Response to Questions Posed by Commissioners Aguilar, Paredes, and Gallagher*

Division of Risk, Strategy, and Financial Innovation
U.S. Securities and Exchange Commission

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* This report is by the staff of Division of Risk, Strategy, and Financial Innovation. The Commission has expressed no view regarding the analysis, findings, or conclusions contained herein.

Executive Summary

This report addresses the questions posed by Commissioners Aguilar, Paredes, and Gallagher in their September 17, 2012 memo to Chairman Schapiro and Director Lewis. The Commissioners' specific questions can be grouped into three categories. The first category addresses the causes of investor redemptions of prime money market fund shares and purchases of Treasury money market fund shares during the 2008 financial crisis. Many potential explanations exist for the money market fund flows during this period. Since the explanations are not mutually exclusive, it is not possible to attribute shareholders' redemptions and purchases to any single explanation. This report provides evidence in support of each of the different explanations such as flights to quality, liquidity, transparency, and performance. The failure of Lehman Brothers and the breaking of the buck by The Reserve Primary Fund occurred contemporaneously with fund flows, perhaps triggering them. Investors, however, did not appear to react to the earlier financial distress of Bear Stearns or the government's support of Fannie Mae and Freddie Mac.

The Commissioners asked whether money market funds that break the buck outside a period of financial distress would cause a systemic problem. RSFI documents that a number of funds received or requested sponsor support during non-crisis times, an indication that defaults and rating downgrades have led to significant valuation losses for individual funds. With the exception of The Reserve Primary Fund, however, these funds' distress did not trigger industry-wide redemptions. This finding suggests that idiosyncratic portfolio losses may not cause abnormally large redemptions in other money market funds. However, data is limited even on these and other potential events because the instances where sponsor support was provided generally were not publically disclosed to money market fund investors and thus, it is difficult to determine the exact number of funds that might have been affected or the consequences if investors had been aware of sponsor support.

The second category of Commissioner questions covers the efficacy of the 2010 money market fund reforms in three general areas: fund characteristics, the events during the summer of 2011 and an analysis of the potential effect of the reforms on money market funds in 2008 had they been in place. First, the report considers the effects of the reforms on fund characteristics, including interest rate risk, liquidity, and credit risk. The report documents that the reduction in maximum weighted average maturity (WAM) from 90 to 60 days did not cause all funds to lower their WAMs. Instead, the largest effect was on funds that had WAMs above 60 days. For example, the 95th percentile decreased from approximately 70 days at the end of 2009 to approximately 55 days at the end of 2010. The range of fund shadow prices contracted after the 2010 reforms.

To further assess the effectiveness of the 2010 reforms, RSFI staff used Monte Carlo simulations, based on two different modeling frameworks, to estimate the difference in probabilities that a money market fund breaks the buck under different WAM scenarios: 90-day

WAM (the maximum before the 2010 reforms) and 60-day WAMs (the maximum after the 2010 reforms). The analyses simulate how interest rate changes (in one model) and interest rate changes and defaults (in another model) affect the stability of money market funds. The most important finding from the models is that the probability of breaking the buck declined after the 2010 reform assuming a fund had been at the maximum allowable WAM. Both models exclude the effects of investor redemptions which will underestimate the probabilities because funds are more likely to break the buck if heavy redemptions occur after firms have absorbed capital losses.

In addition to changing the maximum WAM, the 2010 reforms increased the transparency of funds' portfolio holdings and instituted more orderly wind down procedures. While increased transparency should have a beneficial effect, there does not appear to be any empirical evidence or test to parse the independent effects of greater transparency from those of the other amendments included in the 2010 reforms. Because no fund has liquidated and needed to use the revised wind-down procedures, there is no objective way to analyze the effect of these changes on investors' beliefs regarding the ability of the 2010 reforms to adequately insure funds can liquidate quickly and efficiently or investors' redemption behavior.

Second, the effect of the 2010 reforms on prime funds during the 2011 Eurozone sovereign debt crisis and U.S. debt ceiling impasse is examined. Despite heavy redemptions during this time, prime funds were able to meet redemptions without any fund breaking the buck. In contrast to the fall of 2008, however, redemptions in 2011 were relatively light, occurred over a much longer period of time, and funds did not have significant unrealized capital losses as indicated by the fact that funds' shadow NAVs did not deviate significantly from $1.

Third, the Commissioners asked how money market funds would likely have performed during the events of September 2008 had the 2010 reforms been in place at the time. The effect of heightened liquidity standards on fund resiliency, given specific levels of capital losses and redemption activity, is examined using money market fund portfolio holdings in September 2008. The findings indicate that funds are more resilient now to both portfolio losses and investor redemptions than they were in 2008. That being said, no fund would have been able to withstand the losses that The Reserve Primary Fund incurred in 2008 without breaking the buck, and nothing in the 2010 reforms would have prevented The Reserve Primary Fund's holding of Lehman Brothers debt.

The third set of questions relates to how future reforms might affect the demand for investments in money market fund substitutes and the implications for investors, financial institutions, corporate borrowers, municipalities, and states that sell their debt to money market funds. They also ask RSFI to consider systemic risk, and risks to the overall economy. Without modeling investors' individual preferences, it is difficult to predict investors' preferred investments. However, the report presents various tradeoffs investors might consider should money funds become less attractive. If money flows out of prime funds, the effect on issuers of securities held

by money market funds will depend on differences between money market funds and alternative investment vehicle portfolios. Given the supply of very short-term securities is likely to be limited to the same securities in which money funds currently invest, shifts in investor capital are likely to increase demand for these same assets, reducing the net effect on the short-term funding market. In any case, it is anticipated that non-financial commercial paper issuers will be largely unaffected by a decrease in demand because their commercial paper financing is only one percent of their overall credit market instruments. The effect on financial companies, however, is likely to be greater, although they, by their very nature, are well suited to identify alternate mechanisms for short-term funding. Likewise, evidence suggests that a decline in demand from money market funds is unlikely to significantly reduce the ability of municipalities to fund their debt, particularly given other structural shifts in the market for these types of securities.

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1. Introduction

In the September 17, 2012 memo to Chairman Schapiro and Director Lewis, Commissioners Aguilar, Paredes, and Gallagher asked the Division of Risk, Strategy, and Financial Innovation to answer a series of questions. This report addresses the commissioners' specific questions.

The report begins with a discussion of the economics of money market funds. It then discusses several characteristics of money market funds that have important economic implications: pricing money market funds at $1.00, the ability of investors to redeem shares, and restrictions on portfolio composition. Next, the report addresses the specific questions set forth in the memo, which can be categorized into three broad categories.

The first category of questions covers the 2008 financial crisis. The report presents a number of possible motivations for investment flows out of prime funds and flows into Treasury funds during the financial crisis. The "breaking of the buck" by The Reserve Primary Fund is discussed, as well as the possible effects of a money market fund breaking the buck during a non-crisis period. The report describes the role that sponsor support has provided to the money market fund industry throughout its history as well as during the crisis.

The second category covers the 2010 money market fund reforms. In January 2010, the Commission adopted a number of amendments to rule 2a-7 that were designed to reduce the interest rate, liquidity, and credit risks of money market fund portfolios. This section discusses changes in money market fund characteristics around the 2010 reforms. The report presents a comparison of the WAMs of funds before and after the 2010 reforms and an analysis of the likelihood that a fund with the maximum permitted WAM would break the buck before and after the 2010 reforms. The section presents an analysis of fund liquidity after the 2010 reforms and ends with a discussion of redemptions in money market funds during the 2011 Eurozone Sovereign Debt Crisis and the U.S. debt-ceiling impasse, which occurred shortly thereafter.

The third set of questions relates to how future reforms could affect the demand for investments in money market fund substitutes and the size of the underlying short-term funding market. The report presents various tradeoffs an investor might make should it move money into substitute investments as well as the effect of a decline in money market investment in the commercial paper ("CP") and short-term municipal funding markets.

2. Economics of Money Market Funds

Mutual funds, of which money market funds are a specific type, offer many benefits to investors. Investors pool their money for collective investment, and, in exchange for a management fee, receive professional investment management services, portfolio diversification, and liquidity. In

addition to these benefits, money market funds are unique in that they allow investors to buy and sell funds at a stable net asset value (NAV), usually $1.00 per share.[1] A stable NAV mitigates certain accounting and tax complexities for investors because fund share "prices" are designed not to change.

Exemptions in rule 2a-7 that allow money market funds to value portfolio securities using amortized cost and price shares using penny rounding help these funds maintain a stable NAV. Other mutual funds are required to account for fund performance by adjusting share price. Stable NAVs are further supported by the strict guidelines set forth by SEC rule 2a-7 that require money market funds to invest in high credit quality, short-term, well-diversified debt instruments. The net effect of these policies is to enhance the stability of money market funds by reducing price volatility.

Although the stable $1.00 NAV provides a close approximation to market value, differences may exist. The fair value of securities may change if a portfolio asset defaults, its credit profile deteriorates, an asset sale results in a realized capital gain or loss, or interest rates change. If any differences exist, they are reflected in a fund's "shadow NAV." The shadow NAV is defined as the NAV per share of the fund calculated using available market prices and/or fair value pricing models of the portfolio securities.[2]

Deviations that arise from changes in interest rates are temporary as long as securities are held to maturity because amortized costs and market values converge. If, however, a portfolio asset defaults or an asset sale results in a realized capital gain or loss, deviations between the stable $1.00 NAV and shadow NAV become permanent. For example, if a portfolio experiences a 25 basis point loss because an issuer defaults, the fund's shadow price falls from $1.0000 to $0.9975. Even though the fund has not broken the buck, this reduction is permanent and can only be rebuilt internally in the event that the fund realizes a capital gain elsewhere in the portfolio.[3]

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1 Money market funds are not required to use $1.00 as a stable NAV, but only a small number of money market funds do not use that stable value. To simplify the discussion throughout this report, $1.00 per share is used as the fund's stable price.

2 Mutual funds are required to value their shares using this method by rule 2a-4; however, rule 2a-7 affords an exemption for money market funds to this rule.

3 It is important to understand that, in practice, a fund cannot use future portfolio earnings to rebuild its shadow price due to Internal Revenue Service rules that effectively force money market funds to distribute earnings to investors. Moreover, management fee waivers will not rebuild NAVs because fees are deducted from fund earnings and not fund assets. These restrictions can cause permanent reductions in shadow prices to persist over time, even though funds' other portfolio assets are otherwise unimpaired.

Permanent losses may also be repaired by sponsor support. Evidence provided by Moody's (2010) and Brady, Anadu, and Cooper (2012) indicates that hundreds of money market funds have received financial support from sponsors over the years.[4] The number of funds that have required sponsor support indicates that permanent reductions in the value of the portfolio, and, hence, shadow NAVs below $1.00, may not be unusual.

If a fund's stable NAV deviates far enough from its shadow price, investors may have an economic incentive to trade money market fund shares. For example, investors may have an incentive to buy shares when a fund's shadow price is greater than $1.00 and sell shares when a fund's shadow price is less than $1.00. If investors redeem shares when the shadow NAV is less than $1.00, the fund's shadow price will decline even further because portfolio losses are spread across a smaller asset base. If enough shares are redeemed, a fund can break the buck due, in part, to investor redemptions. This reason alone provides an incentive for investors to redeem shares ahead of other investors: Early redeemers get $1.00 per share, whereas later redeemers may get less than $1.00 per share.

To illustrate the incentive for investors to redeem shares early, consider a money market fund that has one million shares outstanding and holds a portfolio worth exactly $1 million. Assume the fund's reported NAV and shadow price are both $1.00. If the fund recognizes a $4,000 loss, the fund's shadow price will fall below $1.00 as follows:

$$\frac{\$996{,}000}{1{,}000{,}000\,\text{shares}} = \$0.996/\text{share}.$$

If investors redeem one quarter of the fund's shares (250,000 shares), the redeeming shareholders are paid $1.00. Because redeeming shareholders are paid more than the shadow price of the fund, the redemptions further concentrate the loss among the remaining shareholders. In this case, the amount of redemptions is sufficient to cause the fund to break the buck, i.e.,

$$\frac{\$996{,}000 - \$250{,}000}{1{,}000{,}000\,\text{shares} - 250{,}000\,\text{shares}} = \frac{\$746{,}000}{750{,}000\,\text{shares}} = \$0.9947/\text{share}.$$

[4] Moody's Investment Services ("Moody's") estimates at least 145 U.S. money market funds received sponsor support to maintain either price stability or share liquidity before 2007. *See* Moody's Investors Service Special Comment, *Sponsor Support Key to Money Market Funds* (Aug. 9, 2010). *See* also Brady, Steffanie, Ken Anadu and Nathaniel Cooper, 2012, The Stability of Prime Money Market Mutual Funds: Sponsor Support from 2007 to 2011, Federal Reserve Bank of Boston working paper.

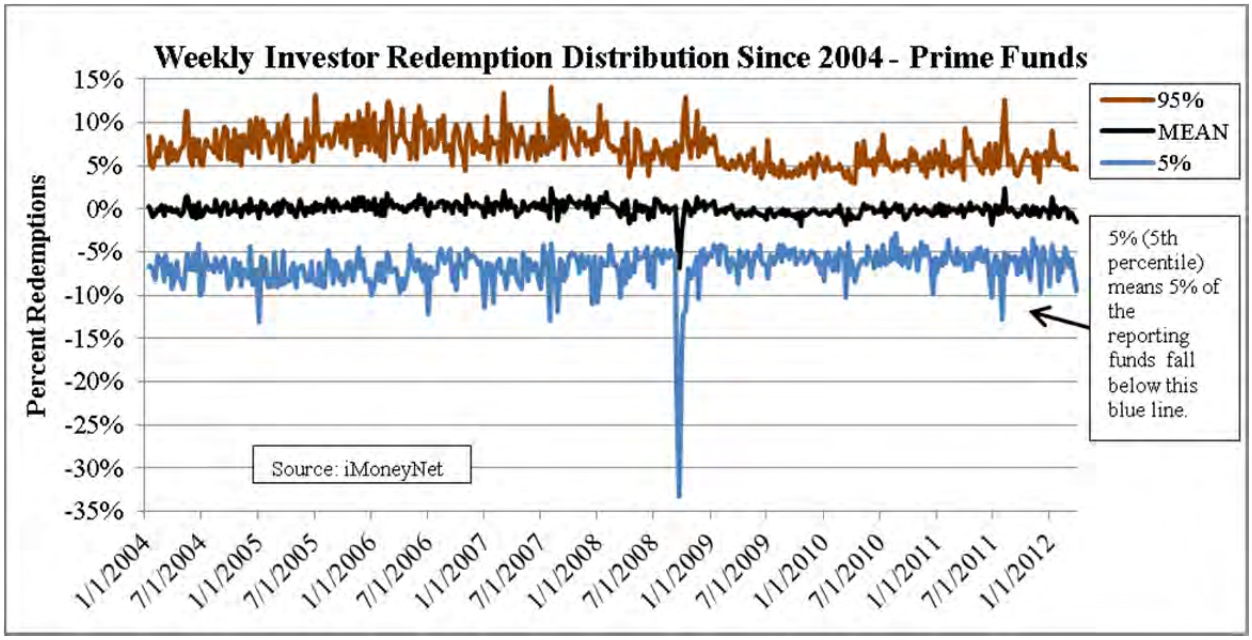
This example shows that once a fund's shadow price falls below $1.00, investors have an incentive to redeem shares to potentially avoid holding shares worth less than $1.00. This incentive exists even if investors do not expect the fund to incur further portfolio losses.

The incentive for investors to redeem shares ahead of other investors is heightened by liquidity concerns. Money market funds, by definition, offer investors the ability to redeem shares upon demand. If liquidity levels are insufficient to satisfy redemption requests, funds may be forced to sell portfolio securities that are imperfectly liquid or have relatively long maturities. Most money market fund securities are held to maturity, and secondary markets in these securities are not deeply liquid. In these instances, funds may have to sell securities at fire-sale prices, thereby incurring capital losses. Although all mutual funds are subject to this type of liquidity pressure, money market funds are unique in that their share prices do not reflect such realized losses unless they break the buck. The need to sell assets at discounts to their amortized cost can directly affect, in turn, the shadow prices of other money market funds. If other funds hold the same securities that were sold, they must value the securities in their portfolios at those lower-than-usual market prices.

As discussed in Section 3A.3, some funds have dealt with large-scale redemptions by relying on sponsor support. One approach has been for sponsors to provide liquidity by purchasing portfolio assets at amortized cost when such assets may be valued or traded at prices below amortized cost. Another approach has been for sponsors to add capital to restore shadow NAVs. If it becomes apparent to investors that a fund may break the buck and it seems unlikely that the fund will receive sponsor support, investors will have heightened incentives to redeem shares.

The distribution of weekly net flow in prime money market funds is presented in Figure 1. The results show that the 5th percentile of weekly net flow is usually between -10% and -5% while the 95th percentile is usually between 5% and 10%. The mean net flow is usually very close to 0%.

Figure 1



3. The 2008 Financial Crisis

This section addresses Commissioners' questions regarding possible causes of redemption activity during the 2008 financial crisis. It begins by describing the circumstances and events that coincided with large-scale investor redemptions from prime money market funds during September 2008. Next the section presents stylized facts that emerge from this discussion and uses the academic literature to help answer the Commissioners' questions.

Although there are a number of possible explanations for investor redemptions in September 2008, it is difficult, if not impossible, to attribute the redemptions to any single explanation. That being said, there is a possibility that investor redemption behavior was attributable to the breaking of the buck by Reserve Fund and a "flight to quality" by risk averse investors. In addition, investor redemptions may have resulted from a flight by investors to funds offering liquidity, transparency, and performance. Finally, the influence on redemptions caused by the failure and, in some cases government-sponsored rescue, of prominent financial institutions, including The Bear Stearns Companies, Inc. ("Bear Stearns"), Lehman Brothers Holdings, Inc. ("Lehman Brothers"), American International Group, Inc. ("AIG"), Federal National Mortgage Association ("Fannie Mae"), and Federal Home Loan Mortgage Corporation ("Freddie Mac") is considered.

A. What Caused Money Fund Share Redemptions in September 2008?

1. Characterization of the Events during the 2008 Financial Crisis

During the peak of the financial crisis, in September 2008, investors redeemed assets from prime money market funds and, to a great extent, reinvested those assets into Treasury money market funds with the same structural features as prime money market funds. Do the sizeable inflows into Treasury money market funds during this period belie the claim that investors fled prime money market funds because of any structural flaws of money market funds? Did investors instead behave this way for another reason, such as a general aversion to risk or a "flight to quality" during the crisis? Did investors redeem from prime money market funds primarily in response to a single event, specifically the "breaking of the buck" by the Reserve Primary Fund? Or did other events, such as the failure and, in some cases government-sponsored rescue, of prominent financial institutions Lehman Brothers and AIG, as well as Fannie Mae, Freddie Mac, and Bear Stearns, contribute to the conditions that resulted in the run?

Beginning in August 2007, the market for commercial paper became relatively illiquid and commercial paper spreads widened by as much as 100 basis points. These issues, coupled with losses from investments related to mortgages, caused several structured investment vehicles (SIVs), including Cheyne Finance Plc and Axon Financial Funding LLC, which purchased longer-term assets by issuing commercial paper, to default. In the ensuing months, there were additional SIV defaults, and some assets held by money market funds were downgraded. Problems in the financial markets were compounded by the near collapse of Bear Stearns in March 2008 and the failure of auctions for auction-rate securities and the corresponding drop in liquidity.

On September 7, 2008, the Federal Housing Finance Agency placed Fannie Mae and Freddie Mac in conservatorship. On September 14, 2008, Bank of America Corporation ("Bank of America") announced that it was buying Merrill Lynch & Co., Inc. ("Merrill Lynch"). The next day, September 15, 2008, Lehman Brothers filed for Chapter 11 bankruptcy protection, and on September 16, 2008 the Federal Reserve Bank's Board of Governors announced that the Federal Reserve Bank of New York would financially support AIG. During this period, a number of securities issued by these firms and other financial institutions were downgraded.

On September 16, 2008, The Reserve Primary Fund broke the buck, and several other money market funds would have broken the buck without sponsor support. The Reserve Primary Fund petitioned the SEC on September 22, 2008 to suspend redemptions. At this time, the fund began

to unwind its positions and liquidate its portfolio in a process that took over a year to complete.[5]

Investor perceptions of market risk increased over this period. One measure of market risk is the CBOE's Volatility Index (VIX), which is an estimate of the volatility implicit in the prices of S&P 500 index options. During the peak of the crisis (9/2/2008 to 10/7/2008), the VIX tripled from 23 to 67.

Investors began selling prime money market funds on Friday, September 12th, ahead of Lehman Brothers' bankruptcy filing on Monday, September 15th. They continued to sell prime money market funds on Monday, September 15th. On the following day, The Reserve Primary Fund broke the buck, and the sell-off of prime funds continued. At the same time, investors began buying government money market funds, which include Treasury and government funds.[6] During the Crisis Month (9/2/2008 to 10/7/2008), government money market fund assets increased by $409 billion (44 percent), whereas prime fund assets fell by $498 billion (24 percent).

Despite the massive liquidations in prime money market funds during the Crisis Month, overall prime fund assets have increased since 2007: over the 28-month period beginning January 2007, aggregate prime money market fund assets increased from $1,526 billion to $1,888 billion. Over that same period, Treasury money market fund assets increased from $428 billion to $1,137 while national and state money market fund assets were largely unchanged.[7]

The weekly net prime money market fund flow presented in Figure 1 also includes the Crisis Month. In that month, the mean prime money market fund experienced large weekly net redemptions, and many individual funds experienced weekly net redemptions that exceeded 10 percent; nevertheless, there were many individual prime funds that experienced weekly net purchases that exceeded 5 and 10 percent of fund assets during the Crisis Month. In other words, prime money market funds lost assets as a whole during the Crisis Month, but many individual prime money market funds gained assets during that period.

2. Possible Explanations for Redemption Activity during the 2008 Financial Crisis

There are many possible explanations for the shift from prime money market funds toward

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5 The Reserve Primary Fund repriced its shares at $0.9667 at the close of business on September 16th, 2008.

6 iMoneyNet includes Treasury and government funds in a category called "Government."

7 iMoneyNet defines "National" funds as tax-free funds that invest in municipal securities from multiple states. "State "funds buy tax-free municipal securities from a single state.

Treasury funds during the month of the crisis.

One explanation may be a "flight to quality." Because most of the assets held by Treasury funds have lower default risk than the assets of prime funds, investors may have been seeking the safety of the Treasury funds, either because prime funds suddenly looked riskier than before or investors became more risk averse. Consistent with a "flight to quality", many commentators interpret the change in industry assets to mean that investors redeemed prime money market fund shares and reinvested in government money market funds.

The academic literature supports this perspective. Wermers (2012) documents that investors redirected assets from riskier, prime money market funds to safer, government funds during September 2008,[8] and that the effects were more pronounced for institutional funds. Consistent with this finding, McCabe (2010) shows that redemption activity was higher for riskier funds.[9]

A second explanation is the closely related "flight to liquidity." Although all types of money market funds are, in principle, equally liquid because investors can sell their entire positions at $1.00 per share, investors might have recognized that funds' underlying assets are not equally liquid. Moreover, investors might have recognized that in periods of market turmoil, the "flight to liquidity" in the asset market might lessen prime funds' attractiveness because a decrease in asset liquidity also reduces asset value. During these same periods, investors might find Treasury

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[8] Wermers (2012) examines whether flows in money market funds were driven by widespread withdrawal of all investors or whether withdrawals were information-based. He finds that during the September-October 2008 money market fund crisis, flows were highly correlated from one day to the next within fund categories, suggesting that net redemptions from prime institutional (or retail) funds strongly predicted further redemptions the next day. He next examines whether within-in complex flows are autocorrelated but does not find any evidence that flows in one particular fund complex predicts future flows in the same complex. However, within a specified fund complex, fund flows from prime to government funds (or vice versa) are predictive of future flows from prime to government funds. The effect for retail funds is much weaker. Investors, both retail and institutional, also condition their tendency to redeem shares during the crisis on the liquidity of the complex. He also studies whether investors are moving their assets from one fund in a complex to another. He finds weak evidence that investors collectively sell all prime institutional money market funds at the complex level. Overall, certain fund complexes were harder hit by redemptions than others and he interprets this to mean that investors redeemed more heavily in complexes that may have not had the financial wherewithal for sponsor support. He concludes that heavy redemptions were a combination of information about funds as well as externalities (such as correlated run behavior of investors).

[9] McCabe (2010) also examines redemptions in money market funds at the time of the financial crisis. He finds that outflows were larger for money market funds a) that paid higher gross yields in the previous year (greater portfolio risk), b) that had larger pre-crisis flow volatility signifying greater investor risk, and c) that had sponsors with wider credit default swap (CDS) spreads.

funds more attractive because the liquidity of Treasury securities is enhanced.

A third explanation is a "flight to transparency." Because Treasury funds are restricted from holding more than 20 percent of their portfolios in securities of issuers other than the U.S. government, the portfolio holdings of Treasury funds are effectively more transparent than those of prime funds. If investors expect the values of certain securities to be impaired—but do not know which funds hold them—they may sell shares in more opaque funds and invest in more transparent funds. Consistent with this hypothesis, a number of non-government money market funds voluntarily released their portfolio holdings in the wake of Lehman Brothers' declaration of bankruptcy and issued statements regarding their funds' holdings.[10]

A fourth explanation may be explained by a "flight to performance." Substantial academic evidence indicates fund performance attracts additional flows. Patel, Zeckhauser, and Hendricks (1994) and Kane, Santini, and Aber (1991) find prior risk-adjusted performance is positively associated with net inflows into funds.[11] Similarly, Sirri and Tufano (1998) show returns that are not adjusted for risk drive fund growth, and that fund inflows are greater following good performance than outflows after poor performance.[12] Work by Zheng (1999) and Johnson (2010) provides evidence that at least some investors are successful in choosing funds that subsequently perform well. Zheng (1999) shows that mutual funds that receive more money subsequently perform significantly better than those that lose money.[13] Johnson (2010), examining exchanges within the mutual fund family, identifies investors who successfully exchange into funds that subsequently outperform their prior funds during their individual holding periods.[14]

Finally, issues related to the structural design of money market funds may have accelerated investor redemptions in September 2008. As discussed in the prior section, investors have an incentive to sell shares if funds have embedded losses from non-performing assets. The incentive

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10 *See* Bernard, Tara Siegel, "Money Market Funds Enter a World of Risk," *New York Times,* September 17, 2008.

11 *See* Patel, Jayendu, Richard Zeckhauser, and Darryll Hendricks, "Investment Flows and Performance: Evidence from Mutual Funds, Cross-Border Investments, and New Issues," in *Japan, Europe, and International Financial Markets: Analytical and Empirical Perspectives,* Ryuzo Sato, Richard M. Levich, and Rama Ramachandran (eds.), New York: Cambridge University Press, 1994, 51-72 and Kane, Alex, Don L. Santini, and Jack W. Aber, 1991, Lessons from the growth history of mutual funds, working paper.

12 *See* Sirri, Erik R. and Peter Tufano, "Costly Search and Mutual Fund Flows," *Journal of Finance,* 1998, 53 (5), pp. 1589-1622.

13 *See* Zheng, Lu, "Is Money Smart? A Study of Mutual Fund Investors' Fund Selection Ability," *Journal of Finance,* 1999, 54 (3), pp. 901-933.

