20 and 24 bps for retail investors, and there is an additional premium between 7 and 11 bps for institutional ones.

4.3 Premium decomposition: fees and gross yield

A fund's net yield is the difference between its gross yield and the fees it charges. As a result, the increase in net-yield spread between prime and government MMFs must be due to either a decrease in relative fees, an increase in the gross-yield spread, or a combination of both.

In Table 9, we run our baseline premium regression (2) using fund fees and gross yield as dependent variables. We show that, after the implementation of the reform, the fee spread between prime and government MMFs decreases by 9 to 12 bps for retail investors and by an additional 2 to 5 bps for institutional ones. That is, the decrease in relative fees amounts to 25% to 50% of our estimated premium for money-likeness. The remainder is accounted by an increase in the gross-yield spread: about 10 bps for retail investors and an additional 6 bps for institutional ones. The decrease in relative fees and the increase in relative gross yield are not driven by changes in MMFs' relative risk taking: indeed, if we control for our proxies of fund risk taking, results are unchanged (see Appendix D).

	(1)	(2)	(3)	(4)	(5)	(6)
	Fees_{ijkt}	Fees_{ijkt}	Fees_{ijkt}	Gross Yield_{ijkt}	Gross Yield_{ijkt}	Gross Yield_{ijkt}
$\text{Prime}_k \times 1_{t \geq \text{Nov. 2015}}$	1.43	0.54	0.22	1.98	2.54	1.09
	(1.23)	(1.78)	(1.33)	(1.89)	(2.88)	(1.98)
$\text{Prime}_k \times 1_{t \geq \text{Oct. 2016}}$	-11.14**	-9.70**	-11.87***	7.92	8.29	7.72*
	(3.81)	(3.54)	(3.70)	(4.41)	(4.60)	(4.21)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t \geq \text{Nov. 2015}}$	-5.30***	-9.56***	-4.59***	-0.66	-0.38	-0.42
	(1.27)	(2.20)	(1.32)	(1.28)	(2.58)	(1.22)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t \geq \text{Oct. 2016}}$	2.91	4.84	2.52	6.17	5.86	6.85**
	(2.95)	(3.04)	(2.65)	(3.31)	(3.75)	(3.13)
$\text{Prime}_k \times \sum_s 1_{t \geq s}$	-9.71**	-9.17**	-11.65***	9.91**	10.83**	8.81**
$\text{Inst}_j \times \text{Prime}_k \times \sum_s 1_{t \geq s}$	-2.39	-4.71	-2.07	5.51	5.48	6.43*
Balanced		Yes			Yes	
Nov. 2010 - Sep. 2017			Yes			Yes
Adj. R^2	0.83	0.80	0.82	0.98	0.98	0.97
Adj. Within R^2	0.08	0.10	0.09	0.22	0.28	0.13
Observations	5257	3333	15723	5257	3333	15723

Table 9. The Premium for Money-likeness: Decomposition in Fees and Gross Yields. Fee_{ijkt} (Gross Yield_{ijkt}) is the weighted average fee (gross yield) of family i's share classes of type j (institutional or retail) in MMFs of type k (prime or government) in month t. Prime_k is a dummy for $k =$"prime." Inst_j is a dummy for $j =$"institutional." $1_{t \geq \text{Nov. 2015}}$ is a dummy for November 2015 onward and $1_{t \geq \text{Oct. 2016}}$ is a dummy for October 2016 onward. All regressions include fixed effects for the interaction of family, MMF-type, and class-type; and fixed effects for the interaction of class-type and time. Columns 1 and 4 report the results for the unbalanced panel of MMF families active in any month from January 2015 to September 2017. Columns 2 and 5 report the results for the balanced panel of families continuously active from January 2015 to September 2017. Columns 3 and 6 report the results for the unbalanced panel of MMF families active in any month from November 2010 to September 2017. Standard errors (in parentheses) are HACSC robust from Driscoll and Kraay (1998) with 3-month lags. Significance values are computed according to critical values from fixed-b asymptotics derived by Vogelsang (2012). ***, **, and * represent 1%, 5%, and 10% statistical significance.