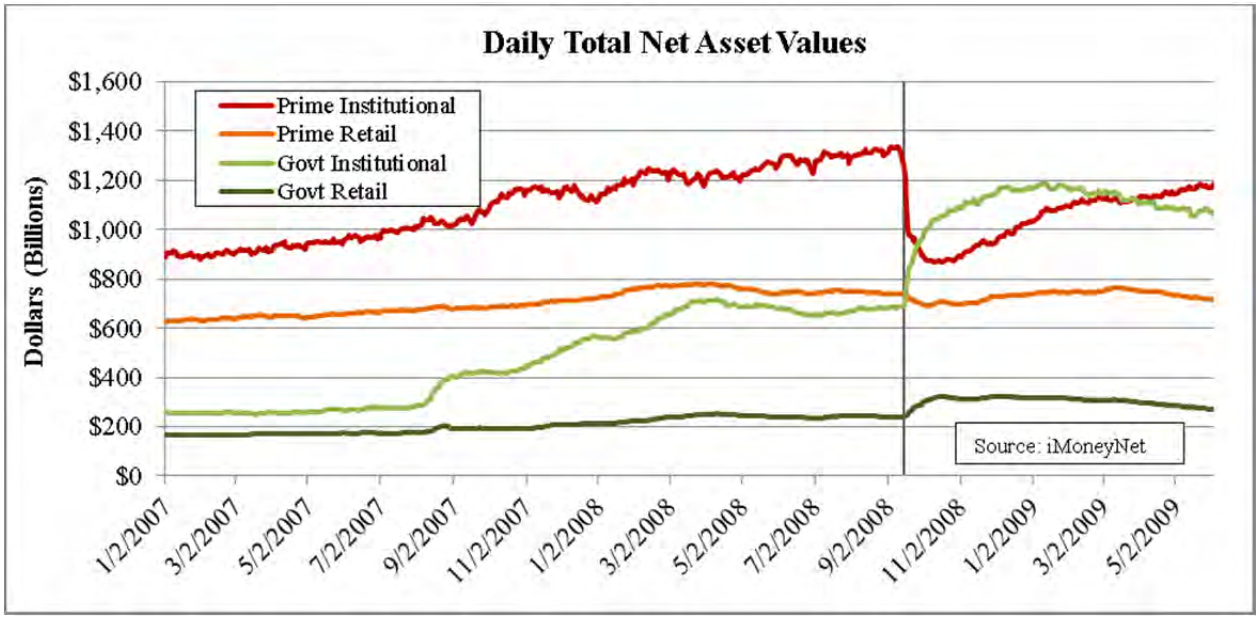
14 *See* Johnson, Woodrow T., "Who Incentivizes The Mutual Fund Manager, New or Old Shareholders?" *Journal of Financial Intermediation,* 2010, 19, pp. 143-168.

for investors to redeem shares ahead of other investors will be exacerbated if investors believe that a fund may have to sell some of its assets and incur capital losses to raise cash for redeeming investors. The illiquidity problem is not unique to money market funds. Chen, Goldstein, and Jiang (2010) provide empirical evidence that the sale of illiquid assets to meet redemption requests impairs future performance in all mutual funds, creating incentives to redeem ahead of other investors.[15]

Figure 2 shows daily total net assets over time, where the vertical line indicates the date that Lehman Brothers filed for bankruptcy, September 15th, 2008. Investor redemptions during the 2008 financial crisis, particularly after Lehman's failure, were heaviest in institutional share classes of prime money market funds, which typically hold securities that are illiquid relative to Government funds. It is possible that sophisticated investors took advantage of the opportunity to redeem shares to avoid losses, leaving less sophisticated investors (if co-mingled) to bear the losses. The figure indicates institutional share classes of government money market funds, which include Treasury and government funds, experienced heavy inflows.

This figure also tracks aggregate redemption activity in retail share classes. Retail investor redemption activity was not sensitive during the September/October 2008 period suggesting that retail investors may not be sufficiently informed to take advantage of the "redemption put."

Figure 2



15 *See* Qi Chen, Itay Goldstein, and Wei Jiang, "Payoff Complementarities and Financial Fragility: Evidence from Mutual Fund Outflows, 2010, *Journal of Financial Economics*, V 97, 239-262.

When The Reserve Primary Fund announced on September 16th that it was breaking the buck, it held $785 million of Lehman Brothers commercial paper, which comprised 1.2 percent of its portfolio. Over the next four days, The Reserve Primary Fund received redemption requests for approximately $60 billion of the $62.5 billion under management.[16]

Figures 3 and 4 use iMoneyNet data to show the weekly net flow in the Reserve family's prime money market funds (3 funds), government money market funds, which include Treasury and government money market funds (6 funds), national money market funds (1 fund), and state money market funds (13 funds). The vertical line in each chart indicates the date that The Reserve Primary Fund announced it was breaking the buck, September 16th, 2008. Figure 3 shows the weekly total net assets from January 2004 through October 2008. Among these four categories, the Reserve prime funds had the most growth, especially starting in late 2007.

Figure 3

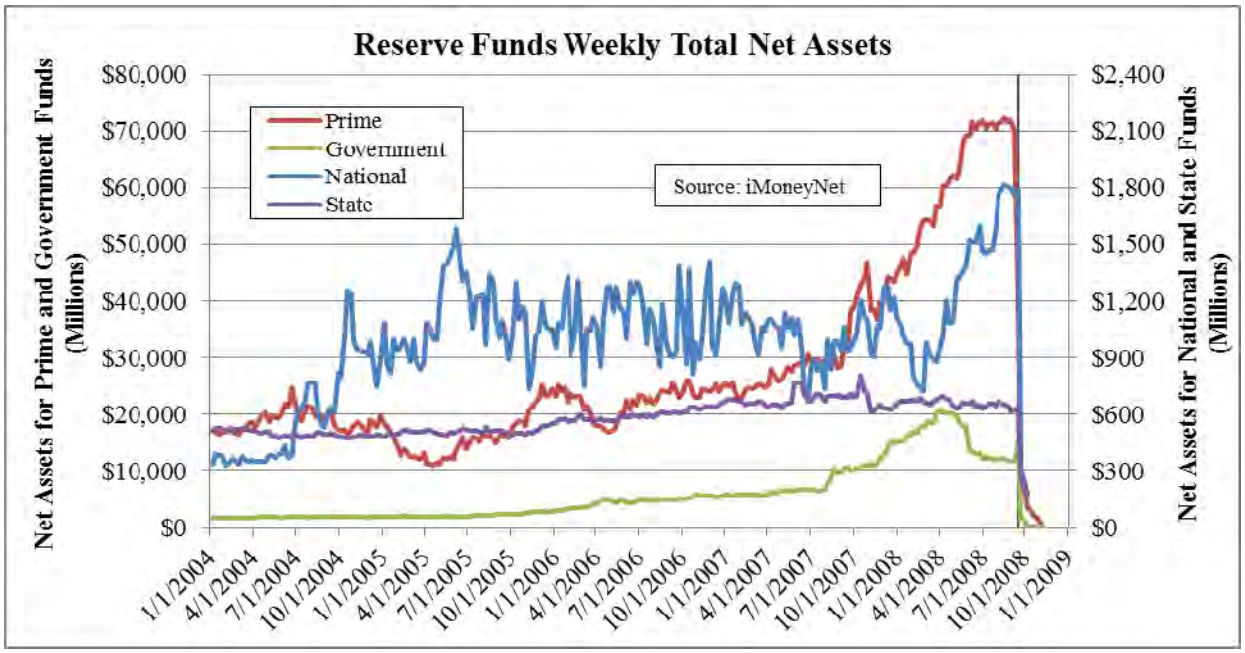
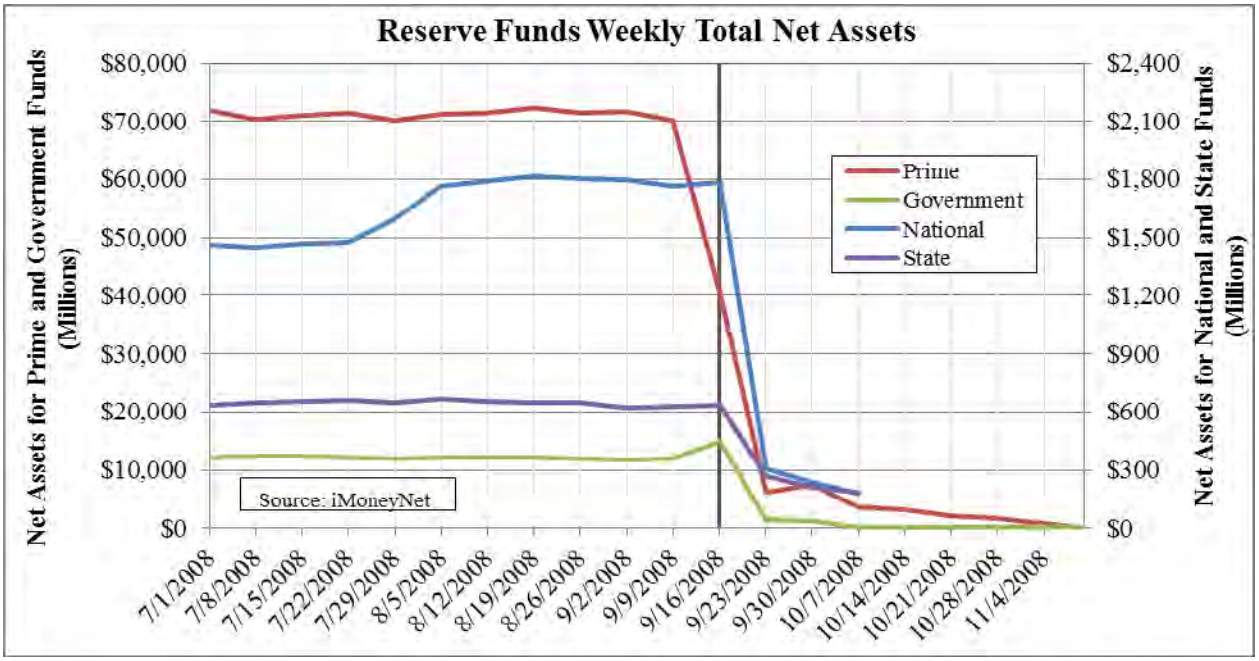


Figure 4 highlights the period from July 2008 through October 2008. During the first week of the crisis, prime fund assets fell dramatically, Government fund assets—consisting mostly of treasuries, government agencies, and repurchase agreements—rose slightly, and the other two fund categories were roughly unchanged. However, the assets of all four fund categories fell dramatically after The Reserve Primary Fund broke the buck.

16 *See* the *Report of the Money Market Working Group*, submitted to the Board of Governors of the Investment Company Institute, March 17, 2009, footnote 163.

Figure 4



On September 19, 2008, the U.S. Department of the Treasury announced the Temporary Guarantee Program for Money Market Funds, which insured more than $2.4 trillion in shares of money market funds,[17] and the Federal Reserve Board authorized the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility, which financed the purchases of high-quality asset-backed commercial paper from money market funds by U.S. depository institutions and bank holding companies. A number of other initiatives were undertaken by the Federal Reserve to stabilize both the underlying short-term credit market and money market funds in October 2008.[18]

Figure 5 graphs the change in daily assets of different types of MMFs by time and highlights the redemption activity surrounding the events of September 2008. (The chart is not continuous because many events occurred over the weekend when MMFs did not trade.) There are two striking patterns in the net flow data. First, both institutional government and retail government funds received abnormally large daily net inflow during the calendar week of the crisis and, to a lesser extent, the following three calendar weeks. Institutional government funds received more net inflow than retail government funds during the first week, but the net inflow is similar in the

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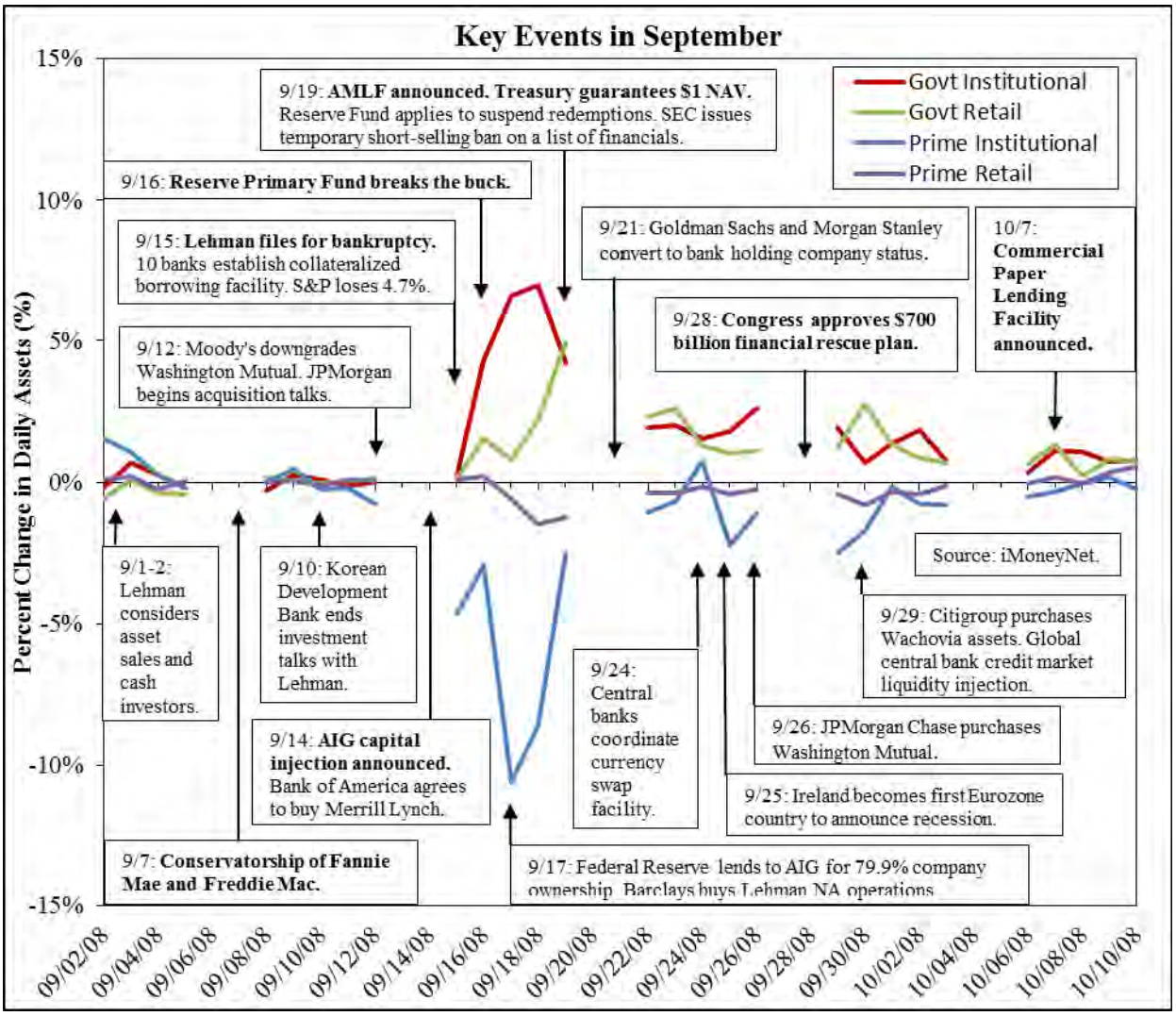
17 *See* http://www.cnbc.com/id/48578949/Treasury_s_Secretive_2_4_Trillion_Mutual_Fund_Guarantee

18 The Federal Reserve implemented several additional programs, including the Commercial Paper Funding Facility, Money Market Investor Funding Facility, and the Term Asset-Backed Securities Loan Facility, to support the liquidity of financial institutions, borrowers, and investors in key credit markets.

following three weeks. The second change is the abnormally large daily net outflow in institutional prime funds and retail prime funds. In the calendar week of the crisis, institutional prime funds had large net outflow every day while retail prime funds had net outflow Wednesday through Friday only. Institutional prime funds continued with net outflow during the following two calendar weeks with the exception of one day. Retail prime funds also had net outflow during the following two calendar weeks, but their flow was much less than they experienced on Thursday and Friday of the crisis week.

Figure 5



Following this announcement, money market funds that chose to participate in the Treasury guarantee program were required to report to the Treasury Department and the Commission whenever their weekly shadow price fell below $0.9975 for any of their share classes. According

to these data, 29 of the 74 share classes reporting had shadow NAV prices below $0.995 at least once between September 5th and October 17th, 2008. [19]

3. Sponsor Support of Money Market Funds

During this period, a number of funds received financial support from sponsors. Brady, Anadu and Cooper (2012) document cash contributions and outright purchases of distressed securities at above-market prices by fund sponsors,[20] and Moody's Investment Services ("Moody's") reported that 62 money market funds required sponsor support during 2007-2008.[21] Some money market funds entered into credit support agreements with their sponsors, but did not subsequently receive support because their financial circumstances improved.

Kacperczyk and Schnabl (2011) study the characteristics of sponsors that provided support during the 2008 financial crisis and find that conglomerates were more likely to provide it than stand-alone fund complexes. They also report funds appear to have endogenously responded to the possibility of sponsor support by lowering portfolio risk, presumably to reduce the likelihood of needing it.[22] Kim (2012) finds that money market funds are more likely to experience

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19 Data from the Treasury Guarantee Program.

20 *See* Brady, Steffanie, Ken Anadu and Nathaniel Cooper, 2012, The Stability of Prime Money Market Mutual Funds: Sponsor Support from 2007 to 2011, Federal Reserve Bank of Boston working paper. They examine 341 money market funds and find that 78 of the funds disclosed sponsor support on Form N-CSR between 2007 and 2011 (some multiple times). They exclude Capital Support Agreements and/or Letters of Credit that were not drawn upon. Large sponsor support (in aggregate) representing over 0.5 percent of assets under management (AUM), occurred in 31 money market funds, and the primary reason disclosed was losses on Lehman Brothers, AIG, and Morgan Stanley securities.

21 *See* Moody's Investors Service Special Comment, *Sponsor Support Key to Money Market Funds* (Aug. 9, 2010).

22 Kacperczyk and Schnabl (2011) measures portfolio risk in three ways – the percentage of risky assets in a firm, the weighted average maturity of the fund's assets, and the fund's portfolio return over the risk-free rate. The authors assign organizational form based on the share of the firm's fund business in institutional prime money market funds and a non-fund financial business indicator (including commercial banking, investment banking or insurance as well as access to credit markets as proxied by the sponsor's CDS spread and whether the firm has a credit rating). Considering the two firm types (stand-alone versus conglomerate) separately, they analyze the effect of access to financial markets on risk taking, and find that funds held by stand-alone investment companies take on statistically and economically significant higher risk by all three measures. In addition, Kacperczyk and Schnabl find that both a decrease in CDS spread and the existence of a credit rating increase all risk measures, suggesting that firms that can access capital to backstop a fund would be more likely to take on risk. The authors examine the post-September 2008 government guarantee of all money market funds that essentially replaced the need for sponsor guarantees. In an analysis over this period, they find that differences in risk taking dropped between the two organizational structures, consistent with the claim that the sponsor's

shareholder redemptions if a sponsor has more than one money market fund and one of their funds needs support. He posits investors fear the sponsor will have insufficient resources to support all of its funds.[23]

B. Investor Redemptions during Non-Crisis Periods

If a money market fund were to break the buck outside a period of financial distress, would it cause a systemic problem, or only a problem limited to that particular fund?

Interest rate changes, issuer defaults, and credit rating downgrades can lead to significant valuation losses for individual funds, but not all of these events cause systemic problems. Table 1, provided by Division of Investment Management staff, documents that, in addition to the 2008 financial crisis, 11 non-systemic events were deemed to have been sufficiently negative that some fund sponsors chose to provide support or to seek staff no-action assurances permitting support.[24] The table indicates that these events affected 158 different money market funds. This finding is consistent with estimates provided by Moody's that at least 145 U.S. money market funds received sponsor support to maintain either price stability or share liquidity before 2007.[25] It is important to note that although these events affected money market funds and their sponsors, the events did not appear to cause systemic problems. However, it also is important to note that no money market fund broke the buck from these events and that sponsor support was not immediately disclosed and so investors may have been unaware that their money market fund had come under stress.

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potential role in backstopping the fund drives willingness to take risk.

[23] *See* Kim, Hugh Hoikwang, 2012, Contagious Runs in Money Market Funds and the Impact of a Government Guarantee, Working paper.

[24] The table does not comprehensively describe every instance of sponsor support of a money market fund or request for no-action assurances to provide support, but rather summarizes some of the more notable instances of sponsor support.

[25] *See* Moody's Sponsor Support Report, *supra* note 21, noting in particular 13 funds requiring support in 1990 due to credit defaults or deterioration at MNC Financial, Mortgage & Realty Trust, and Drexel Burnham; 79 funds requiring support in 1994 due to the Orange County bankruptcy and holdings of certain floating rate securities when interest rates increased; and 25 funds requiring support in 1999 after the credit of certain General American Life Insurance securities deteriorated). Moody's estimates that 62 money market funds required sponsor support during the 2007-2008 financial crisis. *Id.*

Table 1

Year	Estimated Number of Affected Money Market Funds	Event
1989	4	Default of Integrated Resources commercial paper (rated A-2 by Standard & Poor's until shortly prior to default)
1990	11	Default of Mortgage & Realty Trust commercial paper (rated A-2 by Standard & Poor's until shortly prior to default)
1990	10	MNC Financial Corp. commercial paper downgraded from being a second tier security.
1991	10	Mutual Benefit Life Insurance ("MBLI") seized by state insurance regulators, causing it to fail to honor put obligations after those holding securities with these features put the obligations en masse to MBLI.
1994	40	Rising interest rates damaged the value of certain adjustable rate securities held by money market funds.
1994	43	Orange County, California bankruptcy.
1997	3	Mercury Finance Corp. defaults on its commercial paper.
1999	25	Credit rating downgrade of General American Life Insurance Co. triggered a wave of demands for repayment on its funding contracts, leading to liquidity problems and causing it to be placed under administrative supervision by state insurance regulators.
2001	6	Pacific Gas & Electric Co. and Southern California Edison Co. commercial paper went from being first tier securities to defaulting in a 2-week period.
2010	3	British Petroleum Gulf oil spill affects price of BP debt securities held by some money market funds.
2011	3	Investments in Eksportfinans, which was downgraded from being a first tier security to junk-bond status.

One important observation about Table 1 is that more than one fund was affected by each event. Holdings across funds caused multiple funds to experience losses and sponsors to provide support or seek staff no-action assurances permitting support. It is important to note, however, that funds may also have requested sponsor support in anticipation of shadow prices falling below a certain threshold, even though they might not have ultimately needed or accepted such support.

Fund sponsors provide financial support for a number of different reasons. Sponsors may support funds to protect their reputations and their brands. Support may be used to keep a fund from breaking a buck or to shore up a fund's shadow price if its sponsor believes investors avoid funds that have low shadow prices. A fund that finds itself in this situation may use sponsor support to

help protect the reputation of the fund and by extension the fund family if it believes that a shadow price below $1.00 conveys negative information.[26] Due to these reasons, one should be careful to avoid interpreting Table 1 as evidence that funds seeking support necessarily would have broken the buck had it not been provided.

4. The 2010 Money Market Fund Reforms

This section addresses the Commissioners' questions as to the efficacy of the 2010 money market fund reforms in three general areas. First, the report considers the effects of changes to various fund characteristics. Second, the performance of the money market fund industry since 2010 is discussed. Last, several alternative investment choices available to money market fund investors are evaluated.

[26] *See, e.g.*, Marcin Kacperczyk & Phillipp Schnabl, *How Safe are Money Market Funds?* unpublished working paper (Apr. 2012), *available at* http://pages.stern.nyu.edu/~pschnabl/public_html/KacperczykSchnablApril2012.pdf ("Even though fund sponsors have no contractual obligation to support their funds, they may find it optimal to do so, because the costs of not providing support may be large. Such costs are typically reputational in nature, in that an individual fund's default could generate negative spillovers to the remaining operations of the fund sponsor, such as an outflow from other mutual funds managed by the same sponsor, or a loss of business for the sponsor's commercial banking, investment banking, or insurance operations."); Patrick E. McCabe, *The Cross Section Money Market Fund Risks and Financial Crises*, Federal Reserve Board Finance and Economic Discussion Series Paper No. 2010-51 (2010) ("Nothing required these sponsors to provide support, but because allowing a fund to break the buck would have been destructive to a sponsor's reputation and franchise, sponsors backstopped their funds voluntarily."); *Value Line Posts Loss for 1st Period, Cites Charge of $7.5 Million*, WALL ST. J. (Sept. 18, 1989) ("In discussing the charge in its fiscal 1989 annual report [for buying out defaulted commercial paper from its money market fund], Value Line said it purchased the fund's holdings in order to protect its reputation and the continuing income from its investment advisory and money management business.").

A. Changes in Fund Characteristics

1. Interest Rate, Liquidity, and Credit Risk

The Commission's 2010 money market fund reforms have not been shown to be ineffective in enabling money market funds to satisfy large redemptions and to remain resilient in the face of a sharp increase in withdrawals. In fact, the empirical evidence we have so far, such as the performance of money market funds during the ongoing Eurozone crisis and the U.S. debt ceiling impasse and downgrade in 2011, suggests just the opposite – that money market funds can meet substantial redemption requests, in large part, we have heard, because of the 2010 reforms. What have been the effects of the money market fund regulatory reforms that the SEC promulgated in 2010? To what extent have those reforms improved the liquidity of money market funds? Reduced the credit risk of money market funds? Reduced the interest rate risk of money market funds?

To address concerns about money market funds that arose during the 2008 financial crisis, the Commission adopted a number of amendments to rule 2a-7 on February 23, 2010. These amendments were designed to reduce the interest rate, liquidity, and credit risks of money market fund portfolios and, therefore, make money market funds less likely to break the buck. In particular, the amendments reduced money market funds' maximum exposure to interest rate risk by decreasing the maximum WAM of fund portfolios from 90 to 60 days.[27] This reduction in allowable WAM reduced portfolio volatility insofar as it prevents funds from choosing WAMs that exceed 60 days.

The amendments also require that money market funds maintain liquidity buffers in the form of specified levels of daily and weekly liquid assets.[28] These liquidity buffers provide a source of internal liquidity and are intended to help funds withstand high redemptions during times of market stress. Finally, the amendments decreased money market funds' credit risk exposure by further restricting the amount of lower quality (second tier) securities that funds can hold.[29]

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[27] The 2010 amendments also introduced a weighted average life requirement of 120 days, which limits the money market fund's ability to invest in longer-term floating rate securities.

[28] The requirements are that, for all taxable money market funds, at least ten percent of assets must be in cash, U.S. Treasury securities, or securities that convert into cash (*e.g.*, mature) within one day and, for all money market funds, at least 30 percent of assets must be in cash, U.S. Treasury securities, certain other government securities with remaining maturities of 60 days or less, or securities that convert into cash within one week. *See* rule 2a-7(c)(5)(ii) and (iii).