Since the increase in the gross-yield spread is not due to an increase in the relative risk taking of prime MMFs, it must be due to an increase in the yields paid by the securities held by prime funds relative to those held by government funds (holding relative riskiness constant). Figure 5 shows the weighted average gross yields by MMF type along with the market rates on high-quality short-term unsecured debt, such as CDs and CPs, and the market rates on T-bills and repos. The prime-MMF gross yield tracks CD and CP rates, whereas the government-MMF gross yield tracks T-bill and repo rates, suggesting that the increase in the gross-yield spread after the reform implementation is due to changes in the market rates of those securities in which prime and government funds invest. The increase of the spread between unsecured rates and the rates paid by Treasuries and Treasury-backed repos is consistent with the shrinkage of the prime-MMF segment and the decline in the demand for the unsecured debt securities in which prime funds invest.[41]

[41]In Appendix D, we also construct counterfactual gross-yield time series for both prime and government MMFs based on their portfolio holdings as of January 2015. More precisely, we match each asset class and maturity bucket with the corresponding market rate from FRED and, for each MMF, we compute the weighted average gross yield over time fixing portfolio weights as of January 2015. Figure D.1 shows that the weighted-average spread between these counterfactual gross yields tracks the weighted-average spread between the actual gross yields. This evidence supports the idea that the increase in gross-yield spread is not due to a portfolio rebalancing toward riskier investment by prime MMFs.

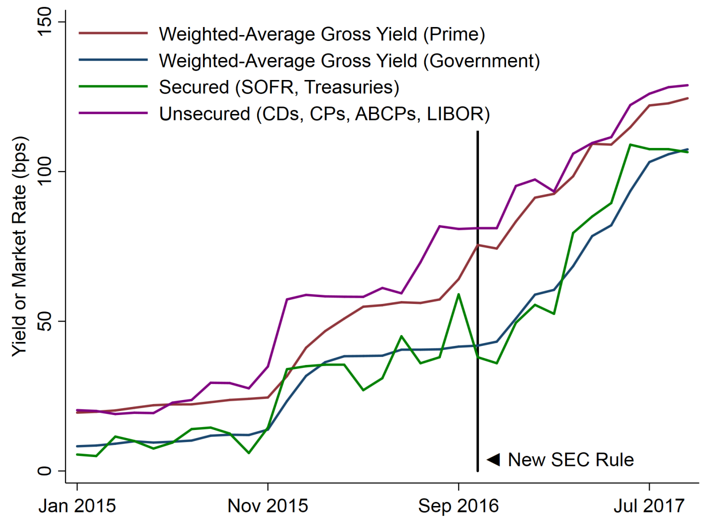


Figure 5. Gross Yields by MMF Type and Average Market Rates on Unsecured and Secured Debt. The sample is all US MMF families active on any given day between January 2015 and September 2017. The red and blue lines are the weighted average gross yields of prime and government MMFs respectively. The purple line is the average of the market rates on 3-month CDs, AA CPs and ABCPs, and LIBOR (which is the typical benchmark rate for floating rate notes). The green line is the average of the 3-month T-bill rate and the secured overnight financing rate (SOFR). Data on the market rates of CDs, CPs, LIBOR, and T-bill are from the FRED database; data on SOFR are from the NY Fed website.

4.4 The value of information insensitivity: the case of gates and fees

If, as we have suggested, the premium for money-likeness is driven by the increased information sensitivity due to the possibility of imposing redemption gates and liquidity fees, we should expect it to be larger for prime MMFs that are more likely to impose gates and fees. In other words, in the cross-section of MMFs, we should observe the premium for money-likeness to be larger for funds with lower proportion weekly liquid assets (WLA) as share of TNA. To test this hypothesis, we add WLA, its interactions with Prime_k, Inst_j, and the regulatory dummies (post November 2015 and post October 2016), and all higher-order interactions to our baseline premium regression (2). The sum of the coefficients on $\text{WLA}_{ijkt}* \text{Prime}_k * 1_{t\geq \text{Nov. 2015}}$ and $\text{WLA}_{ijkt}* \text{Prime}_k * 1_{t\geq \text{Oct. 2016}}$ measures the decrease in the premium paid by retail funds as their WLA increase, whereas the sum of the coefficients on $\text{WLA}_{ijkt}* \text{Inst}_j * \text{Prime}_k * 1_{t\geq \text{Nov. 2016}}$ and $\text{WLA}_{ijkt}* \text{Inst}_j * \text{Prime}_k * 1_{t\geq \text{Oct. 2016}}$ measures the additional decrease in the premium paid by institutional prime MMFs.[42] Although both retail and institutional prime MMFs can impose fees or gates, we expect the effect of WLA on the premium to be stronger for institutional funds, since institutional investors are more sophisticated and possibly more attentive to changes in the fund's portfolio.

Results are in Table 10. Across all samples, an increase of 10 pp in a prime MMF's WLA reduces the premium paid by retail investors by 3 bps and the premium paid by institutional investors by an additional 3 or 4 bps. These results show that the likelihood of gates and fees being imposed is priced by MMF investors and confirm that the premium we estimate is the average compensation investors demand for keeping their investment in prime MMFs, where gates and fees can be imposed and information about fund portfolio is therefore valuable.

[42]Note that these coefficients do not capture the mechanical impact of WLA on net yields (more liquid portfolios tend to have lower yields); rather, they measure the additional effect of WLA on the spread between prime and government MMFs after the reform takes effect, and gates and fees become a possibility.

	Net Yield$_{ijkt}$		
	(1)	(2)	(3)
$\text{Prime}_k \times 1_{t\geq \text{Nov. 2015}}$	10.54**	16.21**	8.13***
	(3.35)	(6.03)	(2.58)
$\text{Prime}_k \times 1_{t\geq \text{Oct. 2016}}$	31.49***	25.05***	32.80***
	(6.61)	(7.16)	(6.18)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t\geq \text{Nov. 2015}}$	8.49*	8.86	6.03
	(3.44)	(7.97)	(4.31)
$\text{Inst}_j \times \text{Prime}_k \times 1_{t\geq \text{Oct. 2016}}$	19.02*	21.33*	15.77
	(9.27)	(10.07)	(9.47)
$\text{WLA}_{ijkt} \times \text{Prime}_k \times 1_{t\geq \text{Nov. 2015}}$	-11.26**	-18.85*	-10.19***
	(4.11)	(8.77)	(3.12)
$\text{WLA}_{ijkt} \times \text{Prime}_k \times 1_{t\geq \text{Oct. 2016}}$	-17.62	-8.61	-19.44*
	(10.53)	(11.34)	(10.16)
$\text{WLA}_{ijkt} \times \text{Inst}_j \times \text{Prime}_k \times 1_{t\geq \text{Nov. 2015}}$	-12.40*	-2.20	-6.72
	(5.14)	(13.86)	(6.74)
$\text{WLA}_{ijkt} \times \text{Inst}_j \times \text{Prime}_k \times 1_{t\geq \text{Oct. 2016}}$	-29.72	-37.89*	-24.10
	(16.18)	(17.03)	(16.70)
$\text{Prime}_k \times \sum_s 1_{t\geq s}$	42.03***	41.26***	40.93***
$\text{Inst}_j \times \text{Prime}_k \times \sum_s 1_{t\geq s}$	27.51**	30.18***	21.80**
$\text{WLA}_{ijkt} \times \text{Prime}_k \times \sum_s 1_{t\geq s}$	-28.87**	-27.45	-29.63***
$\text{WLA}_{ijkt} \times \text{Inst}_j \times \text{Prime}_k \times \sum_s 1_{t\geq s}$	-42.12**	-40.08*	-30.82*
Balanced		Yes	
Nov. 2010 - Sep. 2017			Yes
Adj. R^2	0.92	0.92	0.90
Adj. Within R^2	0.29	0.32	0.27
Observations	5202	3291	15667

Table 10. The Premium for Money-likeness and WLA . Net Yield$_{ijkt}$ is the weighted average net yield of family i's share classes of type j (institutional or retail) in MMFs of type k (prime or government) in month t. Prime$_k$ is a dummy for $k =$"prime." Inst$_j$ is a dummy for $j =$"institutional." $1_{t\geq \text{Nov. 2015}}$ is a dummy for November 2015 onward and $1_{t\geq \text{Oct. 2016}}$ is a dummy for October 2016 onward. WLA$_{ijkt}$ is the share of weekly liquid assets in the portfolio of family i's share classes of type j (institutional or retail) in MMFs of type k (prime or government) in month t, in decimals. All regressions include fixed effects for the interaction of family, MMF-type, and class-type; and fixed effects for the interaction of class-type and time. Finally, all regressions include WLA$_{ijkt}$, $\text{WLA}_{ijkt} \times \text{Inst}_j$, $\text{WLA}_{ijkt} \times \text{Prime}_k$, $\text{WLA}_{ijkt} \times \text{Inst}_j \times \text{Prime}_k$, and their own interactions with $1_{t\geq \text{Nov. 2015}}$ and $1_{t\geq \text{Oct. 2016}}$. Column 1 reports the results for the unbalanced panel of MMF families active in any month from January 2015 to September 2017. Column 2 reports the results for the balanced panel of families continuously active from January 2015 to September 2017. Column 3 reports the results for the unbalanced panel of MMF families active in any month from November 2010 to September 2017. Standard errors (in parentheses) are HACSC robust from Driscoll and Kraay (1998) with 3-month lags. Significance values are computed according to critical values from fixed-b asymptotics derived by Vogelsang (2012). ***, **, and * represent 1%, 5%, and 10% statistical significance.