[29] Specifically, the amendments placed tighter limits on a money market fund's ability to acquire "second tier" securities by (1) restricting a money market fund from investing more than three percent of its assets in second tier securities (rather than the previous limit of five percent), (2)

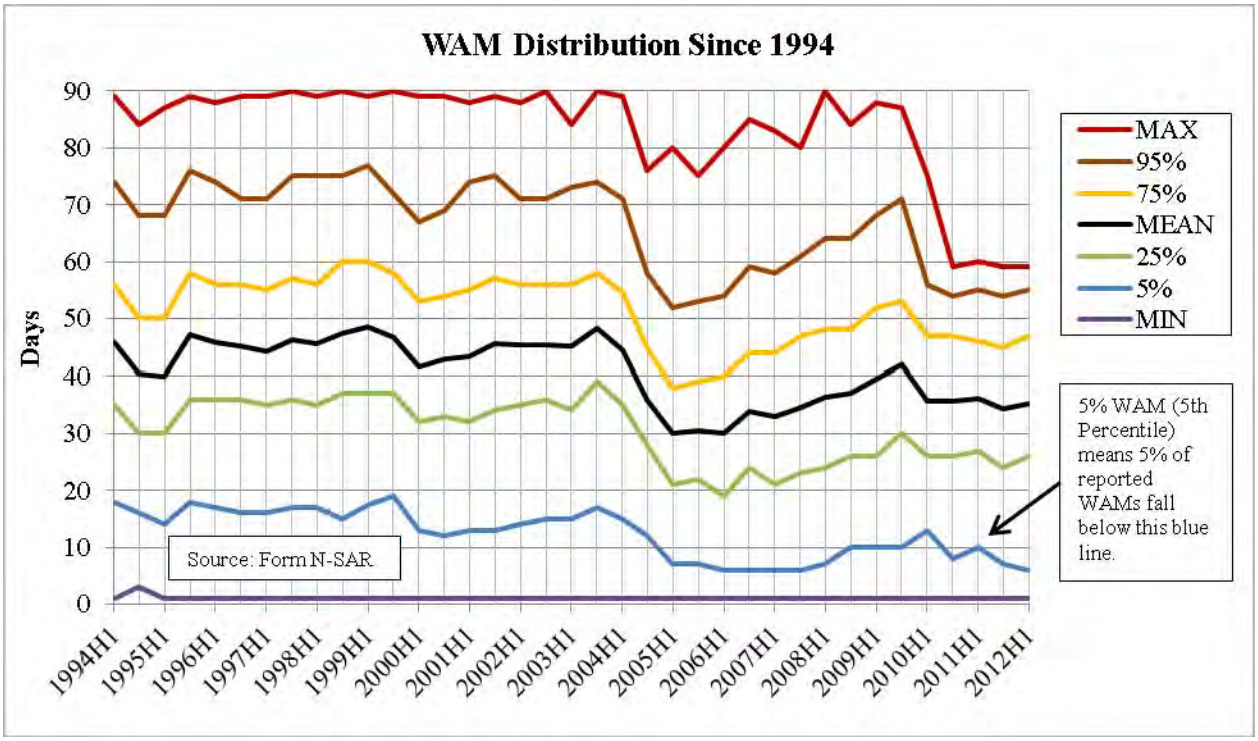
Figure 6 plots the distribution of WAM from 1994 through 2012 using information from Form N-SARs, which are filed twice a year by each fund.[30] The 2010 amendments to WAM were adopted on February 23, 2010 and became effective on June 30, 2010. The results show that the highest WAM fell from approximately 90 days before the rule change to approximately 60 days thereafter. The 5th percentile also changed around the rule change (it was 13 days in the first half of 2010 and six days in the first half of 2012), but the other percentiles did not change substantially. The largest change in the distribution of WAM happened between the first half of 2004 through the first half of 2005 when industry WAMs fell 10 to 20 days. Between that time and the last half of 2009, WAMs gradually increased. Blackwell, Troske, and Winters (2012), focusing only on the second quarter of 2007 through the second quarter of 2012, find evidence that the average WAMs for prime retail and prime institutional money market funds declined after the 2010 reforms. They note that differences in WAM among money market fund types appear to have declined after the 2010 reforms, but they do not identify a specific cause.[31]

restricting a money market fund from investing more than ½ of one percent of its assets in second tier securities issued by any single issuer (rather than the previous limit of the greater of one percent or $1 million), and (3) restricting a money market fund from buying second tier securities that mature in more than 45 days (rather than the previous limit of 397 days). *See* rule 2a-7(c)(3)(ii) and (c)(4)(i)(C). Second tier securities generally are securities rated in the second highest rating category by an NRSRO.

30 The charts in this report that use information from Form N-SAR are based on reports from the end of the second fiscal quarter (NSAR-A) and the end of the fiscal year (NSAR-B). As such, changes that occur between filings may not show up in time series analyses.

31 *See* Blackwell, David W., Troske, Kenneth R., and Winters, Drew B., *Money Market Funds Since the 2010 Regulatory Reforms*, Fall 2012, Center for Capital Markets.

Figure 6



An important part of the 2010 amendments is the requirement that money market funds create enough liquidity to meet their expected investor redemption demands. Adopted on February 23, 2010 and effective on May 28, 2010, money market funds are required to maintain at least ten percent of their portfolios in daily liquid assets ("DLA") and 30 percent of their portfolios in weekly liquid assets ("WLA") immediately after the purchase of any security.[32] Figure 7 reports the fund-level average of these two estimated statistics using one-month Form N-MFP data for prime money market funds.[33] Today, the typical prime fund holds over one quarter of its portfolio in DLA and nearly one half of its portfolio in WLA. Some prime money market funds choose to hold considerably more DLA and WLA than required. In almost every reporting period, the maximum is 100% for both DLA and WLA. One reported portfolio with 100% DLA consists entirely of (1-day) tri-party repos.

It is important to note that the level of liquidity in a money market fund is not necessarily a measure of portfolio risk. For example, a money market fund could increase its DLA without

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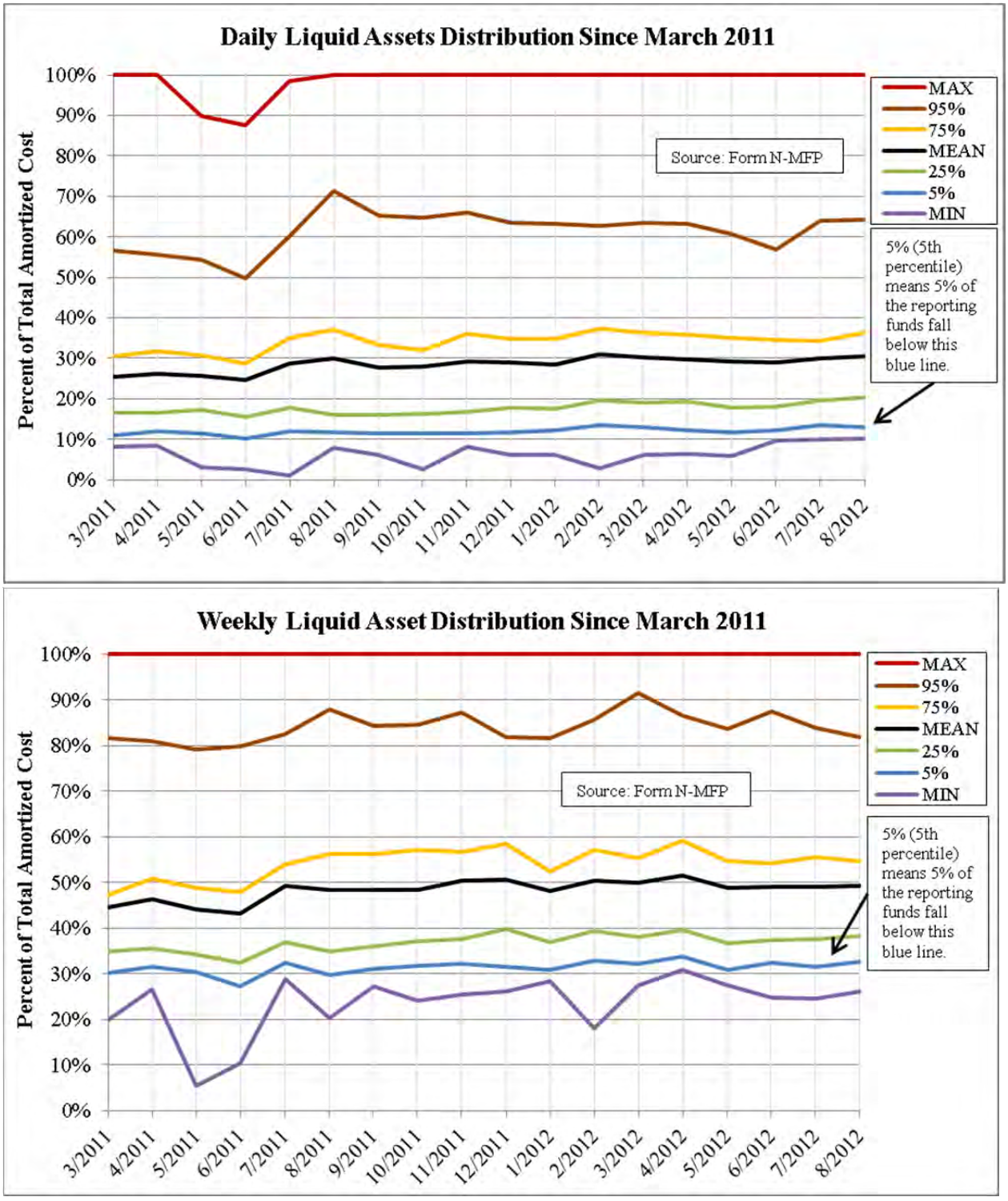
[32] Money market funds are not required to meet the 10% or 30% thresholds at other times. For example, it is permissible for a money market fund to sell all of its DLA in order to satisfy investor redemptions.

[33] The amount of DLA and WLA in the fund must be manually calculated because Form N-MFP does not require money market funds to specify which of their assets are DLA or which of their assets are WLA.

changing its overall risk profile by increasing its holdings of Treasury bills while simultaneously increasing the risk in its commercial paper holdings by an offsetting amount.

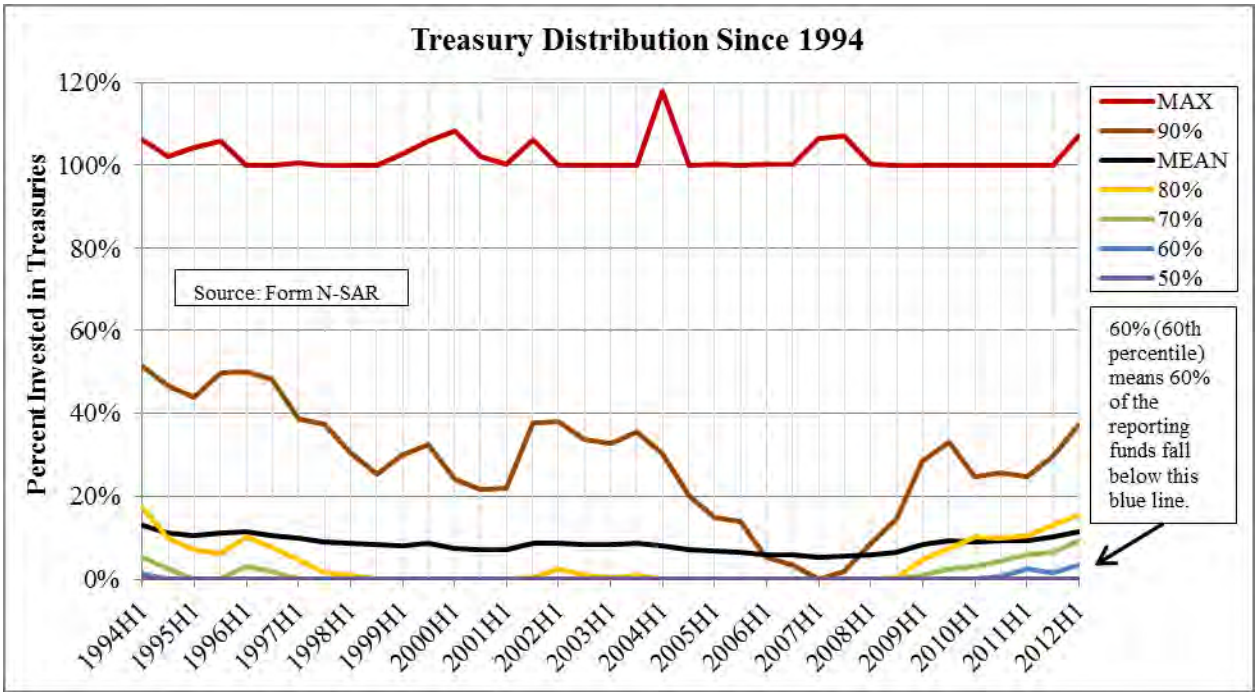
Figure 7



Figures 8–13 use information from Form N-SARs to examine the change in asset composition of

money market funds before and after the 2010 reforms.[34] The form categorizes money market fund assets into several categories, including: 1) Treasury securities; 2) repurchase agreements; 3) government agency securities; 4) state and municipal tax-free securities; 5) commercial paper, and 6) CDs and time deposits. As shown in the following figures, funds have steadily increased their holdings of Treasury securities since 2008 and repurchase agreements collateralized by high-quality collateral (typically Treasury and agency securities) since 2009. Money market fund holdings of government agency securities peaked in the second half (H1) of 2008 and declined thereafter. Commercial paper holdings by money market funds have declined since the second half (H2) of 2006.[35] Money market fund holdings of CDs and time deposits have increased over the last ten years, but most of the increase appears to have occurred before 2010.

Figure 8



34 The SEC requires funds to report their portfolio holdings as a fraction of net assets, including a category for "All other" assets that incorporates liabilities and can be negative, on Form N-SAR. As such, a specific asset category can have a value greater than 100 percent that is then offset by a negative percentage in the "All other" asset category.

35 "Operation Twist," a Federal Open Market Committee policy designed to stimulate the economy, may be confounding some of the effects of the 2010 reforms. In September 2011, the U.S. Federal Reserve began buying longer-term Treasury securities while simultaneously selling some of the shorter-dated issues it already held to lower long-term interest rates. This program may have induced money market funds to hold more short-term Treasury securities.

Figure 9

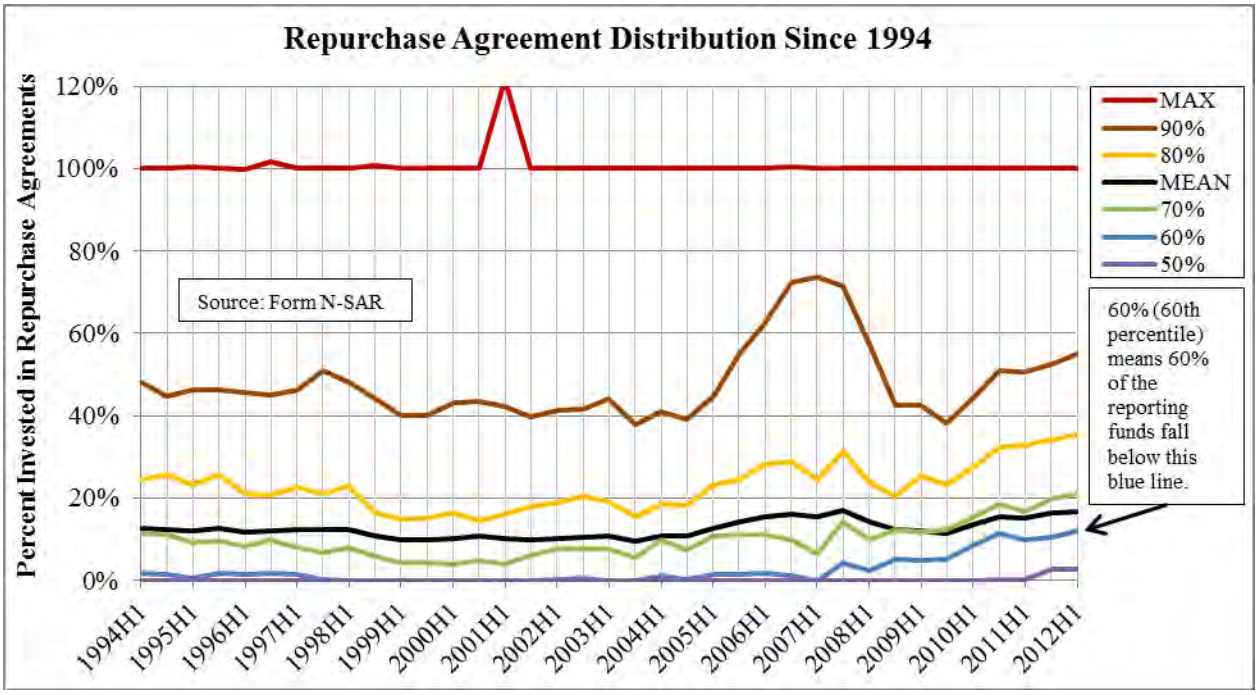


Figure 10

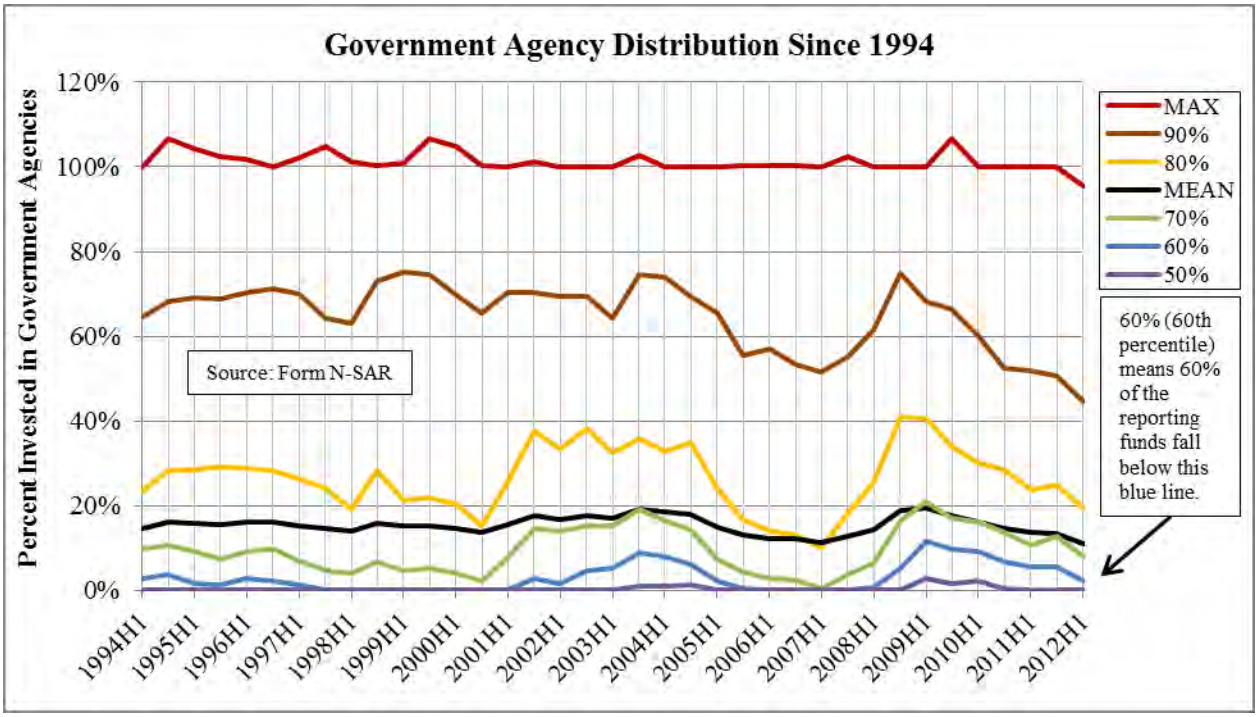


Figure 11

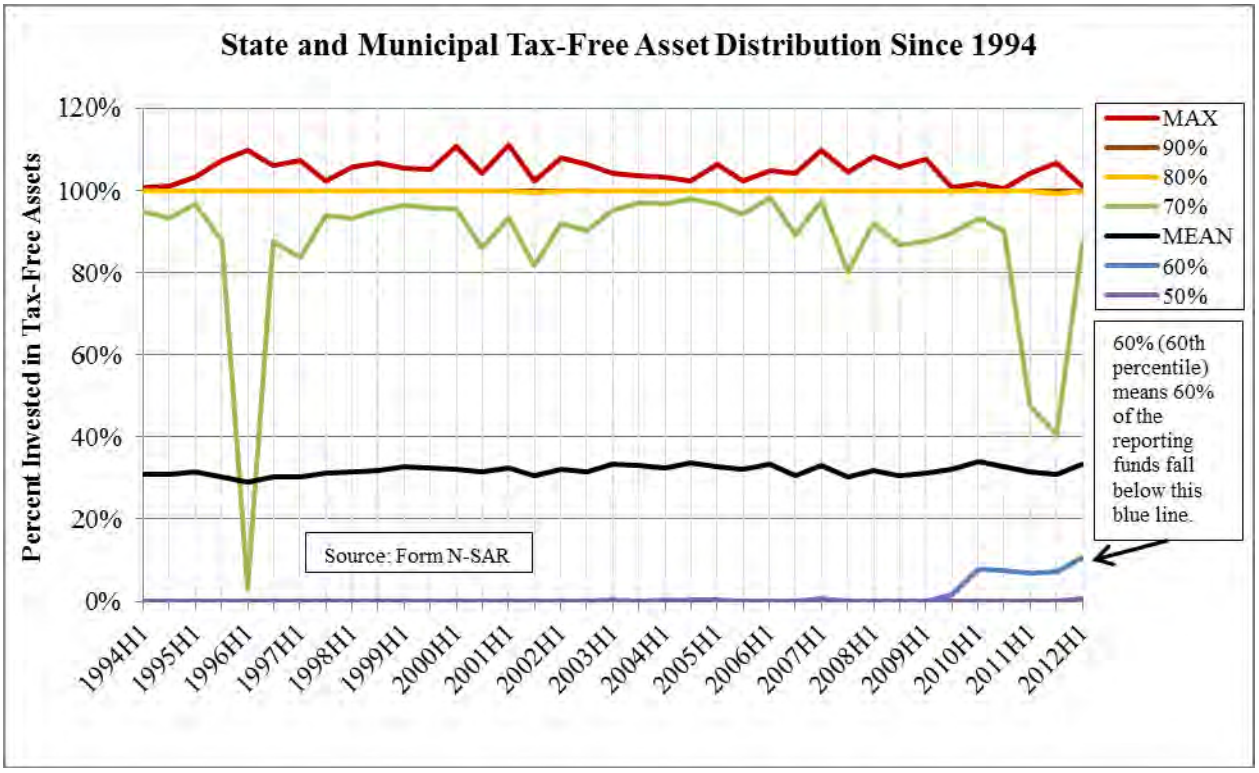


Figure 12

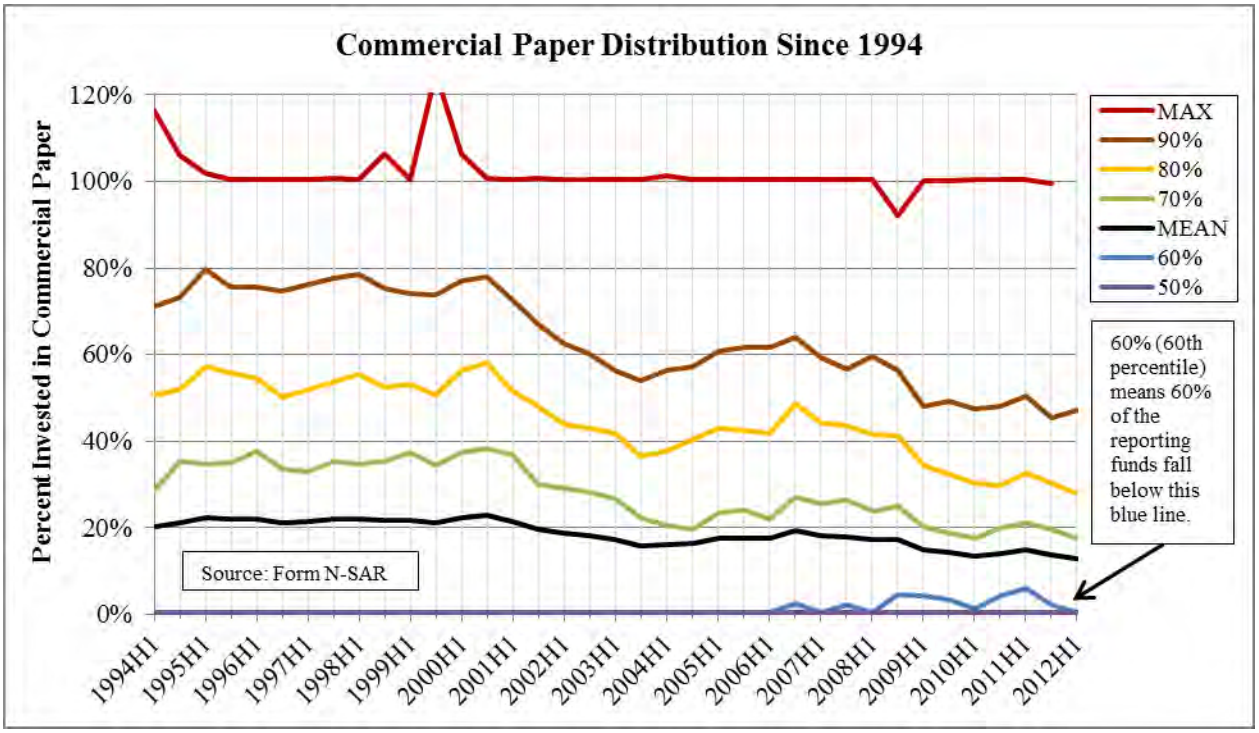


Figure 13

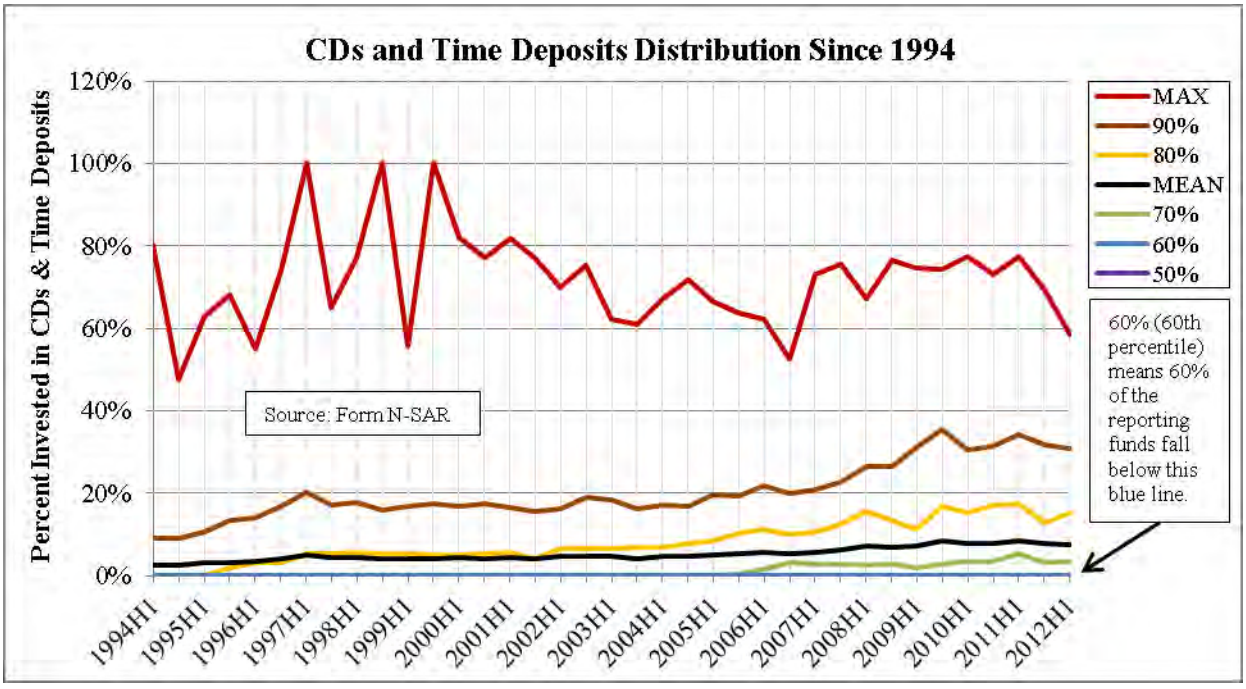


Figure 14 shows the cross-sectional distribution of money market funds weekly gross yields from 2004 through 2012, and Figure 15 shows the difference in gross yields for prime funds, only. The vertical lines indicate the date that Lehman Brothers filed for bankruptcy, September 15th, 2008, and the date the SEC adopted the 2010 reforms, February 23, 2010. The figures indicate there has been a noticeable reduction in the cross-sectional volatility of yields since 2010. Nevertheless, it is not appropriate to conclude by these facts alone that the amendments are fully responsible for reducing yield volatility. The average nominal yields in the market have been below 50 basis points over the post-amendment period, and therefore, the cross sectional distribution would have displayed lower cross-sectional volatility even had the amendments not been adopted. Thus, it is difficult to establish a causal link between the 2010 reforms and the reduction in yield volatility.

Figure 14

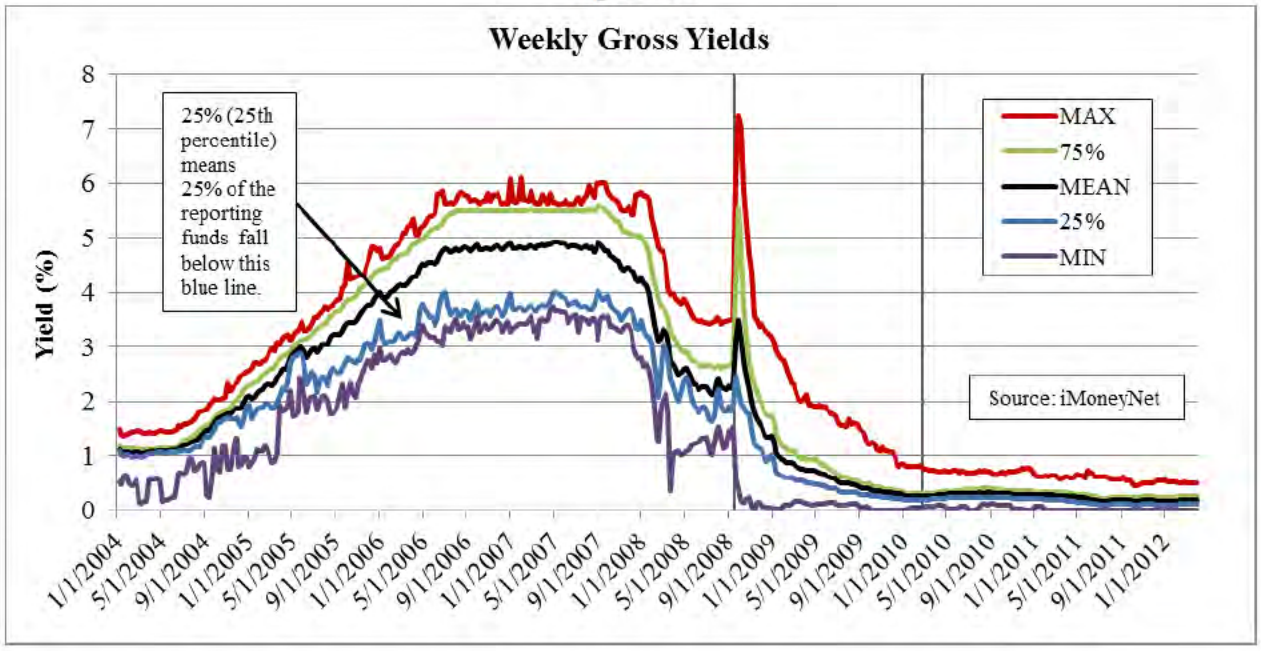
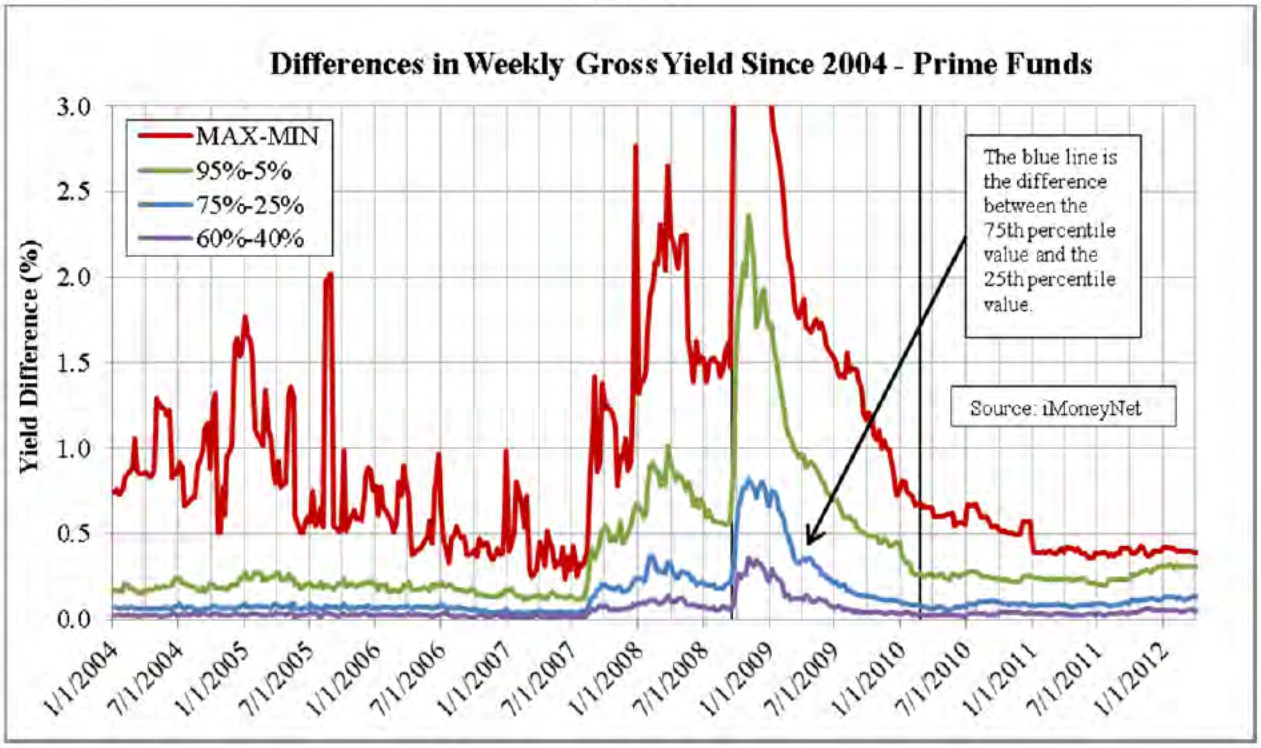


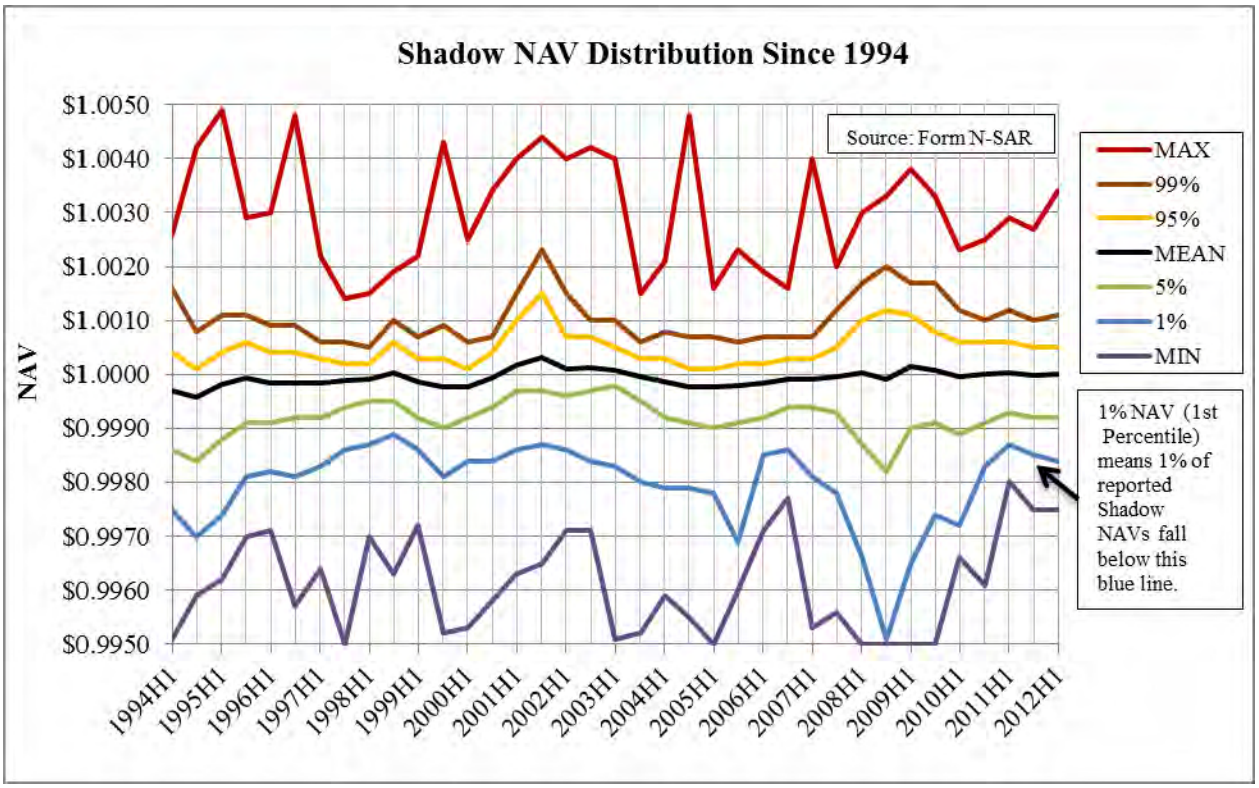
Figure 15



To see whether the 2010 reforms have affected the shadow price of funds, Figure 16 reports the distribution of shadow prices between 1994 and 2012 using information from twice-yearly Form

N-SAR filings.[36] The largest change appears to be in the minimum reported shadow price (it used to be as low as $0.995, but now it is always above $0.9970) and the maximum reported shadow price (it used to be often above $1.003, but now it is generally below $1.003).

Figure 16



To further assess the effectiveness of the 2010 reforms, RSFI staff analyzed the difference in probabilities that a money market fund breaks the buck under different WAM scenarios: 90-day WAM (the maximum possible before the 2010 reforms) and 60-day WAMs (the maximum possible after the 2010 reforms). To evaluate the robustness of the results, two different Monte Carlo simulations are employed where each is based on a different modeling framework. The first analysis (Model A1) simulates how interest rate changes affect the stability of money market funds. Interest rate changes are modeled using historical data over a period that includes the 2008 financial crisis. The analysis excludes the effects of security defaults and investor redemptions.

[36] Footnote 30 documents that funds file Form N-SAR twice a year. As such, changes that occur in between filings may not show up in time series analyses. The analysis excludes funds that either do not report a shadow price or that report a shadow price that appears to be erroneous.

The second analysis (Model A2) is a more technical simulation that includes a model of not only interest rate changes but also security defaults (WAM does not directly affect security defaults). Similar to Model A1, the second analysis excludes the effects of investor redemptions. Both models are commonly used in the finance industry.

As documented in Figure 6, money market funds do not generally maintain WAMs that are near the maximum WAMs permitted by rule 2a-7 (for example, the 75th percentile of money market fund WAMs has been at or below 60 days each reporting period since at least 1994, and the mean has been as low as 30 days since 1994). Thus, the following simulation results should not be interpreted as average effects. Instead, they are designed to illustrate the maximum effects for a fund that chooses to have the maximum WAM before the 2010 amendments.

The probabilities that representative money market funds break the buck under different modeling assumptions are summarized below in Table 2 for portfolios that have 0 percent, 50 percent, or 100 percent of their portfolios in Treasury securities. (The details of both of these analyses are included in Appendices 1 and 2.) Results are reported for both 90-day and 60-day WAMs. Panels A and B, respectively, present the probability that the NAV falls below $0.995 using Models A1 and A2.[37] Panel C repeats Model A2 under the assumption that the volatility rates used in the simulation are doubled.

Table 2

Weighted Average Maturity Simulations Proportion of Portfolio Invested in Treasury Securities	Probability of NAV < $0.995	
	WAM = 90	WAM = 60
Panel A: Model A1: Interest Rate Changes		
100%	0.05%	0.00%
50%	0.17%	0.00%
0%	4.05%	0.52%
Panel B: Model A2: Interest Rate Changes and Security Defaults		
100%	0.00%	0.00%
50%	0.00%	0.00%
0%	0.92%	0.18%

[37] A more complete discussion of the distribution of NAVs hitting specific thresholds is presented in Appendix 2.

Panel C: Model A2: Interest Rate Changes and Security Defaults (Double Volatility)		
100%	1.97%	0.09%
50%	1.97%	0.09%
0%	5.50%	2.09%

Panels A and B present results that are very similar. The most important finding is that the probability of breaking the buck for a money market fund with a WAM of 90 days is higher than that for a money market fund with a WAM of 60 days. Under the assumptions in the model, the probability of breaking the buck for a money market fund with a WAM of 60 days is close to zero (results in the table are rounded to two decimal places). We note, however, that there have been repeated instances of defaults and credit deterioration in securities held by money market funds since 1989 (see Table 1). As expected, the simulated probabilities of breaking the buck are higher for funds that have a 90-day WAM, suggesting that the 2010 reform improved the resiliency of money market funds to interest rate shocks (meaning, in this context, changes in the default-free rate of interest and changes in credit spreads). For those instances in Model A1 where the probability of breaking the buck is non-zero (Panel A), the 2010 reforms were still able to reduce the likelihood approximately eight times (4.05%/0.52% = 7.79). The analogous calculation from Panel B indicates a reduction of approximately five times.

Several caveats should be considered when interpreting these results. First, the results are conservatively biased because the analysis is based on the maximum WAM permitted under rule 2a-7. Since the average WAM has been less than 50 days since at least 1994 (today it is close to 35 days; see Figure 6), one would expect lower "failure" rates than those reported above. Second, the model does not use actual historical data, and it assumes that all risky securities behave in the same manner. Third, the results cannot be viewed as an upper bound because they do not incorporate investor redemptions. If redemptions occur after firms have realized capital losses, there should be more instances where funds break the buck.[38]

Panel C reports the effect of doubling the volatility rates in Model A2. When volatility is relatively high, the probability of breaking the buck is non-zero. Also note that the effect of shortening WAM from 90 to 60 days results in a 2-fold decrease in the probability that a money market fund breaks the buck (13.19%/6.19% = 2.13). This reinforces the earlier finding that the mandatory reduction in the maximum WAM significantly reduces price volatility as a result of interest rate changes. It also indicates that the probability of breaking the buck could increase to

[38] A model of the percentages of funds that in 2008 would have broken the buck as a result of credit losses and investor redemptions with and without the weekly liquid asset requirement adopted in the 2010 amendments can be found in Table 5.

an economically important level during high volatility periods, even for portfolios with WAMs of 60 days.

2. Transparency of Portfolio Holdings and Wind-Down Procedure

Has the increased transparency into the portfolio holdings of money market funds made funds less susceptible to runs? Has the establishment of an orderly wind-down procedure mitigated the risk of a run? If so, to what degree?

The 2010 reforms increased the information that money market funds are required to disclose to the Commission and the public. Money market funds are now required to submit monthly information on portfolio holdings to the SEC using Form N-MFP and to post portfolio information on their websites each month. These disclosures were adopted to allow the Commission, investors, and third parties to monitor funds' compliance with rule 2a-7 and better understand the risk of money market fund portfolio securities.

The additional disclosures improve fund transparency; however it must be remembered that funds file the form on a monthly basis with no interim updates. The Commission also makes the information public with a 60-day lag, which may cause it to be stale. There does not appear to be any empirical evidence to measure the effects of this change. The central challenge is that there is no clear way to parse the independent effects of greater transparency from those of the other changes included in the 2010 reforms.

Since the 2010 rule changes, no fund has liquidated and needed to use the revised wind-down procedure. Therefore, there is no objective way to analyze the effect of these changes on investors' redemption behavior.

B. Post-Reform Performance of the Money Market Fund Industry

1. Summer 2011: Eurozone Sovereign Debt Crisis and U.S. Debt Ceiling Impasse

What do the available data tell us about how money market funds performed following the implementation of the 2010 reforms, considering, for example, the performance of funds during the European sovereign debt crisis and the 2011 U.S. debt ceiling impasse and ratings downgrade?

The Eurozone sovereign debt crisis and U.S. debt ceiling impasse occurred in the summer of 2011. As the Eurozone sovereign debt crisis unfolded, peaking in July 2011, banks with exposure to the region were forced to offer high yields. Prime money market funds bought their

securities,[39] possibly to improve returns and attract additional investment.[40] By May 31, 2011, approximately 30 percent of U.S. prime money market fund assets were securities with exposure to Eurozone issuers.

As shown in Figure 17, prime money market fund investors began redeeming shares in summer 2011: Assets under management of prime funds fell by 5.1 percent in June 2011, and by another 4.1 percent in July 2011.[41] Prime funds lost approximately $100 billion (or six percent) of assets during a three-week period beginning June 14, 2011. Some prime funds had redemptions of almost 20 percent of their assets in each of June, July, and August 2011,[42] and one fund lost 23 percent of its assets during that period after articles began to appear in the financial press that warned of *indirect* exposure of money market funds to Greece.[43] Chernenko and Sunderam (2012) document that investors in institutional funds redeemed shares more aggressively than investors in retail funds, and investor redemptions from funds with exposure to Eurozone banks were greater than those without. Redemptions were concentrated in funds that had exposure to Eurozone banks through unsecured lending.

39 This information is based on Form N-MFP data as of May 31, 2011.

40 *See* Chernenko, Sergey, and Adi Sunderam, September 2012, Frictions in Shadow Banking: Evidence from the Lending behavior of Money Market Funds, Working paper No. 2012-4, Fisher College of Business.

41 Based on information from Form N-MFP filings.

42 Based on information from Form N-MFP filings.

43 Based on iMoneyNet data. *See, e.g.*, John Carney, *Why Your Money-Market Fund Could be Hit by Greek Default*, CNBC.COM, June 11, 2011, *available at* http://www.cnbc.com/id/43425080; *Money-Market Mayhem*, WALL ST. J., June 27, 2011.

Figure 17

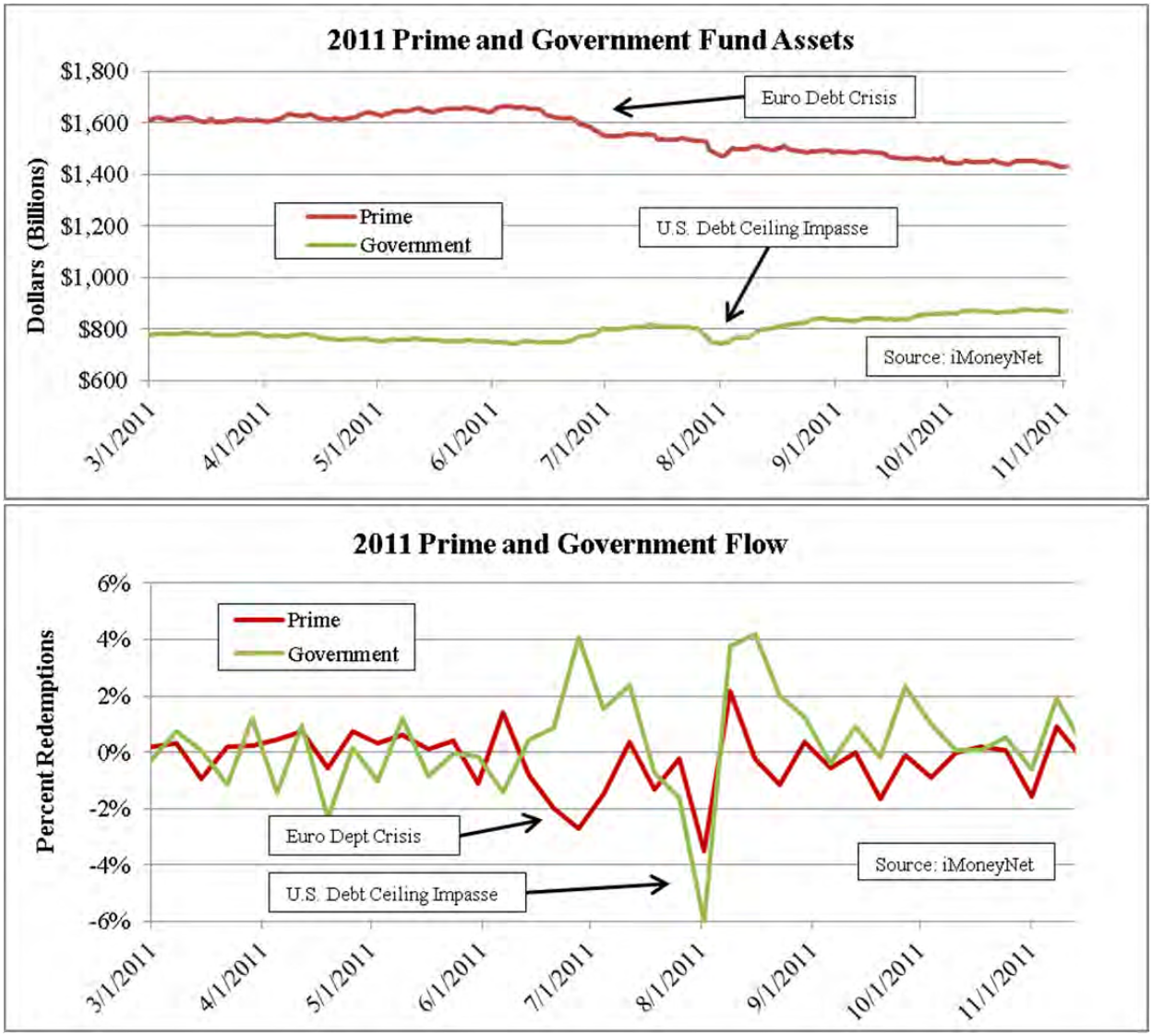


Figure 17 also shows investors bought government money market funds in late June and early July when they were concerned about the Eurozone debt crisis, but then began redeeming government money market fund shares in late July and early August when concerns about the U.S. debt ceiling impasse and possible ratings downgrades of government securities may have fueled investor concerns.

The events in the summer of 2011 differed, however, from those in 2008 in several important respects. First, unlike in 2008, money market funds were able to respond to the Eurozone sovereign debt crisis and U.S. debt ceiling impasse without any fund breaking the buck. Money market funds reduced their exposure to European Union member countries between April and

September 2011,[44] and, although commercial paper issued by some Eurozone banks was downgraded in 2011,[45] money market funds did not experience any significant capital losses. As shown in Table 3, funds' shadow NAVs did not deviate significantly from their stable NAVs.

Table 3

Shadow Prices of Prime Money Market Funds

Month	Mean	Std Dev	Min	Percentiles					Max
				10	25	50	75	90	
April - 2011	1.0000 1	0.0003 6	0.9984	0.9996	1.0000	1.0001	1.0002	1.0003	1.0011
May - 2011	1.0000 0	0.0003 7	0.9983	0.9997	1.0000	1.0001	1.0001	1.0003	1.0012
June - 2011	0.9999 8	0.0003 7	0.9983	0.9996	1.0000	1.0001	1.0001	1.0002	1.0011
July - 2011	0.9999 4	0.0003 7	0.9983	0.9995	0.9999	1.0000	1.0001	1.0002	1.0011
August - 2011	0.9999 1	0.0003 5	0.9983	0.9995	0.9999	1.0000	1.0001	1.0001	1.0009
September - 2011	0.9999 0	0.0003 5	0.9981	0.9995	0.9999	1.0000	1.0000	1.0001	1.0008
October - 2011	0.9999 1	0.0003 5	0.9983	0.9995	0.9999	1.0000	1.0001	1.0001	1.0008

Second, unlike in 2008, funds in 2011 had sufficient liquidity to satisfy investors' redemption requests. Two aspects likely explain the orderly nature of the observed redemption activity. First, the amendments to rule 2a-7 required money market funds to hold more liquid assets. Funds had greater resources to redeem shares than in 2008. Second, the events of the Eurozone sovereign debt crisis and U.S. debt ceiling impasse were slow moving compared to the 2008 financial crisis. During the three-week period beginning June 14, 2011, investors withdrew approximately $100 billion from prime money market funds.[46] By contrast, investors withdrew over $300 billion from prime money market funds in a few days during the 2008 financial crisis. The slower speed on the 2011 Eurozone sovereign debt crisis and U.S. debt ceiling impasse likely allowed funds to better manage anticipated redemptions because internal liquidity reserves were able to build organically.

A number of commentators view the success of money market funds to respond to the economic challenges of 2011 as an indication that the 2010 reforms were successful.[47] It is important to note, however, investor redemptions has a direct effect on short-term funding liquidity in the

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44 *See* Blackwell, David W., Troske, Kenneth R., and Winters, Drew B., *Money Market Funds Since the 2010 Regulatory Reforms*, Fall 2012, Center for Capital Markets.

45 *See* Committee on the Global Financial System, CGFS Papers No 43, July 2011, The impact of sovereign credit risk on bank funding conditions, Report submitted by a Study Group.

46 The largest weekly outflow from prime money market funds during the summer of 2011 was $53.8 billion (the week ending August 2, 2011), according to iMoneyNet data.

47 *See*, for example, Blackwell, David W., Troske, Kenneth R., and Winters, Drew B., *Money Market Funds Since the 2010 Regulatory Reforms*, Fall 2012, Center for Capital Markets.

U.S. commercial paper market. Chernenko and Sunderam (2012) report that "creditworthy issuers may encounter financing difficulties because of risk taking by the funds from which they raise financing." Similarly, Correa, Sapriza, and Zlate (2012) finds local branches of foreign banks reduced lending to U.S. entities in 2011,[48] while Ivashina, Scharfstein, and Stein (2012) document European banks that were more reliant on money funds experienced bigger declines in dollar lending.[49] While these studies show that, even though money fund investors were not harmed, heavy redemptions in money market funds reduced short-term funding liquidity, they do not attempt to quantify the economic costs of these disruptions nor do they consider whether borrowers endogenously reduced their demand for commercial paper in light of the same risks.

2. Money Market Fund Performance in September 2008 under Current Rules

How would money market funds have performed during the events of September 2008 had the 2010 reforms been in place at the time?

This subsection characterizes how money market funds might have performed during the events of September 2008 had the 2010 reforms been in place at that time. The goal of this analysis is different from our prior examination of interest rate and credit risk. Whereas the former considers how shortening the WAM from 90 to 60 days affects the probability of breaking the buck (and abstracts from redemption activity), this analysis considers whether heightened liquidity standards improve fund resiliency given specific levels of capital losses and redemption activity. The analysis quantifies how often funds would have broken the buck under various redemption rate and portfolio loss assumptions. The idea is to ask whether a particular fund would have broken the buck if X percent of the investors were to redeem immediately following a capital loss of Y percent.

The analysis does not model optimal investor response to capital losses. Rather, given each money market fund's actual portfolio holdings, it quantifies how many firms would have broken the buck in September 2008 based on specific capital loss and redemption scenarios.[50] It then

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48 *See* Correa, Ricardo, Horacio Sapriza, and Andrei Zlate, November 2012, Liquidity Shocks, Dollar Funding Costs, and the Bank Lending Channel During the European Sovereign Crisis, Board of Governors of the Federal Reserve System International Finance Discussion Papers Number 1059.

49 *See* Ivashina, Victoria, David S. Scharfstein, and Jeremy C. Stein, October 2012, Dollar Funding and the Lending Behavior of Global Banks.

50 Form N-SAR is used to estimate the actual portfolio holdings on September 2008. The form is filed semi-annually and provides aggregate position data, including the amounts invested in U.S.

compares how many of these same firms would have broken the buck had funds been required to hold at least 30 percent WAL.