5 The elasticity of substitution between prime and government MMFs

In this section, we estimate the effect of the 2014 SEC reform on the elasticity of substitution between prime and government MMFs. As we explained in the previous sections, the introduction of gates, fees, and a floating NAV has reduced the money-likeness of prime MMFs vis-à-vis that of government MMFs. Here we estimate whether the substitutability of these two type of instruments has changed as a result.

We model investors' relative demand for prime versus government MMFs in the following way:[43]

$$\log(q_{it}^P/q_{it}^G) = \alpha + \delta_0 1_{t\geq \text{Oct. } 2016} + \delta_1 \log(p_{it}^P/p_{it}^G) + \delta_2 1_{t\geq \text{Oct. } 2016} \times \log(p_{it}^P/p_{it}^G) + \varepsilon_{it}, \quad (4)$$

where q_{it}^P and q_{it}^G are the TNA of prime and government funds of family i in month t, and p_{it}^P and p_{it}^G are the corresponding weighted average prices; in our regressions, we approximate the log of the price ratio with the net yield spread between government and prime funds, $y_{it}^G - y_{it}^P$.[44] $1_{t\geq \text{Oct. } 2016}$ is a dummy for October 2016 (the month in which the new rule comes into effect) onwards. The parameter δ_0 is the change in the relative demand for prime versus government MMFs caused by the reform independently of prices, that is, a parallel shift in the demand curve. The parameter δ_1 is the elasticity of substitution (i.e., the slope of the demand curve when both the dependent and the independent variable are modeled as log ratios) before the regulatory change; the parameter δ_2 is the change in the elasticity of substitution

[43]We use the term "demand" because we interpret our results as estimates of investors' willingness to hold money-like assets (i.e., their demand for such assets). Of course, one could reinterpret this demand function as investors' supply of funds to the MMF industry.

[44]This is equivalent to treating a MMF share as a zero-coupon bond with a face value of \$1 and yield y; its price is then $p = 1/(1 + y)$; for small yields, $\log(p^P/p^G) \approx y^G - y^P$.

caused by the reform.

Of course, prices and quantities are jointly determined in equilibrium. To address this endogeneity problem, we use an instrumental variables approach. We exploit the fact that, over the years, MMF families have specialized in either the prime or the government segment of the industry. That is, different families have accumulated differential expertise and economies of scale in managing prime rather than government MMF portfolios. This heterogeneity in specialization across MMF families can be interpreted as a cross-sectional shifter of the relative supply function that allows us to estimate the demand equation.

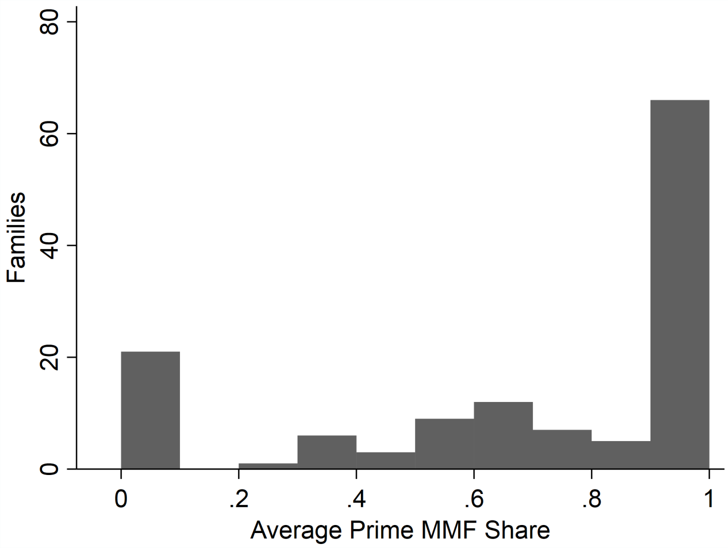
In particular, we run a two-stage least squares regression that uses family specialization in prime MMFs from a pre-sample period to instrument for the time-varying endogenous relative price in the regression sample.

Our proxy for prime MMF specialization is the average share of a family's prime MMF business relative to its total MMF business in a pre-sample period.[45] The top panels of Figure 6 show its distribution across families in 2012 (left) and in 2013 (right), roughly three and two years before investors started reacting to the SEC reform.[46] In both years, the distribution is widely dispersed and clearly bi-modal: about 50% of the families have more than 90% of their MMF business in prime MMFs, about 15% have more than 90% of their business in government MMFs, and the rest are evenly distributed between these two extremes. Moreover, our proxy for prime MMF specialization is stable over time; that is, it does not fluctuate significantly within-family. The bottom panels of Figure 6 show the distribution of the within-family standard deviation of the share prime MMF business in 2012 and 2013: for