Despite the fact that the analysis in section 4A.1 shows that the probability of breaking the buck due to interest rate changes is low, a fund that experiences a significant capital loss, most likely due to a default, must determine whether its liquidity reserves are sufficient to meet redemption requests. To provide some context, consider that the losses incurred by The Reserve Primary Fund would still have been realized had the 2010 amendments been in place in September 2008. At the time, its holdings of Lehman Brothers commercial paper did not violate the 2010 concentration limits of 5 percent because the commercial paper had a first tier rating. As shown in Table 4, The Reserve Primary Fund's shadow price fell from exactly $1.00 on Friday, September 12, 2008 to $0.9667 at the close of business on Tuesday, September 16, 2008.

Table 4

The Reserve Primary Fund		
	Monday Sept. 15, 2008	Tuesday Sept. 16, 2008
Starting Balance = $62.5 Billion		
Total Redemptions	26.4%	64%
Total Capital Loss ($ Billions)	$0.157	$0.785
Total Capital Loss	0.25%	1.26%
Starting NAV	$1.0000	$0.9967
Ending NAV	$0.9967	$0.9667

SOURCE: Court filings and staff calculations

Had money market funds maintained high levels of weekly liquid assets at the start of the 2008 financial crisis, further losses might have been reduced. However, the original loss due to Lehman Brothers' bankruptcy would have remained and still would have been concentrated by redemptions.

To estimate the effect of the WAL requirement, RSFI staff analyzed the differences in shadow NAVs in the presences of losses and redemptions. (According to Figure 1, it is not unusual for weekly net redemptions to exceed 10 percent.) The analysis begins by extracting portfolio information and shadow prices from Form N-SAR for all money market funds as of September 2008. The fund's WLA is estimated to be the sum of its Treasury securities, Agencies, and

Treasury securities and Treasury repurchase agreements. For purposes of this analysis, the last form N-SAR prior to September 2008 is used to estimate the proportions of default-free and risky securities.

Treasury repos.[51] All other assets are assumed to be non-WLA. Any fund that has less than 20 percent of its portfolio in non-WLA assets is dropped from the analysis (which is about 30 percent of the N-SAR filings from that period) because it is considered to have characteristics that are similar to those of Treasury money market funds. The analysis then assumes that the non-WLA assets experience capital losses that range from 25 to 300 basis points. The fund shadow price is then estimated for different levels of investor redemptions, ranging from 0 to 56 percent.[52] The proportion of funds that break a buck is then calculated. The analysis is repeated assuming each fund rebalances it portfolio, if necessary, to satisfy the 30 percent WLA requirement that was adopted in 2010.[53]

Table 5 presents the results. The first panel reports results for funds using the reported portfolio composition (i.e., without imposing the 30 percent WLA requirement), and the second panel reports results for the simulated funds that have at least 30 percent WLA. As expected, the results show that funds with a 30 percent WLA requirement are more resilient to both portfolio losses and investor redemptions. For example, 67 percent of funds would break the buck without a WLA rule after experiencing a 50 basis point loss to their non-WLA assets and ten percent investor redemptions.[54] Under the new 30 percent WLA requirement, the fraction of funds that would break the buck is estimated to fall to seven percent. The rate at which funds break the buck approaches 100 percent for capital losses that exceed 1 percent regardless of whether there are either redemption requests or WLA requirements. Since The Reserve Primary Fund lost 1.26 percent during September 2008 (row 5 of Table 5), it would have broken the buck even in the presence of the 2010 liquidity requirements. This assumes, of course, that The Reserve Primary Fund would hold exactly the same portfolio of non-WLA assets had the 2010 amendments been in place in September of 2008.

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51 Given the information required on Form N-SAR, it is not possible to measure precisely the amount of DLA or WLA that money market funds held during this period. This estimate is both overly inclusive (for example, Agency discount notes that mature in more than 60 days are not WLA) and overly restrictive (for example, commercial paper that matures in one business day is WLA).

52 An analysis of the historical daily investor flows from iMoneyNet from 2004 to 2010 shows that the first percentile redemption rates (meaning that only one percent of the filers had larger outflows) were generally greater than 10 percent, rarely over 25 percent, and never greater than 56 percent. Many prime funds had weekly net redemptions that exceeded 25 percent in September 2008.

53 This analysis is simply an approximation. Among other simplifications, it ignores the fact that the DLA and WLA tests are made only at the time of security purchase.

54 These calculations are affected by a fund's reported shadow price: the higher the reported shadow price, the larger the loss the fund can bear. They are also affected by the fraction of the fund's portfolio held in "risky" assets: the higher the fraction of risky assets, the smaller the loss the fund can bear.

Table 5

Percentage of Funds That Break The Buck in September 2008

Loss to non-WLA Assets	Without 30% WLA				With 30% WLA			
	Investor Redemptions				Investor Redemptions			
	0%	10%	25%	56%	0%	10%	25%	56%
0.25%	1.2%	2.4%	4.2%	63.0%	1.2%	1.2%	3.4%	15.4%
0.50%	20.6%	66.6%	88.8%	97.0%	3.8%	7.4%	23.4%	96.6%
0.75%	92.6%	94.4%	96.6%	98.4%	64.6%	87.8%	96.4%	98.4%
1.00%	96.6%	97.0%	97.8%	99.2%	96.6%	97.0%	97.8%	99.2%
1.26%	97.6%	98.0%	98.6%	99.8%	97.6%	98.0%	98.6%	99.8%
2.00%	99.0%	99.2%	99.8%	100.0%	99.0%	99.2%	99.8%	100.0%
3.00%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

SOURCE: Staff calculations

In modeling these scenarios, it is important to note that the triggering event that caused The Reserve Primary Fund to break the buck was the default of Lehman Brothers commercial paper, which had a first tier rating at the time of its default. Even under the current regulatory regime, a security that has a first tier rating would not be considered particularly risky. To the extent that investors could have known The Reserve Primary Fund was holding Lehman Brothers commercial paper through Form N-MFP disclosures (had the 2010 reforms been in place at the time), it is unclear how they would have responded given that the information is reported with a 60-day lag. Of course, increased transparency, even if reported on a delayed basis, might dampen a fund manager's willingness to hold securities whose ratings are at odds with the underlying risk, especially at times when credit conditions are deteriorating.

C. Investment Alternatives to Money Market Funds

1. Alternative Investments

> *If money market funds were to be fundamentally restructured and investors were then to shun such funds, to where would those assets migrate? What would be the implications of such a reallocation of capital for investors, financial institutions, systemic risk, and the overall economy?*

Money market fund investors have many investment options, each offering a different combination of price stability, risk exposure, return, investor protections, and disclosure. This subsection analyzes the characteristics of money market fund alternatives and discusses where current money market fund investors might invest if they find money market funds are no longer a viable investment.

Table 6 outlines the principal features of various cash investment alternatives to prime and Treasury money market funds, as currently defined. The features examined include how alternatives are valued, their investment risk relative to a "Benchmark" (defined as a representative prime money market fund), current redemption restrictions, expected yield relative to the Benchmark, whether products are regulated, and whether restrictions exist on investor eligibility. Existing investment alternatives to prime funds include the following: bank deposit accounts, bank collective trust funds, local government investment pools, offshore funds, private funds, separately managed accounts, ultra-short bond funds, short-duration exchange-traded funds, and direct investments in money market instruments.[55] Each of these choices involves different tradeoffs, and none are perfect substitutes for money market funds.

Table 6

Cash Investment Alternatives						
Product	**Valuation**	**Investment Risks[56]**	**Redemption Restrictions**	**Yield[57]**	**Regulated**	**Restrictions on Investor Base**
Current prime MMFs	Stable NAV	Benchmark	No	Benchmark	Yes	No
Current Treasury MMFs	Stable NAV	Lower than benchmark	No	Below benchmark	Yes	No
Bank demand deposit below the insurance limit[58]	Stable	Lower then benchmark	No	Below benchmark	Yes	No
Bank demand deposit above the insurance limit[59]	Stable	Above benchmark	No	Below benchmark	Yes	No

55 *See, e.g.*, ICI Feb 2012 PWG Letter; Comment Letter of the Association for Financial Professionals, File No. 4-619 (Apr. 4, 2012).

56 For purposes of this table, investment risks include exposure to interest rate and credit risks. The column also indicates the general level of investment risk for the product compared with the baseline of prime money market funds and is generally a premium above the risk-free or Treasury rate.

57 The table entries reflect average yields in a normal interest rate environment. Certain cash management products, such as certificates of deposits ("CDs") and demand deposits, may be able to offer rates above the baseline in a low interest rate environment.

58 The current depository insurance limit is $250,000 per owner for interest-bearing accounts. See Deposit Insurance Summary, Federal Deposit Insurance Corporation ("FDIC"), http://www.fdic.gov/deposit/deposits/dis/. Non-interest bearing accounts have unlimited depository insurance coverage through December 31, 2012.

59 *Ibid.*

Cash Investment Alternatives						
Product	**Valuation**	**Investment Risks[56]**	**Redemption Restrictions**	**Yield[57]**	**Regulated**	**Restrictions on Investor Base**
Time deposits (CDs)	Stable	Bank counterparty risk above DI limit	Yes[60]	Below benchmark	Yes	No
Offshore money funds (European short-term MMFs)[61]	Stable or Floating NAV	Comparable to benchmark	Some[62]	Comparable to benchmark	Yes	Yes[63]

60 Time deposits, or CDs, are subject to minimum early withdrawal penalties if funds are withdrawn within six days of the date of deposit or within six days of the immediately preceding partial withdrawal. *See* 12 CFR 204.2(c)(1)(i). Many CDs are also subject to early withdrawal penalties if withdrawn before maturity, although market forces, rather than federal regulation impose such penalties. CDs generally have specific fixed terms (*e.g.*, one-, three-, or six-month terms), although customized CDs with terms of seven days or some banks offer more.

61 The vast majority of money fund assets are held in U.S. and European money funds. *See* Consultation Report of the IOSCO Standing Committee 5 (April 27, 2012) ("IOSCO SC5 Report"), at App. B, §§ 2.1 - 2.36 (in 2011, of the assets invested in money funds in IOSCO countries, approximately 61 percent were invested in U.S. money market funds and 32 percent were invested in European money funds). Consequently, dollar-denominated European money funds may provide a limited offshore money fund alternative to U.S. money market funds. *See infra* note 63 for a discussion of these limitations. Most European stable value money market funds are a member of the Institutional Money Market Funds Association (IMMFA). According to IMMFA, as of May 2011, there was $288 billion U.S. dollar denominated IMMFA money market funds. *See* www.immfa.org (this figure excludes accumulating NAV US$-denominated money market funds). Like U.S. money market funds, European short-term money market funds must have a dollar weighted average maturity of no more than 60 days and a dollar weighted average life maturity of no more than 120 days, and their portfolio securities must hold one of the two highest short-term credit ratings and have a maturity of no more than 397 days. However, unlike U.S. money market funds, European short-term money market funds may either have a floating or fixed NAV. *Compare* Common Definition of European Money Market Funds (Ref. CESR/10-049) *with* rule 2a-7.

62 European money funds are subject to legislation governing Undertakings for Collective Investment in Transferable Securities ("UCITS"), which also covers other collective investments. *See, e.g.,* UCITS IV Directive, Article 84 (permitting a UCITS to, in accordance with applicable national law and its instruments of incorporation, temporarily suspend redemption of its units); Articles L. 214-19 and L. 214-30 of the French Monetary and Financial Code (providing that under exceptional circumstances and if the interests of the UCITS units holders so demand, UCITs may temporarily suspend redemptions).

63 Section 7(d) of the Investment Company Act requires that any non-U.S. investment company that wishes to register as an investment company in order to publicly offer its securities in the U.S. must first obtain an order from the SEC. To issue such an order, the SEC must find that "by reason of special circumstances or arrangements, it is both legally and practically feasible to

Cash Investment Alternatives						
Product	**Valuation**	**Investment Risks[56]**	**Redemption Restrictions**	**Yield[57]**	**Regulated**	**Restrictions on Investor Base**
Offshore money funds (European MMFs)[64]	Floating NAV	Above benchmark	Some	Above benchmark	Yes	Yes[65]
Enhanced cash funds (private funds)	Stable NAV (generally)	Above benchmark	By contract	Above benchmark	No[66]	Yes[67]

enforce the provisions of [the Act against the non-U.S. fund,] and that the issuance of [the] order is otherwise consistent with the public interest and the protection of investors." No European money fund has received such an order.

European money funds could be offered to U.S. investors privately on a very limited basis subject to certain exclusions from investment company regulation under the Investment Company Act and certain exemptions from registration under the Securities Act. *See infra* note 66. U.S. investors purchasing non-U.S. funds in private offerings, however, may be subject to potentially significant adverse tax implications. *See e.g.*, Internal Revenue Code of 1986 §§ 1291 through 1297. Moreover, as a practical matter, and in view of the severe consequences of violating the Securities Act registration and offering requirements, most European money funds currently prohibit investment by U.S. Persons, consistent with Regulation S.

64 European money market funds may have a dollar weighted average portfolio maturity of up to six months and a dollar weighted average life maturity of up to 12 months that are significantly greater than are permitted for U.S. money market funds. *Compare* Common Definition of European Money Market Funds (Ref. CESR/10-049) *with* rule 2a-7.

65 *See infra* note 36.

66 Private funds likely rely on one of two exclusions from investment company regulation by the Commission. Section 3(c)(1) of the Investment Company Act, in general, excludes from the definition of "investment company" funds whose shares are beneficially owned by not more than 100 persons where the issuer does not make or propose to make a public offering. Section 3(c) (7) of the Act places no limit on the number of holders of securities, as long as each is a "qualified purchaser" (as that term is defined in Section 2(a)(51) of the Act) when the securities are acquired and the transaction does not involve a public offering. Most retail investors would not fall within the definition of "qualified purchaser." Moreover, such private funds also generally rely on the private offering exemption in Section 4(2) of the Securities Act or Securities Act rule 506 to avoid the registration and prospectus delivery requirements of Section 5 of the Securities Act. Rule 506 establishes "safe harbor" criteria to meet the private offering exemption. The protection most often relied upon by private funds under Rule 506 exempts offerings made exclusively to "accredited investors" (as that term is defined in Rule 501(a) under the Securities Act). Most retail investors would not fall within the definition of "accredited investor."

Offshore private funds also generally rely on one of the two non-exclusive safe harbors of Regulation S, an issuer safe harbor and an offshore resale safe harbor. If one of the two is satisfied, an offshore private fund will not have to register the offer and sale of its securities under the Securities Act. Specifically, rules 903(a) and 904(a) of Regulation S provide that offers and sales must be made in "offshore transactions" and rule 902(h) provides that an offer or sale is

Cash Investment Alternatives						
Product	**Valuation**	**Investment Risks[56]**	**Redemption Restrictions**	**Yield[57]**	**Regulated**	**Restrictions on Investor Base**
Ultra-short bond funds	Floating NAV	Above benchmark	Some	Above benchmark	Yes	No
Collective investment funds[68]	Not stable	Above benchmark	No	Above benchmark	Yes	Tax-exempt bank clients[69]
Short-term investment funds ("STIFs")	Stable	Above benchmark	No	Above benchmark	Yes[70]	Tax-exempt bank clients[71]
Local government investment pools ("LGIPs")	Stable (generally)[72]	Above benchmark[72]	No	Above benchmark[73]	Yes[74]	Local government and public entities[75]

made in an "offshore transaction" if, among other conditions, the offer is not made to a person in the United States. Regulation S is not available to offers and sales of securities issued by investment companies required to be registered, but not registered, under the Investment Company Act. *See* Regulation S Preliminary Notes 3 and 4.

67 *See id*.

68 Collective investment funds include collective trust funds and common trust funds managed by banks or their trust departments, both of which are a subset of short-term investment funds. For purposes of this table, short-term investment funds are separately addressed.

69 Collective trust funds are generally limited to tax-qualified plans and government plans, while common trust funds are generally limited to tax-qualified personal trusts and estates and trusts established by institutions.

70 STIFs are generally regulated by 12 CFR 9.18. A recent Treasury proposal would impose upon STIFs similar requirements to those governing money market funds. *See* Office of the Comptroller of Currency, Treasury, Short Term Investment Funds (April 2, 2012) [68 FR 21057 (April 9, 2012)].

71 *See supra* note 69.

72 Local government investment pools generally are structured to meet a particular investment objective. In most cases, they are designed to serve as short-term investments for funds that may be needed by participants on a day-to-day or near-term basis. These local government investment pools tend to emulate typical money market mutual funds in many respects, particularly by maintaining a stable net asset value of $1.00 through investments in short-term securities. A few local government investment pools are designed to provide the potential for greater returns through investment in longer-term securities for participants' funds that may not be needed on a near-term basis. The value of shares in these local government investment pools fluctuates depending upon the value of the underlying investments. Local government investment pools limit the nature of underlying investments to those in which its participants are permitted to invest under applicable state law. *See* http://www.msrb.org/Municipal-Bond-Market/About-Municipal-Securities/Local-Government-Investment-Pools.aspx.

Cash Investment Alternatives						
Product	**Valuation**	**Investment Risks[56]**	**Redemption Restrictions**	**Yield[57]**	**Regulated**	**Restrictions on Investor Base**
Short-duration ETFs	Floating NAV; Market price[76]	Above benchmark	No	Above benchmark	Yes	No
Separately managed accounts (including wrap accounts)	Not stable	Above benchmark	No	Above benchmark	No	Investment minimum[77]
Direct investment in MMF instruments	Not stable	Comparable to benchmark but may vary depending on investment mix[78]	No	Comparable to benchmark but may vary depending on investment mix	No	Some[79]

As Table 6 shows, money market fund investors would have to analyze the various tradeoffs associated with a shift to one of the available cash investment alternatives. These alternatives may create additional operational costs or complexities, and they may impose redemption restrictions or other limitations on liquidity.

For example, investors that highly value principal stability would likely consider shifting investments to Treasury money market funds or bank deposits, but would be unlikely to prefer

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73 *Id.*

74 *Id.*

75 Investors in local government investment pools may include counties, cities, public schools, and similar public entities. *See, e.g.,* The South Carolina Local Government Investment Pool Participant Procedures Manual, *available at* http://www.treasurer.sc.gov/Investments/The%20South%20Carolina%20Local%20Government%20Investment%20Pool%20Participant%20Procedures%20Manual.pdf.

76 Although the performance of an exchange traded fund ("ETF") is measured by its NAV, the price of an ETF for most shareholders is not determined solely by its NAV, but by buyers and sellers on the open market, who may take into account the ETF's NAV as well as other factors.

77 Many separately managed accounts have investment minimums of $100,000 or more.

78 Depending on the nature and scope of their investments, these investors may also face risks stemming from a lack of portfolio diversification.

79 Some money market fund instruments are only sold in large denominations or are only available to qualified institutional buyers. *See generally* rule 144A under the Securities Act (17 CFR 230.144A(7)(a)(1)).

ultra-short bond funds, short-duration ETFs, collective investment funds, or separately managed accounts that do not offer principal stability. If such investors shift their investments to Treasury money market funds, they would sacrifice yield, but they would not generally increase investment risk, principal stability, or liquidity. If they shift to bank CDs, they would not increase investment risk or principal stability, but they would sacrifice liquidity. Most other alternatives would likely involve increased investment risk.[80] Thus, the extent to which investors would use the above investment vehicles as substitutes for prime money market fund shares, in part, depends on individual preferences.

Some alternatives, such as LGIPs, STIFs, offshore money market funds, separately managed accounts, and direct investments in money market instruments involve significant restrictions on the types of investors that can be accepted, which would render these alternatives unavailable to most current money market fund investors. For example, offshore money market funds can only sell shares in private offerings to U.S. investors, and many prefer to avoid doing so, because it may result in the loss of certain Securities Act exemptions and create adverse tax consequences.[81] Some qualified investors may have additional self-imposed restrictions or fiduciary duties that limit the risk they can assume.

Many unregistered or offshore potential money market fund substitutes—unlike registered money market funds in the United States—are not prohibited from imposing gates or suspending redemptions.[82] Several other alternative investments also can impose redemption restrictions. Investors placing a high value on liquidity may find the potential imposition of these restrictions unacceptable and thus not view them as viable alternatives. Investors who value the disclosure and protections afforded to them by U.S. securities regulations may not regard private funds and some offshore funds as alternatives to prime money market funds.[83]

Money market fund investors that prefer yield over principal stability and low investment risk are likely to shift their investments into floating NAV offshore money market funds, floating value enhanced cash funds, ultra-short bond funds, collective investment funds, short-duration

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80 *See, e.g.*, Craig Karmin & Karen Richardson *How the Credit Crunch Turned Local—Governments' Pools Can Offer Better Yields, But With Risk Exposure*, WALL STREET JOURNAL (Dec. 6, 2007).

81 *See supra* note 63.

82 *See, e.g.*, Article 84 of the European Unions' Undertakings for Collective Investment in Transferable Securities (UCITS) directive. A gate is a restriction placed on a fund limiting the amount of withdrawals from the fund during the period of the gate.

83 According to the 2012 AFP Liquidity Survey, 21 percent of survey respondents reported that enhanced cash funds are permissible investment vehicles under the organization's short-term investment policy.

ETFs, or separately managed accounts.

One practical constraint is that some investors may not have access to LGIPs, STIFs or offshore money market funds due to the significant restrictions on who is eligible to participate. For example, most existing LGIPs are not registered with the SEC, as states and local state agencies are excluded from regulation under the U.S. federal securities laws. By contrast, STIFs only are offered to accounts for personal trusts, estates, and employee benefit plans that are exempt from taxation under the U.S. Internal Revenue Code, and offshore money funds are investment pools domiciled and authorized outside the United States.[84] Finally, investors are unlikely to view private funds, such as enhanced cash funds that are privately offered to institutions, wealthy clients, and certain types of trusts, as equivalent investments because of their greater investment risk, limitations on investor base, and lack of legal protections.[85] However, some investors could shift to stable NAV private funds because they provide a closer substitute to money market funds.

As noted above, some retail investors, particularly those with investment levels that are fully covered by the FDIC insurance limits, may shift their assets to bank deposits. The shift to bank deposits would increase reliance on FDIC deposit insurance and increase the size of the banking sector, which raises additional concerns about the concentration of risk in the economy. However, it is unlikely that many large institutional investors will follow suit. Interest-bearing accounts at depository institutions are insured only through $250,000. Although non-interest-bearing transaction accounts at depository institutions are fully insured today, starting in January 2013 they also will only be insured up to $250,000.

As shown in Figure 18, both individual and business holdings in checkable deposits and currency have significantly increased in recent years relative to their holdings of money market fund shares. The 2012 AFP Liquidity Survey indicates that bank deposits account for 51 percent of the surveyed organizations' short-term investments in 2012, which is up from 25 percent in 2008.[86] Money market funds account for 19 percent of these organizations' short-term investments in

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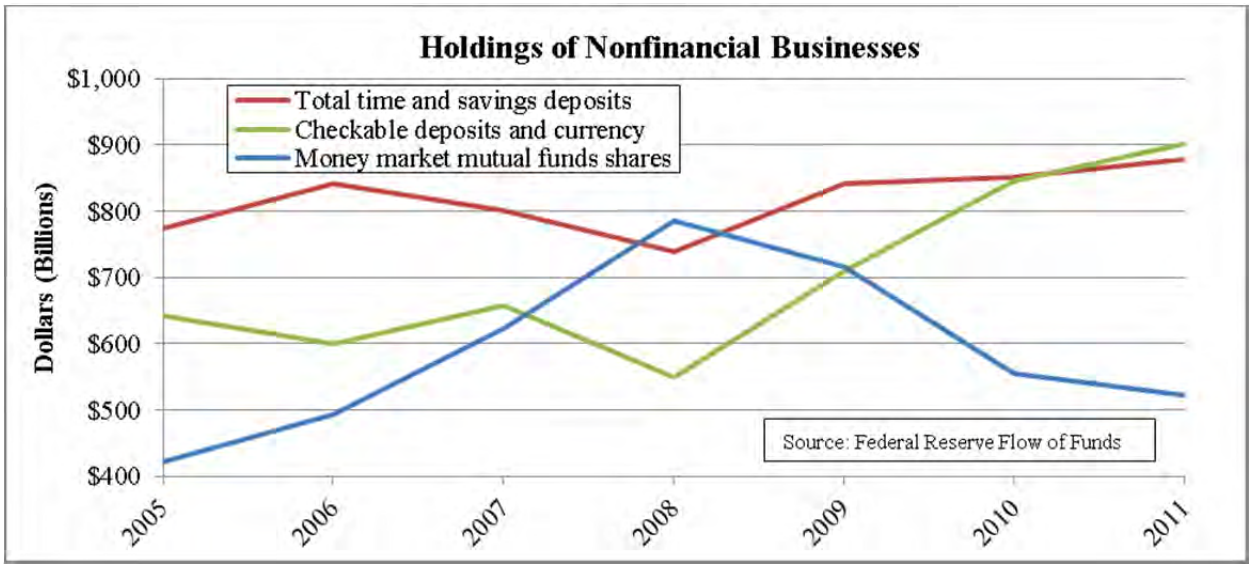
84 *See* Testimony of Paul Schott Stevens, President and CEO of the Investment Company Institute, before the Committee on Banking, Housing, and Urban Affairs, United States Senate, on "Perspectives on Money Market Mutual Fund Reforms," June 21, 2012.

85 According to the 2012 AFP Liquidity Survey, only 21 percent of respondents stated that enhanced cash funds were permissible investment vehicles under the organization's short-term investment policy. In contrast, 44 percent stated that prime money market funds were a permissible investment and 56 percent stated that Treasury money market funds were a permissible investment.

86 *See* 2012 AFP Liquidity Survey: Report of Survey Results, July 2012.

2012 down from 30 percent just a year earlier, and down from almost 40 percent in 2008.[87] This shift has likely been motivated by the availability of unlimited FDIC insurance on non-interest bearing accounts since the end of 2010, and may be likely to reverse if it is eliminated in January 2013.[88]

Figure 18



2. Effect on Current Issuers

> *If substantial assets were to flow out of money market funds, what impact would that have on the commercial paper market and the market for municipal debt? What would be the impact on corporate borrowers, municipalities, and states that sell their debt to money market funds?*

The effect of a significant shift in investment away from money market funds and into alternative investment vehicles would depend on where investors channel their monies. If, for example, investors choose to manage cash on their personal accounts rather than invest in alternate cash management products, they will most likely invest in securities similar to those

87 *See* 2008 AFP Liquidity Survey: Report of Survey Results

88 As of December 31, 2011, the amount in domestic noninterest-bearing transaction accounts over the normal $250,000 limit was $1.4 trillion. *See* Federal Deposit Insurance Corporation Quarterly Banking Profile, Fourth Quarter 2011, at 16, *available at* http://www2.fdic.gov/qbp/2011dec/qbp.pdf. At December 31, 2008, the amount in domestic noninterest-bearing transaction accounts over the normal $250,000 limit was $814 billion. *See* Federal Deposit Insurance Corporation Quarterly Banking Profile, Fourth Quarter 2008, at 20, *available at* http://www2.fdic.gov/qbp/2008dec/qbp.pdf.

held by money market funds. In this case, the effects on capital formation from such a shift are likely to be minimal. The preference for this alternative, however, may be tempered by the cost to investors of managing cash on their own.

Alternatively, investors may shift their monies to alternative investment vehicles. This shift could have an economic effect on the market for short-term securities. Table 7 below shows the aggregate assets under management for different types of money market funds using data on money market holdings, by type of fund, from Form N-MFP as of June 30, 2012. Prime money market funds hold 57 percent of the total assets of all registered money market funds, whereas Treasury money market funds hold 15 percent of these assets. Both types of funds have very different exposures to certain asset classes. For instance, at March 31, 2012, prime money market funds held approximately 43 percent of financial-company commercial paper outstanding and 9.5 percent of Treasury bills outstanding, whereas Treasury funds held approximately 18 percent of Treasury bills outstanding and only 0.23 percent of financial company commercial paper outstanding (see Panel C below).

Thus, any spillover effects from investors substituting away from money market funds and money market fund contraction will likely be largest for commercial-paper issuers, particularly financial company commercial paper issuers. However, the magnitude of the effect will depend on the extent to which there are portfolio investment differences between alternative investment vehicles and reforms on money market funds. Given that the supply of very short-term securities is likely to be limited to the same securities in which money market funds invest, shifts in investor capital to alternative investment instruments are likely to increase demand for these same assets reducing the net effect on the short-term funding market.

Table 7

Holdings of Money Market Funds

Panel A. MMF Holdings in $B, March 31, 2012

	Treasury Debt	Treasury Repo	Govmt Agency Debt	Govmt Agency Repo	VRDNs	Other Municipal Debt	Fncl Co CP	ABCP	Non-Fncl Co CP	CDs	Other
Prime	159.58	47.56	165.79	146.30	66.79	4.53	213.69	120.85	67.40	438.56	228.22
Treasury	301.49	105.49	2.98	2.70	0.00	0.00	1.14	0.41	0.01	3.47	1.67
Other	83.56	33.27	215.12	153.17	225.32	55.56	1.33	3.97	6.48	1.10	12.94
All MMF	*544.63*	*186.33*	*383.89*	*302.16*	*292.12*	*60.10*	*216.16*	*125.23*	*73.88*	*443.13*	*242.83*

Panel B. MMF Holdings as Percentage of Total Amortized Cost of MMFs by Type of Fund, March 31, 2012

	Treasury Debt	Treasury Repo	Govmt Agency Debt	Govmt Agency Repo	VRDNs	Other Municipal Debt	Fncl Co CP	ABCP	Non-Fncl Co CP	CDs	Other
Prime	9.62%	2.87%	9.99%	8.82%	4.03%	0.27%	12.88%	7.28%	4.06%	26.43%	13.75%
Treasury	71.89%	25.16%	0.71%	0.64%	0.00%	0.00%	0.27%	0.10%	0.00%	0.83%	0.40%
Other	10.55%	4.20%	27.17%	19.34%	28.46%	7.02%	0.17%	0.50%	0.82%	0.14%	1.63%
All MMF	*18.97%*	*6.49%*	*13.37%*	*10.53%*	*10.18%*	*2.09%*	*7.53%*	*4.36%*	*2.57%*	*15.44%*	*8.46%*

Panel C. MMF Holdings as Percentage of Amounts Outstanding, March 31, 2012

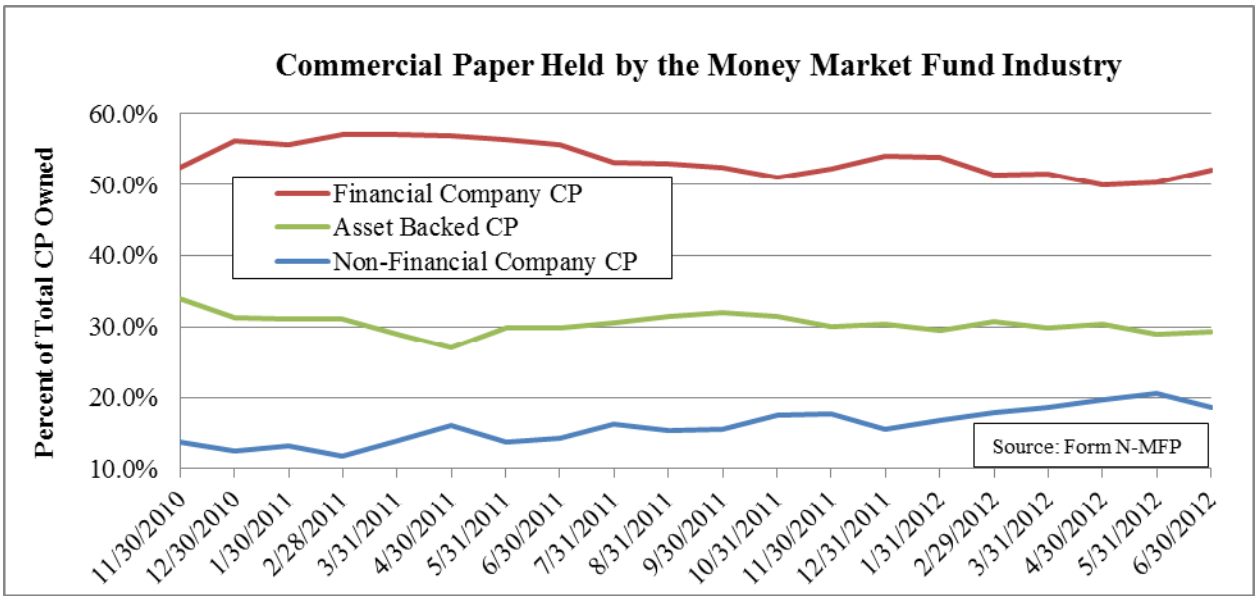
	Treas Debt as % Treas Bills Outstnd	(Treas Debt + Repos) as % Treas Bills Outstnd	Govmt Agency Debt as % of Govmt Agency Sec Outstnd (Q)	(Govmt Agency Debt + Repos) as % of Govmt Agency Sec Outstnd (Q)	VRDN as % of Muni Secs Outstnd	(VRDN+ Other Muni) as % of Muni Secs Outstnd (Q)	Fncl Co CP as % of Fncl Co CP Outstnd	ABCP as % of ABCP Outstnd	Non-fncl Co CP as % of Non-fncl Co CP Outstnd	CDs as % of Savings and Time Deposit Outstnd(Q)	CDs as % of Large Savings and Time Deposit Outstnd (Q)
Prime	9.54%	12.38%	2.20%	4.14%	1.80%	1.92%	42.75%	36.17%	42.02%	4.92%	28.22%
Treasury	18.03%	24.33%	0.04%	0.08%	0.00%	0.00%	0.23%	0.12%	0.00%	0.04%	0.21%
Other	5.00%	6.99%	2.86%	4.89%	6.06%	7.56%	0.27%	1.19%	2.92%	0.01%	0.01%
All MMF	*32.56%*	*43.70%*	*5.10%*	*9.11%*	*7.86%*	*9.48%*	*43.24%*	*37.48%*	*41.37%*	*4.97%*	*28.44%*

Sources: Data on money market fund holdings comes from Form N-MFP as of March 31, 2012. Data on outstanding Treasury debt, government agency debt, certificates of deposit and municipal debt comes from the Federal Reserve Board's Flow of Funds Accounts of the U.S. for Q1, 2012. Data on commercial paper comes for the Federal Reserve Board's Commercial Paper release. VRDNs are Variable Rate Demand Notes; Fncl Co CP is Financial Company Commercial Paper; and ABCP is Asset Backed Commercial Paper.

Historically, money market funds have been a significant source of financing for issuers of commercial paper and of short-term municipal debt. Concerns have been raised that additional regulation of money market funds could cause investors to shift their investments away from money market funds and that this would cause a decline in demand for non-financial commercial paper hampering these businesses' access to capital. The 2008-2011 increase in bank deposits coupled with the contraction of the money market funds presents an opportunity to examine how capital formation is affected as the supply of capital is reallocated among different possible funding sources.

According to Federal Reserve Board flow of funds data, from 2008 to 2011, money market funds' investments in commercial paper declined by 43 percent or $263 billion. Contemporaneously, funding corporations reduced their holdings of commercial paper by 87 percent or $265 billion. The end result was a contraction of more than 39 percent or $630 billion in the amount of commercial paper outstanding. Analysis of Form N-MFP data from November 2010 through June 2012, shown below in Figure 19, indicates that financial company commercial paper and asset-backed commercial paper comprise most of money market funds' commercial paper holdings.

Figure 19

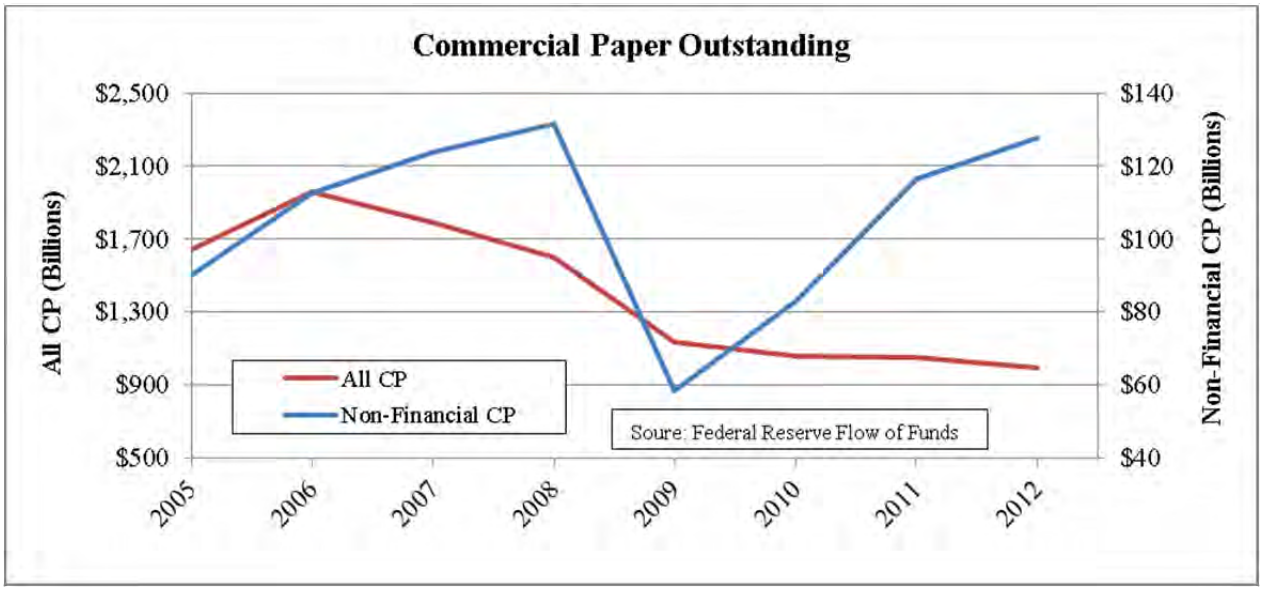


As can be seen in Table 7, the category "Non-Financial Company Commercial Paper," which includes corporate and non-financial business commercial paper, is a small fraction of overall money market holdings. In addition, commercial paper financing by non-financial businesses is a small portion (one percent) of their overall credit market instruments.[90]

[90] According to Federal Reserve Board flow of funds data, as of March 31, 2012 non-financial

The commercial paper market has been in a prolonged decline since 2006, independent of any further money market fund regulatory reforms. Figure 20 presents overall commercial paper outstanding since 2005 and the share of non-financial corporate business commercial paper outstanding. Non-financial commercial paper outstanding fell in 2008, but has since recovered. Financial commercial paper, however, has declined since 2006.

Figure 20



Although the aggregate demand for commercial paper has declined, banks and other financial institutions use money market funds as an important source of short-term funding. Table 7 indicates that as of March 31, 2012, money market funds held $1.4 trillion in Treasury debt, Treasury repo, Government agency debt, and Government agency repo as its largest sector exposure, followed by $659 billion in financial company commercial paper and CDs, its next largest sector exposure. Given that the largest commercial paper exposure of money market funds is to financial institutions, a reduction in the demand of money market instruments may have an effect on the ability of financial institutions to issue commercial paper.

It is important to place commercial paper borrowing by financial institutions into perspective by considering its relative size compared to other funding sources. As with non-financial businesses, financial commercial paper is a small fraction (3.7 percent) of all credit market instruments.[91]

company commercial paper totaled $127.6 billion compared with $11,931.4 billion of total credit market instruments outstanding for these entities.

91 According to the Federal Reserve Flow of Funds data as of March 31, 2012, commercial paper outstanding was $504.2 billion compared with $13,689.8 billion of total credit market instruments

Moreover, financial institutions use of commercial paper has declined dramatically from $1,125.8 billion at the end of 2008 to $507.8 billion at the end of 2011. This reduction of over 50 percent is consistent with regulator efforts to encourage financial institutions to reduce their reliance on short-term wholesale financing.[92] If the amount of capital available for financial commercial paper should experience a further incremental decline because of a reduction in demand from money market funds as a result of reforms, financial institutions, by their very nature, are well suited to identify alternate mechanisms for short-term funding.

Some concerns have been raised about the effect of reforms on municipal financing by money market funds. In terms of the overall market, as Panel C of Table 7 shows, money market funds hold approximately nine percent of outstanding municipal debt securities. Since 2008, money market funds have decreased their holdings of municipal debt by 40 percent or $198 billion.[93] Other types of mutual funds have absorbed much of this decrease, increasing their holdings by 42 percent or $207.8 billion. Depository institutions have increased their funding of municipal issuers by $85.3 billion as investors have shifted their assets away from money market funds into bank deposit accounts. Life insurance companies have almost tripled their municipal securities holdings from $47.1 billion at the end of 2008 to $119.6 billion at March 31, 2012. Other mutual funds increased their holdings of municipal securities during this time period by $173.7 billion or 44.6 percent.

Since the end of 2008, municipal issuers were still able to increase aggregate borrowings by four percent by the end of 2011 despite the fact that money market funds have reduced their exposure to municipal debt investments. Municipalities were able to fill the gap by accessing other sectors. To make their issues attractive to alternative lenders, municipalities had to lengthen the terms of some of their debt offers. Most municipal debt held by money market funds are variable rate demand notes ("VRDNs"), in which long-term municipal bonds are transformed into short-term instruments through the use of third-party credit and/or liquidity enhancement, such as letters of credit and standby bond purchase agreements, from financial institutions. Declines in the creditworthiness of these credit and liquidity enhancement providers have reduced the amount of

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outstanding for these institutions.

92 *See* 2012 FSOC Annual Report, http://www.treasury.gov/initiatives/fsoc/Documents/2012%20Annual%20Report.pdf, at 55-56, 66 (showing substantial declines in domestic banking firm's reliance on short-term wholesale funding compared with deposit funding). The Basel III liquidity framework also proposes requirements aimed at limiting banks' reliance on short-term wholesale funding. *See* 2011 FSOC Annual Report, http://www.treasury.gov/initiatives/fsoc/Documents/FSOCAR2011.pdf, at 90 (describing Basel III's proposed liquidity coverage ratio and the net stable funding ratio).

93 Statistics on sector holdings of municipal securities and loans, and of open market paper and commercial paper come from the Federal Reserve Flow of Funds release dated June 7, 2012.

VRDNs outstanding from $371 billion in December 2011 to only $282 billion in June 2012.[94] This trend is likely to continue irrespective of changes in the money market fund industry because of potential downgrades to the financial institutions providing these services and potential bank regulatory changes, which may increase the cost of providing such guarantees.[95] Thus, even in the absence of further money market fund regulatory reforms a continued decline in issuance is likely.

Investment in commercial paper and short-term municipal securities by prime money market funds, however, will still be likely if the rate that issuers promise is higher than alternatives. This return on short-term funding, if paid to money market fund investors, in total, likely would exceed the rate on Treasury securities.

94 *See* Securities Industry and Financial Markets Association U.S. Municipal VRDO Update (June 2012), *available at* http://www.sifma.org/research/item.aspx?id=8589939397. This data has some limitations as its estimate for outstanding VRDNs in June 2012 is lower than our estimate of money market fund holdings of VRDNs from Form N-MFP as of June 30, 2012.

95 *See, e.g.*, Moody's Downgrades U.S. Muni Obligations Backed by Banks and Securities Firms with Global Capital Markets Operations (Jun. 22, 2012), *available at* http://www.moodys.com/research/Moodys-downgrades-US-muni-obligations-backed-by-banks-and-securities--PR_248937; Chris Reese, *Money Market Funds' Investments Declining*, Reuters (Oct. 24, 2011) (stating that supplies of VRDNs have been constrained and that the "decline in issuance can be attributed to low interest rates, challenges of budget shortfalls at state and local governments and knock-on effects from European banking concerns"); Dan Seymour, *Liquidity Fears May Be Overblown*, BOND BUYER (Jan. 31, 2011).

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Appendix 1 (Model A1)

The stability of money market funds to interest rate changes is analyzed using a Monte Carlo simulation. The simulation assumes that each fund invests in a mixture of three types of assets: 1) *Treasury assets* consist of cash, Treasury securities, and repos backed by Treasury securities; 2) *one-day assets* consist of non-Treasury assets that mature within one business day; and 3) *non-daily liquid assets (non-DLA)* is the residual classification for all other assets. (The sum of Treasury and one-day assets is exactly equal to the fund's DLA.) The simulation considers funds that have portfolio weights on Treasury assets that vary from 0 percent to 100 percent; portfolio weights on one-day assets that vary from 0 percent to 100 percent; and portfolio weights on non-DLA assets that vary from 0 percent to 90 percent. The portfolio weights on non-DLA assets cannot exceed 90 percent in any compliant money market fund because all money market funds are required to maintain at least ten percent of their portfolios in DLA. Including the required 30 percent WLA does not noticeable change any of the simulation results.

This simulation does not consider the effects of security defaults, and it does not consider the effects of investor redemptions.

The daily value of money market fund assets is affected by daily interest rate changes in the money market. The simulation models this relation using the three specified asset categories: Treasury assets are affected by daily changes in six-month Treasury bills; one-day assets are affected by daily changes in 1-day financial commercial paper; and non-DLA assets are affected by daily changes in 30-day financial commercial paper. Figure 1 plots these three interest rates using Bloomberg and Federal Reserve data between 1998 and 2012. The mean daily yield change for the 60-day Treasury bills, 1-day financial commercial paper, and the 30-day financial commercial paper are -0.214, -0.422, and -0.170 (all in basis points). The corresponding standard deviations of daily yield changes are 4.2, 10.3, and 7.8 (all in basis points).

It is important to understand how each of the three types of assets is affected by interest rate changes. The Treasury assets, although default-risk free, are sensitive to interest rate changes. The one-day assets are effectively immune to interest rate changes because they mature in one day. The only risk they face is the possibility of a default, which is not explicitly modeled in this simulation. The non-DLA assets are sensitive to interest rate changes. Additionally, these sensitivities are affected by the assets' WAM, which are restricted to a fixed value throughout the simulation. To

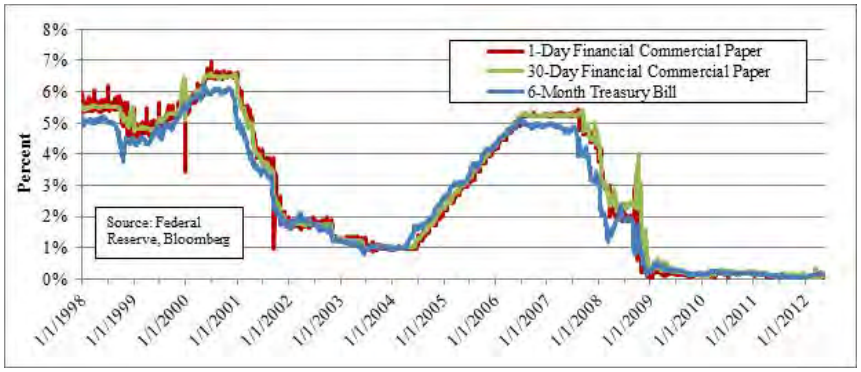


Figure 1: Daily Interest Rates, 1998–2012.

simplify this discussion, however, 60 days is set to be the fund's desired WAM.[96] Portfolios that have a low WAM are less sensitive to interest rate changes than those that have a high WAM.

The simulation starts on day 0 with a fund that has pre-specified portfolio weights, a price of exactly \$1.00, and a 60-day WAM (see footnote 96). Each day thereafter, market interest rates change for each of the portfolio's three types of assets.[97] Based on the size of the net change in rates and the fund's portfolio composition, the fund's value will change accordingly.[98] The fund is followed for one year or until it breaks the buck, whichever comes first.

The simulation is repeated for each possible portfolio in two percent increments. For example, the first simulation has the (Treasury, one-day,

[96]The second asset category (one-day assets) necessarily has a 1-day WAM, which makes it impossible to maintain a constant 60-day WAM for all possible portfolios. For example, to keep a constant 60-day WAM for the overall portfolio, the WAM of the Treasury and non-DLA assets must be increased as the portfolio shifts toward one-day assets; nevertheless, a portfolio that mostly consists of one-day assets must have a WAM that is less than 60 days because rule 2a-7 requires that all assets have maturities no greater than 397 days. For example, a portfolio with no Treasury assets, 95 percent one-day assets, and five percent non-DLA assets has a 60-day WAM only if the WAM of the non-DLA assets were 1181 days ($60 = 0 + 0.95 \times 1 + 0.05 \times 1181$). All simulations in this memo have the portfolio's WAM set at 60 days or, if that is not possible due to the 397-day restriction, the largest possible value.

[97]The simulation randomly chooses a date between 1998 and 2012, and it uses the interest rate changes for each of the three interest rate series on that same day. This is done as a control for the natural correlation that exits between the three interest rate series.

[98]The effect of interest rate changes on prices can be estimated using the following relationship: $\text{Price}_t = \text{Price}_{t-1} - \frac{(\text{change in yield}) \times \text{WAM}}{365 \times 10000}$.

non-DLA) portfolio weights set at (100%, 0%, 0%); the second simulation has portfolio weights set at (98%, 2%, 0%); the tenth simulation has portfolio weights set at (82%, 18%, 0%); and the final simulation has portfolio weights set at (0%, 10%, 90%).

This is repeated 60,000 times. For each set of portfolio weights, the estimated probability of breaking the buck is the quotient of the total number of times the shadow price falls below \$0.995 and 60,000. For example, if the buffer is depleted 300 times for a particular set of portfolio weights, the probability of breaking the buck for that portfolio is estimated to be 0.5 percent $= \frac{300}{60000}$. Because the WAM of each portfolio is kept at 60 days—the maximum WAM permitted by rule 2a-7—the simulation provides an upper bound to the interest rate sensitivity of the overall portfolio.

Appendix 2 (Model A2)

U.S. money market funds are open-end investment companies that are registered under the Investment Company Act of 1940. The principal regulation behind money market funds is rule 2a-7 under the Investment Company Act, which was promulgated in 1983 and most recently amended in 2010.

A mutual fund chooses whether or not to comply with rule 2a-7. A fund that chooses to do so may represent itself as a money market fund, rather than, for example, an ultra-short-term bond fund. All other funds are prohibited from referring to themselves as money market funds.

Under rule 2a-7, a money market fund must satisfy constraints on portfolio holdings related to liquidity, maturity, and portfolio composition, as well as, satisfy a number of additional requirements. These requirements are designed to make money market funds more resilient to certain short-term market risks, and to provide greater protections for investors in the event that a money market fund is unable to maintain a stable price per share.

The portfolio constraints are as follows:

- *Liquidity.* A money market fund (MMF) must have at the time it acquires any security daily liquidity of 10.0% and weekly liquidity of 30.0% of total assets under management. Daily liquid assets are cash, U.S. Treasury securities, and securities that mature or can be sold in one day, such as repurchase agreements. Weekly liquid assets are cash, U.S. Treasury securities, certain government securities with remaining maturities of 60 days or less, and securities that mature or can be sold in five business days.

- *Maturity.* There are three maturity requirements: 1) individual securities generally can have a maximum maturity of 397 days, 2) the weighted average maturity (WAM) cannot exceed 60 days, and 3) the weighted average life (WAL) cannot exceed 120 days. The difference between WAM and WAL is that WAM is calculated using interest reset dates for floating rate securities, whereas WAL generally uses the unadjusted maturity but recognizes demand features.

- *Portfolio Composition.* Portfolio composition constraints generally require funds at the time of acquiring a first tier security to hold no more than 5.0% of total assets in any first tier issuers securities. The maximum aggregate second tier concentration limit at the time of acquiring any second tier security is 3.0%. A fund may not hold more

than 0.5% of total assets in any second tier issuers securities, and a second tier securitys maturity may not exceed 45 days. Any time a fund acquires a security, illiquid securities can comprise at most 5.0% of portfolio assets. A security is deemed to be illiquid if it cannot be sold close to its fair value within seven business days.

The 2010 amendments to rule 2a-7 also include a number of additional requirements. These include reporting portfolio holdings to the Commission on a monthly basis and stress testing. In addition, the Commission broadened affiliates options to purchase fund assets and permitted a money market fund that has broken the buck, or is at imminent risk of breaking the buck, to suspend redemptions to allow for the orderly liquidation of fund assets.

Compliant funds also are permitted to use amortized cost (AC) accounting when valuing their portfolios rather than net asset value (NAV). Using amortized cost valuation allows a money market fund to value its assets at acquisition cost, adjusting for any premium or discount over the bond's life. A fund also must calculate its mark-to-market value, which is commonly referred to as the "shadow NAV." A money market fund share also may use the penny rounding method of pricing to round its share price to $1.

The ability to price at a stable $1 is a distinguishing feature of money market funds compared to other mutual funds. Although the actual differences are more subtle than we describe here, the essential difference can be viewed from the perspective of an investor that invests $1 in two identical funds. The first is a 2a-7 compliant money market fund; the second is an ultra-short bond fund that holds exactly the same portfolio of assets.[99] To maintain a stable $1 share price, a money market fund issues new shares to reflect accrued interest income and "realized" capital gains and losses, holding the price constant at $1. Our representative investor then tracks performance by monitoring the number of shares they own. By contrast, since an ultra-short bond fund is priced at its shadow NAV, this same investor tracks performance by monitoring changes in the shadow NAV, holding the number of shares constant.

A money market fund is a portfolio of fixed income securities that faces three distinct types of risks: 1) interest rate risk, 2) credit risk, and 3) liquidity risk. The analysis in this appendix specifically addresses the first two and abstracts from liquidity risk. The objective is to understand the broad risks that a fund faces and how portfolio risk is affected by the 2010 amend-

[99] Since the two portfolios are identical, the realized returns to investors also should be the same over a sufficiently long holding period. We discuss this distinction in greater detail in Section 4.

ments to rule 2a-7. The ability to analyze liquidity risk is not contemplated here becasuse it requires data not currently available to the Commission.

Interest rate risk reflects the fact that changing market conditions cause interest rates to change. The primary economic factor that determines the level of interest rate risk is changing expectations about future inflation rates. At a fundamental level, all securities are subject to interest rate risk, including default-free U.S. Treasuries.

Money market funds also invest in securities that have default risk. In addition to requiring compensation for expectations about future market conditions, investors require an additional risk premium to compensate for the possibility that a specific borrower may default. Credit risk varies over time as the prospects for repayment change.

The third risk relates to the possibility that a fund may be forced to rapidly liquidate investments at discounts to fundamental value (e.g. fire-sale prices) to meet large-scale redemption requests. Since MMFs typically value their portfolio assets at amortized cost, fund investors transact at "prices" that, almost surely, reflect small deviations from market value. If a MMF must liquidate assets to satisfy redemption requests, the fund realizes capital gains and losses, which will affect the fund's shadow NAV and its deviations form the stable \$1 price.

Investors in MMFs have an embedded put option to sell assets for \$1. That is, since redeeming shareholders settle at amortized cost, any capital losses or liquidity discounts are borne by the remaining investors. This wealth transfer from remaining to redeeming shareholders creates an incentive to be the first to sell shares when asset values drop.

The purpose of this paper is to develop an analytic model that can be used to evaluate certain risk and return characteristics of MMFs and assess the differences between market valuations and amortized cost accounting under the regulatory regimes that existed before and after the 2010 amendments to rule 2a-7. The model does not use actual portfolio holdings, but seeks to model a representative MMF that has a risk profile that is permissible under the exceptions available in rule 2a-7. It does not model redemption activity and leaves open the question of how liquidity risk affects the pricing of MMFs.

Section 1 describes the valuation of fixed income securities. Section 2 describes the econometric approach used to estimate the stochastic evolution of interest rates and credit risk. It also describes the data used to perform these estimates and provides parameter estimates. Section 3 explains our approach to the valuation of MMFs. In Section 4, we provide Monte Carlo simulation evidence of how MMFs perform under the current regulatory

baseline and a scenario that corresponds to the pre-2010 reforms. Section 5 offers a conclusion.