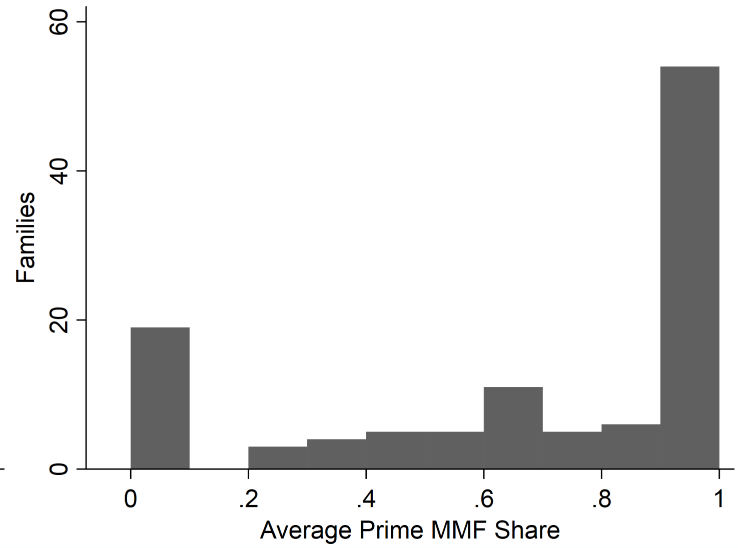
[45]This instrument in similar in spirit to the Bartik instruments used in the empirical labor literature (see Goldsmith-Pinkham *et al.*, 2018).

[46]The specialization proxy is computed estimating the share of a family prime business across both institutional and retail share classes because it represents a family's ability to manage a prime versus a government MMF portfolio.

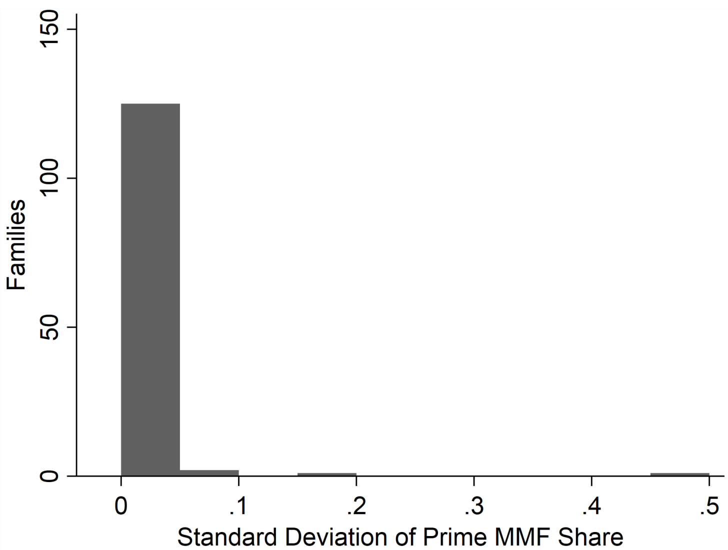
more than 95% of the MMF families, the standard deviation was less than 5% in both years.



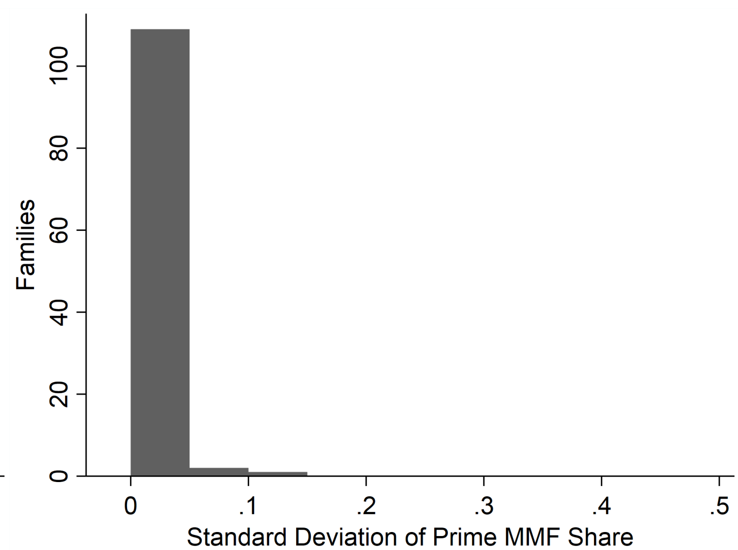
(a) Average Prime Share in 2012



(b) Average Prime Share in 2013



(c) Standard Deviation of Prime Share in 2012



(d) Standard Deviation of Prime Share in 2013

Figure 6. Specialization in the Prime Sector across Money Market Fund (MMF) Families in 2012 (left) and 2013 (right). The sample is all US MMF families ever active in 2012 and 2013, respectively. Top panel: yearly average of the share of prime MMFs in a family's total MMF business. Bottom panel: yearly standard deviation of the share of prime MMFs in a family's total MMF business.