1 The Valuation of Fixed Income Securities

This section describes the valuation of fixed income securities. Initial work in this area by Vasicek (1977) was extended to default free-zero-coupon bonds by Cox, Ingersoll, and Ross (CIR, 1985), and generalized to multivariate affine diffusions (see, for example, Duffie and Kan (1996)).

We assume that state variables follow independent affine processes. Loosely speaking, an affine process is one for which the instantaneous drift vector and covariance matrix have affine dependence on the current state vector X_t. We adopt this modeling framework for three reasons: 1) it provides a fully-specified model of the term structure of interest rates, 2) it accommodates credit risk in a straight-forward manner, and 3) it has closed-form solutions.

We assume that the affine processes are independent one-dimensional "CIR"diffusions, under which

$$dX_t = \kappa\left(\theta - X_t\right)dt + \sigma\sqrt{X_t}dB_t \tag{1}$$

where X_t is the instantaneous state variable, κ is the mean-reversion rate, θ is the long-run mean, σ is the standard deviation of the state variable, and B_t is a standard Brownian motion process.[100] The long-run variance of X_t is

$$\lim_{t\to\infty} var\left(X_t\right) = \frac{\sigma^2\theta}{2\kappa}. \tag{2}$$

1.1 Valuation of Zero-Coupon Default-Free Bonds

To value a default-free zero coupon bond, we make a distinction between the "physical" ("P") and risk-neutral ("N") densities. The physical density is useful for characterizing actual price behavior, while the risk-neutral density allows us to value contingent claims. Based on the assumption that the spot interest rate follows a CIR process, the physical process for the instantaneous spot rate of interest r_t is defined as:

$$dr_t = \kappa_r\left(\theta_r - r_t\right)dt + \sigma_r\sqrt{r_t}dB_t^P \tag{3}$$

[100]The instantaneous state variable will never reach zero provided that $2\kappa\theta > \sigma^2$.

where dB_t^P is a standard Brownian motion under the physical density. In the absence of arbitrage opportunities, it can be shown that the price of any contingent claim can be valued under the corresponding risk-neutral density Q, i.e.,

$$dr_t = \hat{\kappa}_r \left(\hat{\theta}_r - r_t\right) dt + \sigma_r \sqrt{r_t} dB_t^Q. \tag{4}$$

where

$$\hat{\kappa}_r = \kappa_r + \eta_r$$
$$\hat{\theta}_r = \frac{\kappa_r \theta_r}{\kappa_r + \eta_r}$$

and η_r is the market price of risk associated with the default-free rate of interest. Using an application of Ito's lemma, CIR (1985) show that the local expected return equals

$$r_t + \eta_r r_t \frac{\partial b}{\partial r} / b, \tag{5}$$

where $\eta_r r_t$ is the covariance of changes in the spot interest rate with changes in optimally invested wealth. The compensation for risk, as measured by the risk premium in Eq. (5), will be positive if λ is negative, since $\frac{\partial b}{\partial r} < 0$.

The value of a zero-coupon bond that pays \$1 at maturity is

$$b\left(t,T\right) = E_t^Q \left[\exp\left(-\int_t^T r_z \mathrm{d}z\right)\right] = e^{\bar{\alpha}_r(\tau) + \bar{\beta}_r(\tau) r_t} \tag{6}$$

where $\bar{\alpha}\left(\tau\right)$ and $\bar{\beta}\left(\tau\right)$ are coefficients that only depend on $\tau = T - t$. The explicit solutions to $\bar{\alpha}\left(\tau\right)$ and $\bar{\beta}\left(\tau\right)$ are given below:

$$\bar{\beta}_r\left(\tau\right) = \frac{2\left(e^{\gamma_r \tau} - 1\right)}{\left(\gamma_r + \hat{\kappa_r}\right)\left(e^{\gamma_r \tau} - 1\right) + 2\gamma_r}$$
$$\bar{\alpha}_r\left(\tau\right) = \frac{2\hat{\kappa}_r \hat{\theta}_r}{\sigma_r^2} log\left[\frac{2\gamma_r e^{(\hat{\kappa}_r + \gamma_r)\tau/2}}{\left(\gamma_r + \hat{\kappa_r}\right)\left(e^{\gamma_r \tau} - 1\right) + 2\gamma_r}\right]$$
$$\gamma_r = \sqrt{\hat{\kappa}_r + 2\sigma_r^2}$$

1.2 Valuation of Zero-Coupon Bonds with Credit Risk

Next we determine the value of a risky zero-coupon bond that provides for a fractional recovery of face value equal to ω. Introducing credit risk requires

that we specify the "physical" intensity rate density process. We assume that the instantaneous intensity rate follows an independent CIR process,

$$d\lambda_t = \kappa_\lambda \left(\theta_\lambda - r_t\right) dt + \sigma_\lambda \sqrt{\lambda_t} dB_t^P, \tag{7}$$

and has a risk-neutral specification defined in an analogous manner to Eq. (4). Under the intensity density, the time t conditional risk-neutral probability of survival to a future time T is

$$p\left(t,T\right) = E_t^Q\left[\exp\left(-\int_t^T \lambda_z \mathrm{d}z\right)\right] = e^{\bar{\alpha}_\lambda(\tau)+\bar{\beta}_\lambda(\tau)\lambda_t}. \tag{8}$$

Following Duffie and Singleton (2003), let $1_{[\tau>s]}$ take the value 1 if there has been no default prior to s where $\tau \in [t,s)$. They show that the price of a defaultable zero-coupon bond equals

$$d\left(t,T\right) = d_0\left(t,T\right) + \omega E_t^Q\left[\exp\left(-\int_t^\tau r_s ds\right) 1_{[\tau\leq T]}\right] \tag{9}$$

where

$$d_0\left(t,T\right) = E_t^Q\left[\exp\left(-\int_t^T r_s ds\right) 1_{[\tau>T]}\right]. \tag{10}$$

The first term in Eq. (9) is the value of the survival contingent payment and the second term is the present value of the recovered proceeds contingent on a default occurring prior to maturity. Lando (1988) has shown that $d_0\left(t,T\right)$ is valued as

$$\begin{aligned} d_0\left(t,T\right) &= E_t^Q\left[\exp\left(-\int_t^T \left(r_s+\lambda_s\right) ds\right)\right] \\ &= E_t^Q\left[\exp\left(-\int_t^T r_s ds\right)\right] E_t^Q\left[\exp\left(-\int_t^T \lambda_s ds\right)\right] \\ &= b\left(t,T\right) p\left(t,T\right) \end{aligned}$$

The second line follows because, by assumption, r_t and λ_t are uncorrelated; the third line simply reflects the definitions of $b\left(t,T\right)$ and $p\left(t,T\right)$.

The solution to the second term in Eq. (9) is

$$\omega E_t^Q\left[\exp\left(-\int_t^\tau r_s ds\right) 1_{[\tau\leq T]}\right] = \omega \int_t^T b\left(t,u\right) \pi^*\left(t,u\right) du \tag{11}$$

where

$$\pi^*\left(t,u\right) = -\frac{d}{du} p\left(t,u\right) = p\left(t,u\right) \lambda\left(u\right) \tag{12}$$

Although not available in closed-form, the solution to the integration in Eq. (11) is readily calculated numerically using recursive adaptive Simpson quadrature.

2 Estimation of the Stochastic Properties of Interest Rate and Credit Risk Processes

Parameter estimates of the default-free rate of interest and the intensity rate process are estimated with a Kalman filter. This approach is particularly useful when, as is the case here, the underlying state variables are unobservable. The Kalman filter employs a recursive algorithm that exploits the theoretical affine relation between the physical and risk-neutral densities. This recursion allows us to infer the underlying state variables of interest along with the underlying parameters of the distributions.

Estimation begins by specifying a system of measurement and transition equations for the unobserved state variables under the assumption that it follows a CIR diffusion. The idea is to start with a series of observable bond yields that are measured with error, possibly due to differences in the bid and ask prices. Since these yields depend on the unobserved state variables (e.g., the spot rate of interest), the Kalman filter separates the state variables from the "noise" using a recursive forecasting procedure.

The algorithm begins with a set of initial parameter values and an initial estimate of the accuracy of the initial parameters. Using these starting values, we infer the value of the measurement equation. The linearity assumption underlying the Kalman filter permits the calculation of the conditional moments of the measurement equation. The algorithm then compares the predictions to the observed values. This allows us to update our inferences about the current value of the transition system. These updated values are then used to predict the subsequent values of the state variables. This procedure is repeated for each day in our sample period, which allows us to construct a time series of estimates of the underlying state variables. This implicitly creates a likelihood function, which can be treated as an objective function to estimate the parameters using maximum likelihood estimation.

2.1 Estimation of the Process for the Default-Free Rate of Interest

The data used to estimate the parameters that characterize the dynamics of the default-free rate of interest consist of a time series of $T \times M$ zero-coupon yields with

$$y_{t,m} = -\frac{\ln\left(P_{t,m}\right)}{\tau_{t,m}} \tag{13}$$

for $t = 1, \cdots, T$, $m = 1, \cdots, M$, and where $y_{t,m}$ is the yield on a zero-coupon bond with price $P_{t,m}$ and years to maturity $\tau_{t,m}$. We use yields

from U.S. Treasury securities that have 30, 90, 120, 360, and 720-days to maturity. Prices are observed on a daily basis over the period January 4, 2000 through March 22, 2012.

2.1.1 The measurement equation

The measurement equation that links the observed yields to the theoretical yields (see Eq. (6)) is defined as follows:

$$y_{t,m} = -\frac{1}{\tau_m}\bar{\alpha}_r\left(\tau_m\right) - \frac{1}{\tau_m}\bar{\beta}_r\left(\tau_m\right) r_t + e_{t,m} \tag{14}$$

where the measurement error $e_{t,m}$ is assumed to be Normally distributed, i.e., $e_{t,m} \sim N\left(0, h_t^2\right)$. For each day t, this can be expressed as

$$y_t = A_t + B_t r_t + e_t \tag{15}$$

where y_t is $M \times 1$, e_t is $M \times 1$, $A_t = \left(\bar{\alpha}_r\left(\tau_1\right)/\tau_1, \cdots, \bar{\alpha}_r\left(\tau_M\right)/\tau_M\right)$, and $B_t = \left(\bar{\beta}_r\left(\tau_1\right)/\tau_1, \cdots, \bar{\beta}_r\left(\tau_M\right)/\tau_M\right)$, The measurement error vector is assumed to be Normally distributed such that $e \sim N\left(0, H\right)$ where e is the $T \times 1$ error vector such that

$$H = \begin{bmatrix} h_1^2 & 0 & \dots & 0 \\ 0 & h_1^2 & \dots & 0 \\ \vdots & \vdots & \ddots & \dots \\ 0 & 0 & \dots & h_T^2 \end{bmatrix}.$$

2.1.2 The transition equation

The transition equation characterizes the evolution of the state vector r_t over time. It also relies on the assumption that r_t is Normally distributed. Since, under a CIR process, r_t follows a non-central χ^2 distribution, this condition is violated.

Ball and Torous (1996) show that, over small time intervals, diffusions arising from stochastic differential equations behave like Brownian motion. As a result, the assumption that r_t can be approximated by a Normal distribution is sensible, even if r_t is assumed to follow a non-central χ^2 distribution. For estimation purposes, we calculate the conditional mean and variance of r_t under the non-central χ^2 distribution as:

$$r_t \sim N\left(\mu\left(r_t\right), h_\epsilon^2\right) \tag{16}$$

where $\Delta t = \frac{1}{360}$ and

$$\begin{aligned} \mu(r_t) &= \theta_r\left(1 - e^{-\kappa_r \Delta t}\right) + e^{-\kappa_r \Delta t} r_{t-1} \\ h_\epsilon^2 &= \frac{\theta_r \sigma_r^2}{2\kappa_r}\left(1 - e^{-\kappa_r \Delta t}\right)^2 + \frac{\sigma_r^2}{\kappa_r}\left(e^{-\kappa_r \Delta t} - e^{-2\kappa_r \Delta t}\right). \end{aligned}$$

Based on this approximation, the transition equation is described as follows:

$$r_t = \mu(r_t) + \epsilon_t \tag{17}$$

where $\epsilon_t \sim N\left(0, h_t^2\right)$. Given the specifications of the measurement and transition systems, the Kalman filter algorithm is used to estimate a sequence of forecasts and updates of the state vector. The associated variance and parameter estimates are obtained via maximum likelihood estimation.

2.1.3 Sample Characteristics

Panel A of Table 1 depicts the summary statistics for U.S. Treasury yields over the sample period. The mean values range from 1.751% for 30-day yields to 2.3674% for 720-day yields with corresponding medians of 1.21% to 2.04%. Figure 1 illustrates the U.S. Treasury yield curve from January 2000 through March 2012. As you look at the figure, the leading axis represents the evolution of yields over time, while moving from front to back depicts different maturities (shorter maturities are closest to the leading edge).

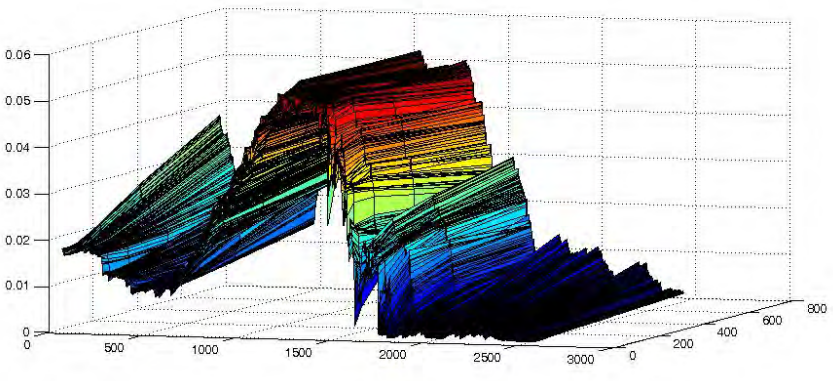


Figure 1: U.S. Treasury yield curve from January 2000 through March 2012.

2.1.4 Parameter Estimates

Panel A of Table 2 presents parameter estimates for the default-free rate of interest. The instantaneous spot rate of interest has an elastic force of 1.3894 that causes the spot-rate of interest r_t to revert to its long-run mean of 0.87%. The standard error for the estimate of κ_r indicates there is significant mean-reversion in the default-free rate of interest. The spot rate r_t has an annualized volatility of 8.07%. Based on Eq. (2) and the parameters estimates in Panel A of Table 2, the spot rate of interest has a long-term standard deviation equal to 0.00452.

To provide some indication of the speed at which the estimated mean-reversion parameter causes volatility to revert to the long-run mean θ, we use κ_r to infer the spot interest rate's "half-life." The half-life is defined as the time required for the expected future spot interest rate to revert halfway to the long-run mean. The half-life is determined by finding the date, t_s, for which

$$E\left(r_{t_s}|r_t\right) = \frac{1}{2}\left(r_t + \theta_r\right) \tag{18}$$

Following Cox, Ingersoll, and Ross (1985), the estimate for the expected future spot interest rate is given by

$$E\left(r_{t_s}|r_t\right) = r_t e^{-\kappa_r(t_s-t)} + \theta_r\left(1 - e^{-\kappa_r(t_s-t)}\right) \tag{19}$$

Examination of Equations (18) and (19) indicates that the half-life is determined by setting $e^{-\kappa_r \tau}$ equal to one-half and solving for τ. Given that κ_r equals 1.3894, the expected time for an arbitrary spot rate of r_t to revert halfway to its long-run mean is 0.50 years.

The default-free rate of interest has a market price of risk equal to -0.3748. To provide some intuition for its economic importance, we estimate the associated risk premium from Eq. (5), i.e., $\eta_r r_t \frac{\partial b}{\partial r}/b = r_t \hat{\beta}_r(\tau)$. Assuming the spot rate of interest rate equals its long-run mean of 0.87%, the annualized risk-premium associated with default-free bonds is 17.6 basis point.

2.2 Estimation of the Process for the Intensity Rate

The parameters for the intensity process are estimated in an analogous manner using 30, 90, and 120-day credit spreads. The credit spread is calculated as the difference between the maturity-matched yields for AA Financial Commercial Paper and U.S. Treasuries securities. Credit spreads are used to estimate the process for the spot intensity rate because they filter out contemporaneous information about the spot rate of interest.

2.2.1 Sample Characteristics

Panel B of Table 1 depicts the summary statistics for credit spreads over the sample period. Unlike the yields for Treasuries, the mean and median credit spreads are not monotonically increasing with maturity. Mean values range from 0.2947% for 30-day spreads to 0.3451% for 90-day spreads with corresponding standard deviations of 0.4353% to 0.4626%. Note that the means are approximately twice the size of the median credit spreads. As can be seen in Figure 2, this is largely an implication of including the 2008 financial crisis in the estimation period. When data is skewed, a more representative measure of the long-run credit spread is the median. The median values respectively range from 0.13% to 0.17% for 30-day amd 90-day credit spreads.

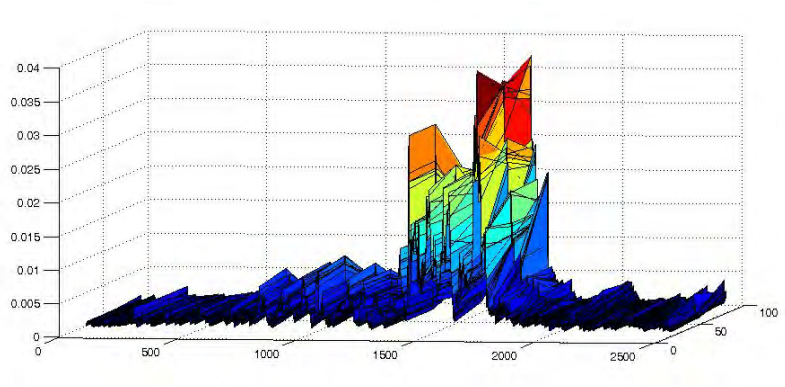


Figure 2: AA financial commercial paper credit spread curve from January 2000 through March 2012.

Figure 3 illustrates the credit spread curves in the post-Financial Crisis period (March 2009 through March 2012).

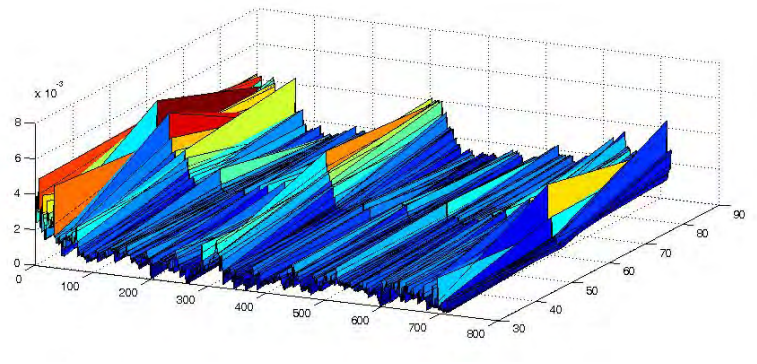


Figure 3: AA financial commercial paper credit spread curve from March 2009 through March 2012.

2.2.2 Parameter Estimates

Panel B of Table 2 indicates that the intensity rate process has a mean-reversion factor of 1.7632 that causes the spot intensity rate λ_t to revert to the long-run mean of 0.14%. The spot intensity rate λ_t has a volatility rate of 3.72%. Given that κ_λ equals 1.7632, the expected time for an arbitrary spot rate of λ_t to revert halfway to its long-run mean is 0.39 years.

The intensity rate has a market price of risk (η_λ) equal to -1.4454. This implies that the corresponding risk premium is 22 basis points when Eq. (5) is evaluated at its long-run mean of 0.14%.

3 Valuation of Money Market Funds

A MMF is a portfolio of fixed income securities. At time t, the net asset value (NAV) of a fund is the market value of its assets

$$MMF_t = \sum_{s=t+1}^{T} \left(m\left(t,s\right) b\left(t,s\right) + n\left(t,s\right) d\left(t,s\right) \right) \tag{20}$$

where $m\left(t,s\right)$ is the number of units of default-free zero-coupon bonds ($b\left(t,s\right)$) with maturity in s days and $n\left(t,s\right)$ is the number of units of risky zero-coupon bonds ($d\left(t,s\right)$) with maturity in s days. The MMF has an associated duration defined as:

$$D_t = \sum_{s=t+1}^{T} s \times \left(m\left(t,s\right) b\left(t,s\right) + n\left(t,s\right) d\left(t,s\right) \right) / MMF_t. \tag{21}$$

Each MMF has a specific risk-return profile that is determined by the duration of the portfolio and the mix of risky and default-free securities. We assume that we can approximate the investment strategy of a fund's advisor by selecting a target duration and the mix of risky and default-free securities. The idea is to build a parsimonious model that has the ability to capture the risk-return dynamics of the underlying portfolio.

We establish the initial portfolio holdings at time 0 by choosing a target duration, D^*, and the proportion of default-free bonds, ϕ. This is tantamount to assuming that the advisor adopts a particular style and maintains this investment philosophy over the fund's life. It ignores, for example, the possibility that a manager may endogenously respond to risk by changing the mix and duration of securities to mitigate certain exposures.

3.1 Initial Portfolio

To calibrate the initial state of the fund, we choose the number of maturities $\hat{T}$ so that the calculated duration matches the target duration. That is, choose $\hat{T}$ such that

$$\hat{T} = min\left\{\tau : |D^* - D_0(\tau)| = 0, \tau = 1, 2, \cdots, \infty\right\}, \tag{22}$$

subject to the constraints that the number of default-free and risky bonds reflect the proportion ϕ, i.e.,

$$\begin{aligned} m(t,s) &= W\phi/\hat{T}, \forall s, 1, \cdots, \hat{T}, \\ n(t,s) &= W(1-\phi)/\hat{T}, \forall s, 1, \cdots, \hat{T}, \end{aligned}$$

and where W is a normalizing constant that sets the initial value of the MMF to \$1.[101]

The time 0 value of the MMF is

$$MMF_0 = \sum_{s=1}^{\hat{T}} W\hat{T}^{-1}\left(\phi b(t,s) + (1-\phi)\, d(t,s)\right) \tag{23}$$

with duration

$$D_0 = \sum_{s=1}^{\hat{T}} sW\hat{T}^{-1}\left(\phi b(t,s) + (1-\phi)\, d(t,s)\right)/MMF_0. \tag{24}$$

[101] The requirement that the number of default-free and risky bonds are the same for every maturity is without loss of generality. It simply provides a convenient way to calibrate the initial portfolio holdings.

Given $\hat{T}$, the normalizing constant W is calculated as:

$$W = D_0 \left(\sum_{s=1}^{\hat{T}} \hat{T}^{-1} \left(\phi b \left(t, s \right) + \left(1 - \phi \right) d \left(t, s \right) \right) \right)^{-1}. \tag{25}$$

3.2 Money Market Valuation at Time t

This section establishes a methodology for evaluating intertemporal changes in a fund's net asset value (NAV). Throughout the paper, we use the terms market value and NAV interchangeably. Using the theoretical values of default-free and risky zero-coupon bonds, we characterize changes in the value of a portfolio of fixed income securities by simulating the time series for both the default-free rate of interest and the process that characterizes defaults.

3.2.1 Monte Carlo simulation of CIR processes

An advantage of the affine structure is that the distribution of a CIR-type process over a given time period of length τ years is distributed as a non-central Chi-Square with $d = 4\kappa\theta/\sigma^2$ degrees of freedom and non-centrality parameter $\zeta \left(X_t, \tau \right)$ where

$$\zeta \left(X_t, \tau \right) = \frac{4\kappa e^{-\kappa\tau} X_t}{\sigma^2 \left(1 - e^{-\kappa\tau} \right)}. \tag{26}$$

To simulate a time series for the spot interest rate and default intensities for days $t = 1, \cdots, \hat{T}$, we use the following algorithm:

- For day t, we estimate the instantaneous spot rate of interest, r_t by taking a draw from a non-central Chi-square distribution, $\chi^2_{nc} \left(d, \zeta \left(r_{t-1}, \tau \right) \right)$.
- The day t spot interest rate is calculated as

$$r_t = \sigma_r^2 \left(1 - e^{-\kappa_r \tau} \right) \chi^2_{nc} \left(d_r, \zeta \left(r_{t-1}, \tau \right) \right) \tag{27}$$

- We next estimate the day t instantaneous intensity rate, λ_t by taking a draw from a non-central Chi-square distribution for the spot intensity rate process, $\chi^2_{nc} \left(d, \zeta \left(\lambda_{t-1}, \tau \right) \right)$.
- The day t intensity rate is then calculated as

$$\lambda_t = \sigma_\lambda^2 \left(1 - e^{-\kappa_\lambda \tau} \right) \chi^2_{nc} \left(d_\lambda, \zeta \left(\lambda_{t-1}, \tau \right) \right) \tag{28}$$

- We assume that all bonds have a common intensity process λ_t and that defaults across different maturities are independent. To determine whether a bond with maturity s defaults on day t, we calculate the probability of default over day t using $p(t, t+1)$ from equation (8).[102] We then take a draw from the implied binomial distribution to determine whether there has been a jump to default. If a default occurs, we assume that $I_t(s) = 1$ and the value of a risky zero-coupon bonds equals the recovery rate. If there is no default, $I_t(s) = 0$. We repeat this process for all maturities $s = 1, \cdots, \hat{T}$.

3.2.2 Portfolio decisions at time t

The next step is to design an algorithm for reinvesting proceeds from maturing bonds subject to two constraints: 1) maintain the target duration D^* and 2) reinvest the proceeds to maintain a constant proportion ϕ of default-free bonds to total bonds. Let X_t denote the cash flow generated by expiring bonds at time t. Since bonds are zero coupon, the holder receives the face value of \$1 at maturity. This implies that $m(t-1, t)$ is the value of expiring default-free securities. Analogously, $n(t-1, t)$ is the value of risky zero coupon bonds conditional on no default and $n(t-1, t)\omega$ reflects the amount that is available after a default event. Taken together,

$$X_t = m(t-1, t) + n(t-1, t)((1 - I_t(0)) + \omega I_t(0)). \tag{29}$$

The proceeds X_t are reinvested in zero-coupon bonds that have a maturity T^* where T^* is the maturity that sets the portfolio duration equal to the target duration D^*.[103] Since all bonds are zero-coupon and each bond's duration equals its maturity, we solve for the maturity date that results in the current duration that is closest to the target duration. This is estimated as

$$T^* = floor((D^* - CurDur)(MMF_t/X_t)) \tag{30}$$

where $CurDur$ is the duration of the portfolio *excluding* X_t, i.e.,

$$CurDur = \sum_{s=t}^{T-1} s \times (m(t-1, s)\, b(t, s+1) + n(t-1, s)\, d(t, s+1))/MMF_t. \tag{31}$$

[102] Equation (8) provides an estimate of the probability of default under the physical density when the parameter estimates for the physical density are used in place of those for the risk-neutral density.

[103] As a practical matter, the duration of the portfolio can be reasonably approximated by reinvesting the proceeds in a zero-coupon bond that matures in $\hat{T}$.

Having identified the maturity of the bonds that will achieve the target duration, the fund advisor allocates X_t between default-free and risky zero-coupon bonds as follows:

$$m\left(t,T^*\right) = \frac{\phi X_t}{\left(\phi b\left(t,T^*\right) + \left(1-\phi\right) d\left(t,T^*\right)\right)}$$
$$n\left(t,T^*\right) = \frac{\left(1-\phi\right) X_t}{\left(\phi b\left(t,T^*\right) + \left(1-\phi\right) d\left(t,T^*\right)\right)}$$

4 Time Series Properties of Money Market Funds

This section examines the time series properties of money market funds under 1) the current regulatory "baseline" as it exists under rule 2a-7 and the 2010 amendments and 2) the regulatory regime prior to the 2010 MMF reforms. The analysis characterizes key statistics for representative MMFs that have different allocations of default-free and risky securities. At one extreme, we consider a portfolio that is equivalent to a Treasury bond portfolio and at the other, a portfolio that only holds risky securities that are designed to behave like securities with a AA bond rating.