The exclusion restriction assumption underlying our identification strategy is that the unobserved component of the within-family demand for prime versus government MMFs in the regression sample is uncorrelated with the equilibrium quantities in the period in which family specialization is measured. In particular, this assumption rules out the presence of family fixed effects in Equation (4); that is, the average investor in one family does not have a stronger idiosyncratic preference for prime relative to government MMFs than the average investor in the other families. In other words, we assume that families' specialization affects investors' preference for prime relative to government MMFs only through its effect on the relative price that the families are able to offer. Our exclusion restriction assumption is reasonable given that most MMF families started their business and specialized in the 1990s (more than 98% of MMF TNA in January 2015 belongs to families that entered the industry before 2000), long before the reform implementation, and each MMF family pools thousands of investors with arguably different idiosyncratic preferences that are likely to cancel out in the aggregate.

Finally, the relevance of our instrument stems from the fact that family specialization (e.g., the experience of their manager) appears to be persistent over time. Specialization affects the relative net yield that families can offer, and as a result of its persistence, some families offer prime-government spreads that are persistently higher. Because informational and relationship frictions make the market non-perfectly competitive, heterogeneity of family specialization generates heterogeneity in equilibrium spreads, hence the validity of our instrument.[47]

[47]In Appendix E, we show the histogram of the prime-government spread across families in 2013, separately for institutional and retail asset classes. The chart for institutional share classes shows the heterogeneity of spreads offered across families, a deviation from perfect competition. Our identification strategy does not work for retail share classes because retail investors are less sophisticated and not price sensitive (e.g., Chernenko and Sunderam, 2014); because of this, as the chart in Appendix E shows, there is precious little variability in the government-prime spread across families; as a result, our first-stage regression has very little explanatory power (indeed, the F statistic is always below 1.5, showing that the instrument is very weak). Nevertheless, for

Before presenting the results of the two-stage regression, let us provide some graphical evidence in support of our identification strategy. The left panel of Figure 7 shows the net-yield spread between government and prime institutional MMFs from January 2015 to September 2017 for MMF families with different levels of prime MMF specialization. The red line is for the families in the top 33% of the distribution of prime MMF specialization in 2012; the blue line is for those in the bottom 33% of the same distribution. Our interpretation is that, since families in the first group are more specialized in prime MMF products, they have a lower marginal cost of producing prime MMFs and can offer them at a better price. Hence, we should expect the government-prime yield spread of the first group to be always below that of the second group and the differential to increase around the reform implementation. This is what we observe in the charts and what underpins our identification strategy. The right panel of Figure 7 shows the same government-prime yield spreads when MMF families are ranked based on their specialization in prime MMFs during 2013 instead of 2012. Results are almost identical.

Regression (4) is estimated on the unbalanced panel of MMF families with institutional share classes in both the prime and the government segment of the industry in any month from January 2015 to September 2017; in the baseline specification, we exclude the transition period November 2015–September 2016, when the relation between prices and quantities adjusts to its new (post-SEC regulation) steady state.

Table 11 reports the results of the second stage estimation for our baseline specification. Standard errors are heteroskedasticity, autocorrelation, and spatial correlation (HACSC) robust to account for both correlations within and across families.[48]

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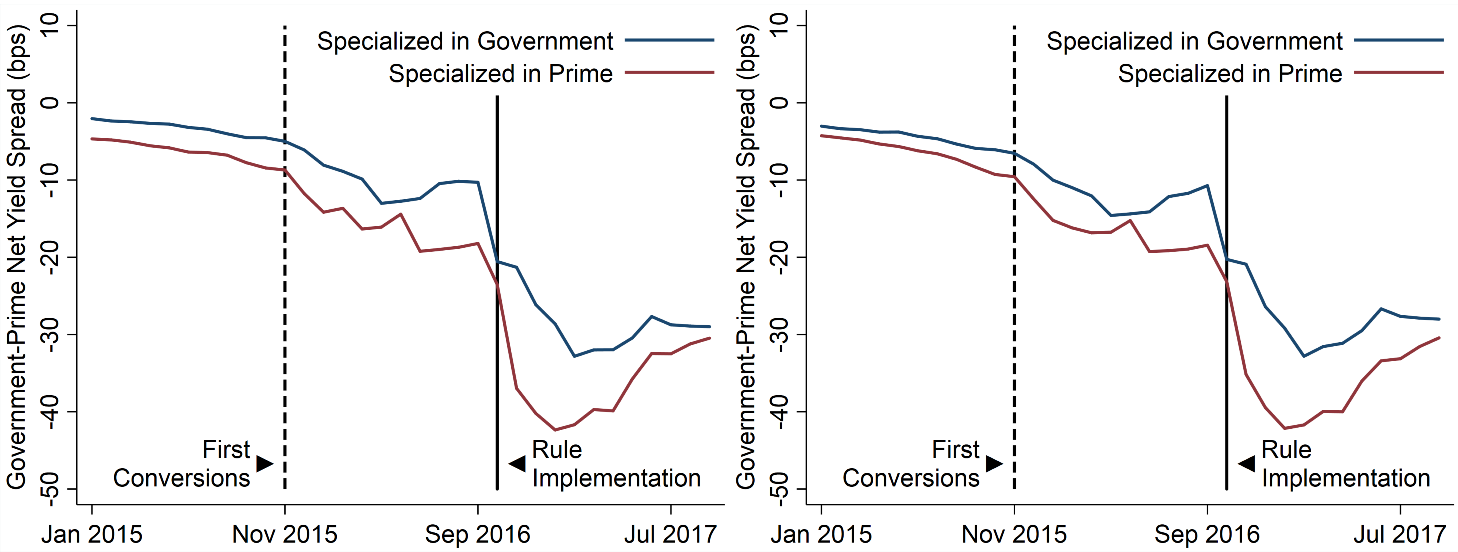
completeness's sake, the results of the demand estimation for retail share classes are reported in Appendix E.

[48]Specifically, as in the previous sections, we use Driscoll and Kraay (1998) standard errors with a three-lag autocorrelation structure, as suggested by Newey and West (1994) plug-in procedure (see footnote 21). Since our instruments are measured more than one year ahead of the regression sample, allowing the residuals in the structural relative demand equation to be correlated within-



(a) Specialization as in 2012

(b) Specialization as in 2013

Figure 7. Net-Yield Spread between Government and Prime Money Market Funds (MMFs) by Family Specialization. The sample is all US MMF families that have both government and prime institutional funds in any month from January 2015 to September 2017. Specialization in the prime MMF sector is measured as the share of a family's prime MMF business in the family's total MMF business in 2012 (left panel) and in 2013 (right panel). The blue line is the net-yield spread of families more specialized in government MMFs (i.e., in the bottom 33% of the prime-share distribution); the red line is the net-yield spread of families more specialized in prime MMFs (i.e., in the top 33% of the prime-share distribution).

First-stage and reduced-form regressions are in Appendix E. The coefficients of the reduced-form regression are consistent with those presented here and are statistically significant.[49]

Column 1 shows the results of the second-stage estimation when the instrument is the 2013 prime MMF share in a family's total MMF business. The F statistic from the first stage is 19, indicating that the instrument is strong. The slope of the demand curve before the SEC rule (δ_1) is, as expected, negative, quantitatively relevant, and statistically significant (p–value = 0.000): when the government-prime spread in institutional share classes (i.e., the relative price of prime MMFs for institutional investors) increases by 1 bp, prime-MMF holdings by institutional investors decrease by 50% relative to their government-MMF holdings. In other words, before the regulatory change, the relative demand for prime MMFs was quite elastic, that is, prime and government MMFs were highly substitutable. Such a high elasticity is not surprising if one considers that, during most of 2015, all money market rates were very compressed, investors scrambled in search of higher yields, and prime and government MMFs offered identical liquidity services.

After the reform implementation, in contrast, the relative demand curve significantly shifts downwards ($\delta_0 = -4.3$, with p–value = 0.008), indicating that institutional investors now demand relatively fewer prime MMF shares. Moreover, as expected, the new regulation also changes the steepness of the relative demand curve, making it less downward sloping. Indeed, the coefficient representing the change in the slope of the demand curve (δ_2) is positive, economically important, and statistically

family for up to three months is consistent with our identification strategy.

[49] To achieve identification, the number of instruments needs to be equal to the number of endogenous variables. In our second-stage regression, we have two endogenous variables: the spread and the additional spread after October 2016. Hence, we use two instruments in our first-stage regression: the share of prime MMFs in the family and the share of prime MMFs in the family interacted with a dummy for the post-October 2016 period. Note that we do not interact the first-stage fitted value of the spread itself with the dummy to avoid the forbidden regression problem (Wooldridge, 2010).

significant (p–value = 0.000): because of this, the relative demand for prime versus government MMFs by institutional investors has become much less elastic, with the elasticity of substitution decreasing from 0.51 to 0.11.

The change in both the position and the slope of the demand curve highlights the importance of the reduction in the information insensitivity of prime MMFs caused by the introduction of redemption gates and fees and the adoption of the floating NAV: not only are investors less willing to hold their shares in prime MMFs for any given spread in government-prime yield, but they are also less willing to substitute from government to prime as the spread increases.

In Columns 2 to 7 of Table 11, we report a series of robustness checks: i) using the 2012 share of prime MMFs in the family as instrument (Column 2); ii) using a longer panel going back to January 2012 and calculating family specialization on 2011 data (Column 3); iii) including the transition period November 2015–October 2016 (Columns 4 and 5); and iv) excluding treasury MMFs (Columns 6 and 7). The estimates are qualitatively and quantitatively similar to those from the baseline specification.

	$\log(q_{it}^P/q_{it}^G)$						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Spread_{it}	-0.51***	-0.42***	-0.29***	-0.29***	-0.24***	-0.36***	-0.34***
	(0.04)	(0.03)	(0.07)	(0.06)	(0.05)	(0.04)	(0.04)
$\text{Spread}_{it} \times 1_{t \geq \text{Oct. 2016}}$	0.40***	0.32***	0.17*	0.17**	0.14*	0.23**	0.23**
	(0.05)	(0.05)	(0.08)	(0.07)	(0.06)	(0.07)	(0.06)
$1_{t \geq \text{Oct. 2016}}$	-4.28***	-4.30***	-5.57***	-4.08***	-4.08***	-5.63**	-4.99***
	(1.12)	(1.08)	(1.32)	(1.11)	(1.08)	(1.68)	(1.31)
Instrument	$\text{Share}_{i,2013}$	$\text{Share}_{i,2012}$	$\text{Share}_{i,2011}$	$\text{Share}_{i,2013}$	$\text{Share}_{i,2012}$	$\text{Share}_{i,2013}$	$\text{Share}_{i,2012}$
Long Sample			Yes				
With Transition				Yes	Yes		
No Treasury Funds						Yes	Yes
CD F-statistic	19.0	23.3	69.9	16.7	19.2	16.6	22.6
Observations	491	491	1634	775	775	459	459

Table 11. The Relative Demand Function of Institutional Investors for Prime versus Government Money Market Funds (MMFs): a Regression Analysis. $\log(q_{it}^P/q_{it}^G)$ is the log ratio of the TNA of prime and government institutional MMF share classes of family i in month t; $\log(p_{it}^P/p_{it}^G)$ is measured as the spread between the (value-weighted) net yield of government and prime institutional classes of family i in month t; $1_{t \geq \text{Oct. 2016}}$ is a dummy for October 2016 onward. The panel is the unbalanced panel of MMF families with both prime and government institutional classes in any month of the regression sample. The table reports the estimates of the second stage of a two-stage least square regression that uses a family's specialization in the prime MMF business and its interaction with $1_{t \geq \text{Oct. 2016}}$ as instruments for the family's Spread_{it} and $\text{Spread}_{it} \times 1_{t \geq \text{Oct. 2016}}$ (the first stage is reported in Appendix E). A family's specialization in prime MMFs is measured as the share of prime MMFs in the family's total MMF business. In Columns 1 and 2, the sample is January 2015–September 2017 excluding the transition period November 2015–October 2016 and family specialization is measured as in 2013 and 2012, respectively. In Column 3, the sample is January 2012–September 2017 excluding the transition period and family specialization is measured as in 2011. Columns 4 and 5 replicate Columns 1 and 2 but include the transition period. Columns 6 and 7 replicate Columns 1 and 2 but exclude treasury MMFs. Standard errors (in parentheses) are HACSC robust from Driscoll and Kraay (1998) with 3-month lags. Significance values are computed according to critical values from fixed-b asymptotics derived by Vogelsang (2012). ***, **, and * represent 1%, 5%, and 10% statistical significance.

6 Conclusions

This paper uses the 2014 SEC reform of the MMF industry as a quasi-natural experiment to study investors' appetite for money-like assets. The reform affected prime and government MMFs differently, by mandating that prime funds adopt a system of gates and fees, and that institutional prime funds also float their NAV. By the changing regulatory regime of prime MMFs, the reform made them less informational insensitive and therefore less money-like. Using a difference-in-difference approach, we exploit such differential regulatory treatment to estimate a premium for money-like assets associated the differential information sensitivity of prime and government funds. We find that the premium for money assets is large, 20 bps on an annual basis for retail investors and 30bps for institutional ones. The estimated premiums are not due to changes in relative risk taking after the reform.

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