4.1 Current Regulatory Baseline

The U.S. money market fund industry is permitted to use amortized cost accounting to value portfolio securities. This implies that fund managers are allowed to price the fund at amortized cost even though the underlying portfolio fluctuates in value as market conditions change.

Amortized cost is, loosely speaking, the accounting or book value of the security. Abstracting from default, a bond always earns its promised yield. The main difference between amortized cost and a fund's market value ("shadow price") is how income accrues.[104] Amortized cost valuations reflect the ratable accrual of interest over the bond's life. By contrast, the NAV not only reflects accrued interest but also capital gains and losses.

[104]Money market funds either distribute or accumulate income. Funds that distribute income do so through either periodic (monthly) dividends or share reinvestments. Funds that accumulate income simply add their daily income to the daily share price. Accumulating funds also have tax advantages over distributing funds in some jurisdictions. For example, by adding income to the daily share price rather than paying it out, (1) the fund shareholders' receipt of the income is postponed, and (2) the earned income is converted into capital gains, which might be taxed at a lower rate. Nearly all U.S. money market funds distribute income monthly.

Amortized cost valuation smooths but does not eliminate the price fluctuations caused by changing market conditions. In fact, as we demonstrate later, amortized cost reflects approximately the same underlying risks as the NAV. The intuition for this observation can be seen best by noting that, when bonds are held to maturity and there are no defaults, capital gains and losses net to zero. It can then be inferred that any difference between NAV and amortized cost is idiosyncratic risk that is not priced in equilibrium.

4.1.1 Results of Monte Carlo simulation

To analyze the stability of MMFs under the current baseline, we summarize the time-series properties of a representative MMF's market value (NAV), its amortized cost (AC), and the ratio of AC to NAV in Table 3. In a separate analysis derived from the same simulation, Table 4 reports the frequencies that this representative MMF penetrates specific "downside" barriers.

The table entitled, "Monte Carlo simulation parameters," describes the parameters used in our analysis. To perform the simulation exercise under the current regulatory regime, we assume that the representative MMF has a duration of sixty days (the maximum weighted average maturity current allowed under rule 2a-7). The long-run rate assumptions are the estimated parameters from Table 2. The 40% recovery rate assumption follows the convention used to price credit default swaps when the underlying reference entity is senior debt. The effective recovery rate of 80% is designed to adjust for the relatively large asset concentrations created by the algorithm used to select assets that achieve the target duration. This assumption effectively cuts the concentration to $\frac{\omega}{\omega_E}$ and carries that implicit assumption that only this fraction of the bonds actually default.[105]

Throughout the remaining analysis, we report results for portfolios that have different combinations of default-free and risky securities where ϕ defines the proportion of default-free securities held in the MMF, i.e., $\phi = \{0.00, 0.25, 0.50, 0.75, 1.00\}$.

The simulation is based on the following algorithm:

1. The starting values for r_1 and λ_1 are set equal to their long-run means of 0.87% and 0.14%, respectively.

2. Based on the simulation parameters and initial values for the spot

[105] Alternative approaches for modeling default risk are on-going and the results based on these assumptions may change.

Monte Carlo simulation parameters

Description	Regulatory Baseline	Pre-2010 Reforms
Duration	60 days	90 days
Long-run rate (θ_r)	0.87%	0.87%
Long-run rate (θ_λ)	0.14%	0.14%
Recovery rate (ω)	40.0%	40.0%
Effective recovery rate (ω_E)	80.0%	80.0%
Evaluation period	360 days	360 days

rates, solve for the number of maturities $\hat{T}$ that result in a portfolio duration of 60 days (see Eq. (21)).

3. To create a single 360-day sample path, we draw $\hat{T}+360$ spot interest and intensity rate pairs $\{r_t, \lambda_t\}$ using the procedure described in Section 3.1. The first $\hat{T}$ days are used to calculate the portfolio amortized cost; the next 360 days are used to evaluate the time-series behavior under the current regulatory baseline.

4. To facilitate the comparison of the NAV to its amortized cost (AC), we calculate AC for the initial portfolio using the following algorithm:

   (a) For each day t, calculate the values of $b(t,\hat{T})$ and $d(t,\hat{T})$ with $\hat{T}$ days to maturity using $\{r_t, \lambda_t\}$ where $t = 1, \cdots, \hat{T}$. Note that this holds the maturity for all bonds purchased on day t constant. This ensures that on day $\hat{T}$, we have bonds with maturities ranging from 1 to $\hat{T}$ days.

   (b) At day $\hat{T}$, the amortized cost $AC_{\hat{T}}$ is

$$AC_{\hat{T}} = \sum_{s=1}^{\hat{T}} m(\hat{T},s)b(s,\hat{T})e^{y_b(s,\hat{T})(\hat{T}-s)/360} + n(\hat{T},s)d(s,\hat{T})e^{y_d(s,\hat{T})(\hat{T}-s)/360}$$

   where $y_b(t,\hat{T})$ and $y_d(t,\hat{T})$ denote the corresponding yields to maturity. These are calculated as $y_x(s,\hat{T}) = ln(x(s,\hat{T})^{-1})$. We assume that amortized cost accrues at each security's yield to maturity. This is an approximation to the approach specified

in rule 2a-7, which requires straight-line amortization over the security's life.

(c) For each day $t, t = \hat{T} + 1, \cdots, \hat{T} + 360$, the portfolio NAV and AC are updated using $\{r_t, \lambda_t\}$.

(d) This is repeated for M sample paths ($M = 2,500$).

Figure 4 depicts a number of representative sample paths from our Monte Carlo simulation. Figure 4a is the market value of the fund (NAV) under the assumptions described in 4.1; Figure 4b is the amortized cost (AC) of the MMF along the same simulation paths. This figure demonstrates that the amortized cost is less volatile than the underlying market values of the securities.

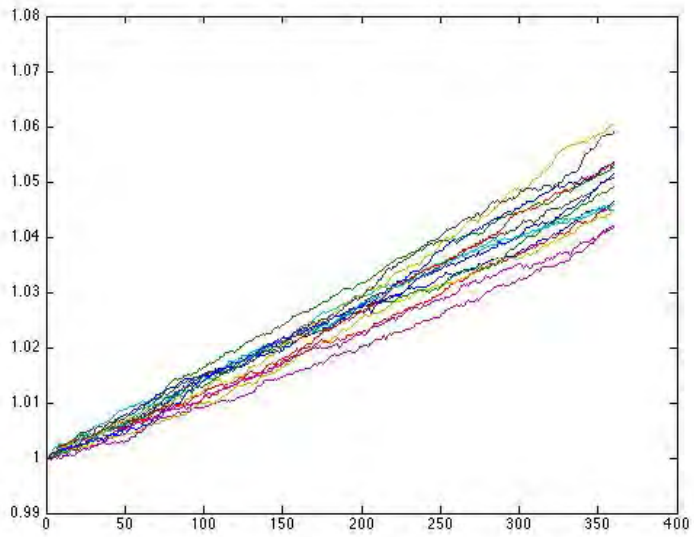
Figure 5 provides a more granular look at the differences between the NAV and AC along two representative sample paths. It can be seen that deviations from amortized cost are mean reverting. This follows directly from the mean-reverting nature of the spot interest and intensity rates.

Table 3 presents summary statistics from the Monte Carlo simulation. Panels A and B respectively report summary statistics based on buy-and-hold returns for a representative MMF at the end of a 360 day holding period and returns based on their associated amortized cost. The five columns depict results for underlying portfolios that are fully invested in securities with credit risk ($\phi = 0.00$) to those fully invested in default-free securities ($\phi = 1.00$). The mean market value returns (NAV) range from 0.92% to 0.91%. These are very close to the corresponding estimates for amortized cost which are 0.91% across all portfolios. Median estimates are slightly lower than the means but are not substantially different.

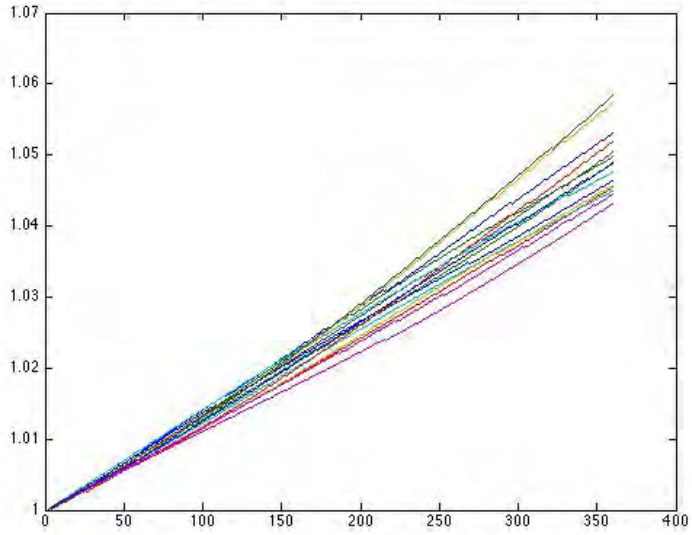
Since amortized cost tends to be relatively smooth compared to market value (see Figure 4), as expected, the the standard deviations for portfolio NAVs exceed those for each portfolio's respective amortized cost. The relatively low volatility rates for NAV returns indicate that there is relatively little times series variation in market values under the current regulatory and interest rate baseline. For example, the standard deviation of the NAV for a portfolio of default-free securities ($\phi = 01.00$) is 0.0028, which is comparable to the long-run volatility estimate (Eq. 2) of 0.00452. The NAV mean/volatility ratio for a portfolio with $\phi = 1.00$ is 3.25 (0.91/0.28).

Panel C of Table 3 presents summary statistics that characterize the distribution of the ratio of amortized cost to market value across all 360 days. Based on this analysis, we make four observations.

- The mean and median are effectively 1.00 across all portfolios. This

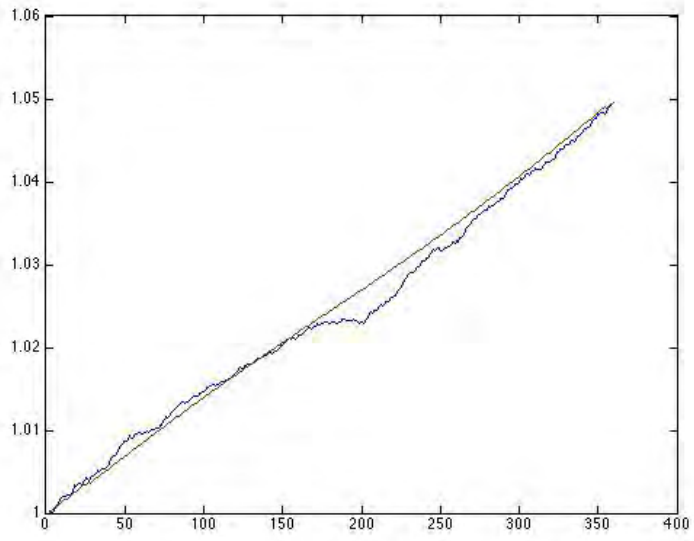


(a) NAV



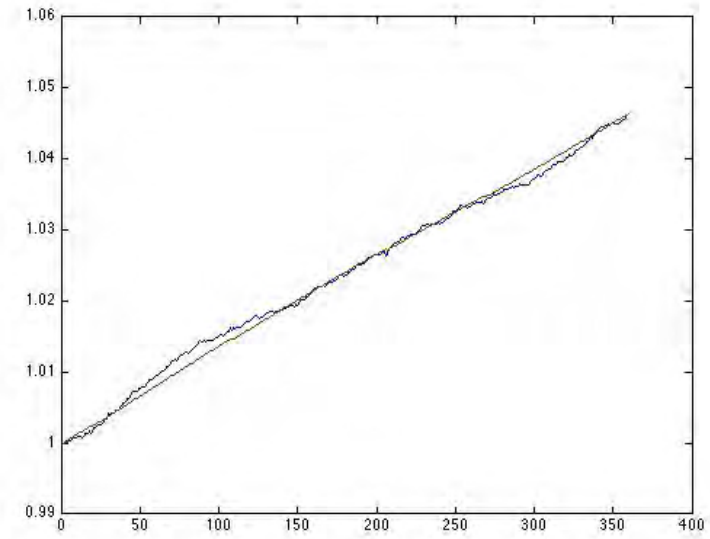
(b) Amortized Cost

Figure 4: Monte Carlo simulation results for a MMF with a duration of 60.0 days and $\phi = 25\%$ over a 360-day period.



//

(a) Path 1



(b) Path 2

Figure 5: Monte Carlo simulation results for two representative paths of a MMF with a duration of 60.0 days and $\phi = 25\%$ over a 360-day period.

confirms the fact that, over time, amortized cost closely approximately market value.

- A MMF breaks the buck if this ratio is either less than 0.9950 or greater than 1.0050. A ratio greater than 1 indicates that the fund has incurred a capital loss large enough to break the buck on the downside. Looking at Panel C, the only fund that has a large enough loss to cause it to break the buck is fully invested in securities with credit risk ($\phi = 0.00\%$). The results also indicate that this occurrence has low probability because the 1-percentile value for this portfolio is 1.008. If one assumes that position concentrations are sufficiently high to cause a fund to break the buck when a default occurs, the frequency of defaults reported in Panel C can be compared to the ex ante expected default rate. Using Eq. 6, the expected frequency of default over a year period is 0.14%, which is consistent with th observed failure rate of less than 1.00%.

- Since the maximum ratio across all funds is 0.9974, none of the funds break the buck on the upside in any of the simulation runs.

- Note that a MMF that is fully invested in default-free securities never breaks the buck on the upside or the downside. This implies that the level of interest rate risk associated with the current interest rate environment is sufficiently low that, by itself, it will not cause a fund to break the buck, which further implies that, to the extent that funds break the buck in our analysis, it largely attributable to security defaults.

One of the limitations of the statistics reported in Panel C is that they evaluate the likelihood of breaking the buck on *any* given day. The "problem" with this approach is that it understates the "true" significance of a fund breaking the buck because shadow prices are mean-reverting relative to amortized cost. As a result, even a fund that has broken the buck, tends to recover from temporary deviations. A more natural way to evaluate the impact of a fund breaking the buck is to consider whether it has broken the buck at any time over a particular holding period.

Table 4 directly addresses this issue. Panel A reports the mean time until the difference between NAV and AC falls below a particular threshold over a 360-day holding period (this can be referred to as the first passage time); Panel B reports the frequency that the difference between NAV and AC falls below a particular threshold over a 360-day holding period. Table

4 indicates that the 2010 amendments to rule 2a-7 do not eliminate the possibility of breaking the buck. For a portfolio that has 100% of its assets under management invested in securities that have credit risk, the mean time to breaking the buck is 359.889 days. If there was no chance that the fund would ever break the buck, the mean time would be 360 days. Panel B reports that the frequency this fund breaks the buck is 0.177%, which is slightly higher than the expected long-run default rate 0f 0.14%.

One of the advantages of Table 4 is that it provides additional information about the distribution of first passage times to specific barriers. For example, the first row in Panel A indicates that credit risk induces incremental volatility relative to a portfolio of default-free securities. Here one sees that the mean time until a MMF first has a NAV that falls 25 basis points below amortized cost is 333.662 days, and Panel B shows that the corresponding frequency of such an event is 13.781%.

By contrast, a MMF holding default-free securities never experiences a loss large enough to cause a deviation between NAV and AC of more than 25 basis points. this suggests that credit risk is the primary factor driving portfolio volatility. Surprisingly, in the current interest rate and regulatory environment, there is virtually no chance that a fund holding default-free securities would experience a decline in NAV relative to its amortized cost of an amount as small as 25 basis points. We evaluate the robustness of these results by considering a period that has higher volatility in Section 4.2.

4.2 Pre-2010 Regulatory Regime

One of the SEC's responses to the market events of 2008 was to propose (June 2009) and later adopt (February 2010) amendments to rule 2a-7. These amendments increased the risk-limiting conditions imposed on MMFs. Consistent with our analysis of the current regulatory baseline, we address this issue in two distinct ways. First, we consider the economic effects of shortening the weighted average maturity (WAM) from a maximum of 90 to 60 days by replicating our previous analysis using a portfolio duration of 90 days (the maximum WAM permitted before the 2010 amendments). The second is to evaluate how different combinations of risky and default-free securities alter the risk-return characteristics of MMFs.

This section provides a benchmark that allows us to evaluate the effectiveness of the 2010 reforms relative to the regulatory framework that preceded them. The only substantive modeling difference between the current regulatory baseline is that the duration is 90 days. The longer average

maturity allows funds to take on more risk, although we note that a significant majority of funds have maintained WAMs of less than 60 days since at least 1994. This is reflected in the uniformly higher rates of return in Panel A of Table 5 where it is reported that the mean buy-and-hold return across all portfolios is 0.94%. Consistent with the notion that a longer duration (WAM) allows MMFs to take on more risk, the standard deviations across different portfolios with 90-day durations range from 0.29% and 0.31% per annum. Despite the increased risk associated with 90-day durations, the actual reduction in the volatility of buy-and-hold returns is relatively small. For example, a portfolio comprised of risky assets experiences a volatility reduction of 2 basis points (31 to 29 or 6.45%). Similar to our 60-day results, median buy-and-hold returns are slightly lower than their means but are not substantially different.

Panel B of Table 5 reports that summary statistics for returns based on NAV and AC are comparable, and are qualitatively similar to the 60-day results reported in Table 3. Panel C characterizes the distribution of the ratio of amortized cost to market value for all 360 days (2,500 $\times$ 360 = 900,000 unique observations). Consistent with our 60-day results, we make three observations. First, the mean and median are effectively 1.00 across all portfolios. Second, the only fund that breaks the buck (has a maximum ratio that exceeds 1.0050) is one that is fully invested in securities with credit risk ($\phi = 0.00\%$). This occurrence has a correspondingly low probability that roughly conforms to the long-run default rate because the 1-percentile value for this portfolio is 1.014. Finally, none of the funds break the buck on the upside in any of the simulation runs.

Panel A of Table 6 reports the mean time until the difference between NAV and AC falls below a particular threshold over a 360-day holding period; Panel B reports the frequency that the difference between NAV and AC falls below a particular threshold over the same 360-day holding period. For a portfolio that has 100% of its assets invested in securities that have credit risk, the mean time to breaking the buck is 358.986 days, which is very similar to the estimate of 359.889 days for a portfolio with a 60-day duration. By contrast, the mean time until the same fund hits a 25 basis point barrier is 316.735 days, which compares to 333.662 days for a portfolio with a 60-day duration.

Panel B of Table 6 provides additional information about the distribution of NAV to AC. It reports the frequency that the difference between the NAV and AC falls below a certain threshold at some point during the year. The results are consistent with those in Panel A. The frequency that a firm breaks the buck is 0.687%, which represents a 3.89-fold increase relative

to portfolios with 60-day durations. By contrast, the frequency that the difference between the NAV and AC is at least 25 basis points is 22.115%. Comparing Panel B in Tables 4 and 6, it can be seen that longer durations increase the volatility quite a bit on a relative basis, even if the frequency that a fund breaks the buck is still quite low on an absolute basis.

4.3 Robustness analysis

This section evaluates the sensitivity of our results to an alternative economic environment that considers the effect of doubling the volatility assumptions. A high volatility regimes increases return volatility and makes it more likely that a fund will break the buck.

Tables 7 and 9 respectively present summary statistics for 360-day buy-and-hold returns under the current regulator baseline (60-day duration) and the pre-2010 reform scenario (90-day duration). As expected, mean returns are comparable to those reported in Tables 3 and 5, but standard deviations are approximately double in magnitude.

Tables 8 and 10 respectively present information about the distribution of the daily differences between NAV and AC. Consistent with the higher volatility rates, Panel A in each table shows that the expected times until the difference between NAV and AC falls below specific thresholds is lower. For example, a fund with a 60-day duration that is fully invested in risky securities has its expected first time until it breaks the buck drop from 359.889to 346.418 days. A comparable fund with a 90-day duration experiences a drop of 6.956 days (358.590-351.63). Tables 8 and 10 report similar decreases across all thresholds.

Panels B of Tables 8 and 10 also present results for the frequency that that the difference between NAV and AC drops below specific thresholds. For example, a fund with a duration of 60 days that is fully invested in risky securities finds that the frequency it is expected to break the buck increases from 0.177% to 2.090%. By contrast, the frequency for an analogous portfolio with a 90-day duration increases from 0.917% to 5.501%. Tables 8 and 10 report similar increases in the frequencies of falling below specific levels across all thresholds.

5 Conclusion

This analysis provides a theoretical model of a representative MMF to address the impact of the 2010 amendments to rule 2a-7. It develops an affine term structure model to consider the effects of interest rate and credit risk

on the risk and return characteristics of MMFs. Based on a Monte Carlo simulation analysis, we estimate summary statistics for buy-and-hold returns based on market value and amortized cost. We demonstrate four main results:

- When portfolio durations are limited to a maximum of 60 and 90 days, amortized cost closely tracks the shadow NAV.
- Deviations between amortized cost and the shadow NAV exist and frequently exceed 25 points if MMFs invest in risky securities. For example, consider a MMF that has 100% invested in risky securities that can have a duration of either 60 or 90 days. These funds respectively have deviations between NAV and AC that exceed 25 basis points 13.781% and 22.018% of the time.
- Money market funds rarely break the buck. For example, portfolios with 100% invested in risky securities and durations of 60 and 90 days respectively have deviations that exceed 50 basis points 0.177% and 0.917% of the time.
- Regardless of whether the duration is 60 or 90 days, MMFs that invest in 100% default-free securities have very little price volatility and rarely experience deviations of more than 25 basis points. In our simulations, these funds do not break the buck.

Before one can use the results of this study to make inferences about the adequacy of the 2010 amendments to rule 2a-7, it is important to understand that this analysis has two important caveats - it does not consider redemption risk, and credit risk is based on average rather than security-specific credit risk. A more complete analysis must recognize that the ability to sell shares at $1, when their market price is less than $1 provides shareholders with an implicit put option that creates an incentive to redeem early. Since the exercise of this "redemption put" is a wealth transfer from remaining to redeeming shareholders, all shareholders have incentives to redeem their shares when the fund has embedded losses because being the first to redeem increases the probability that you can avoid bearing capital losses.

Consideration of this issue requires data that is not currently available to the Commission. To address this concern, it would be useful to have market participants provide data on gross and net redemptions, the percentage of a fund that is owned by institutional investors, and the percentage of institutional investors that could be classified as "hot money."

Table 1: Summary statistics for yields of U.S. treasuries, AA-rated financial commercial paper, and the credit spread between AA-rated financial commercial paper and maturity-matched U.S. Treasury yields over the period January 2000 through January 2012.

Maturity	Mean (%)	Median (%)	Standard Deviation (%)	Minimum (%)	Maximum (%)
Panel A. U.S. Treasury yields					
30-Day	1.7451	1.21	1.6991	-0.01	5.27
90-Day	1.8221	1.29	1.7245	0.00	5.19
120-Day	1.9610	1.54	1.7512	0.02	5.33
360-Day	2.0873	1.68	1.6782	0.08	5.30
720-Day	2.3674	2.04	1.5231	0.16	5.29
Panel B. AA-rated financial commercial paper					
30-Day	2.0398	1.54	1.8076	0.02	5.42
90-Day	2.0902	1.63	1.8059	0.05	5.38
120-Day	2.1453	1.68	1.8057	0.11	5.48
Panel C. Maturity-matched credit spread					
30-Day	0.2947	0.13	0.4353	-0.07	3.84
90-Day	0.3451	0.17	0.4626	-0.05	3.52
120-Day	0.3232	0.15	0.4579	-0.02	3.73

Table 2: Kalman filter estimates of the spot interest rate and intensity rate processes. Panel A reports the parameter estimates for the spot rate of interest process ; Panel B reports parameter estimates for the intensity rate process. The parameter estimates for the physical distribution and their associated standard errors are reported in columns (1) and (2). The corresponding t-statistic are reported in column (3). The risk-neutralized parameters implied by the physical distribution are reported in column (4).

Parameter	Physical Distribution Estimate	Standard Error	t-statistic	Risk-Neutral Distribution Estimate
Panel A. Parameter estimates for the spot interest rate process, r_t				
θ_r	0.0087	0.0047	1.8511	0.0119
κ_r	1.3894	0.1706	8.1442	1.0146
σ_r	0.0807	0.0123	6.5610	0.0807
η_r	-0.3748	0.1478	-2.5359	
Observations	3,066			
Panel B. Parameter estimates for the spot intensity rate process, λ_t				
θ_c	0.0013	3.74E-05	34.7331	0.0072
κ_c	1.7632	0.0571	30.8876	0.3178
σ_c	0.0372	0.0024	15.5367	0.0372
η_c	-1.4454	0.0409	-35.356	
Observations	3,066			

Table 3: Current regulatory baseline. Summary statistics from Monte Carlo simulation. Portfolio duration is 60 days. The simulation is based on 2,500 draws.

	Proportion of fund invested in default-free securities				
Description	0.00	0.25	0.50	0.75	1.00
Panel A. Buy-and-hold return to fund at day 360 based on NAV					
Mean	0.0092	0.0092	0.0091	0.0091	0.0091
Standard Deviation	0.0029	0.0028	0.0028	0.0028	0.0028
Minimum	0.0014	0.0023	0.0033	0.0039	0.0038
1-percentile	0.0034	0.0040	0.0043	0.0043	0.0044
25-percentile	0.0071	0.0071	0.0070	0.0071	0.0071
Median	0.0088	0.0088	0.0088	0.0087	0.0087
75-percentile	0.0109	0.0109	0.0109	0.0108	0.0108
99-percentile	0.0173	0.0172	0.0171	0.0170	0.0170
Maximum	0.0221	0.0221	0.0220	0.0219	0.0218
Panel B. Buy-and-hold return to fund at day 360 based on amortized cost (AC)					
Mean	0.0091	0.0091	0.0091	0.0091	0.0091
Standard Deviation	0.0027	0.0026	0.0026	0.0025	0.0025
Minimum	0.0017	0.0027	0.0037	0.0042	0.0040
1-percentile	0.0038	0.0044	0.0046	0.0046	0.0046
25-percentile	0.0072	0.0073	0.0072	0.0072	0.0072
Median	0.0088	0.0088	0.0088	0.0088	0.0087
75-percentile	0.0108	0.0108	0.0107	0.0107	0.0106
99-percentile	0.0163	0.0162	0.0162	0.0161	0.0160
Maximum	0.0207	0.0207	0.0206	0.0205	0.0204
Panel C. Ratio of amortized cost to market value across all days					
Mean	0.9999	0.9999	0.9999	0.9999	0.9999
Standard Deviation	0.0004	0.0004	0.0004	0.0004	0.0004
Minimum	0.9974	0.9974	0.9974	0.9974	0.9974
1-percentile	0.9989	0.9989	0.9989	0.9989	0.9989
25-percentile	0.9997	0.9997	0.9997	0.9997	0.9997
Median	1.0000	1.0000	1.0000	1.0000	1.0000
75-percentile	1.0002	1.0002	1.0002	1.0002	1.0002
99-percentile	1.0008	1.0008	1.0008	1.0008	1.0008
Maximum	1.0052	1.0041	1.0031	1.0020	1.0016

Table 4: Current regulatory baseline analysis of the difference between market value and amortized cost. Portfolio duration is 60 days. Panels A and B respectively report the mean time until a threshold is reached and the corresponding frequency that the threshold is reached. The simulation is based on 2,500 draws.

	Proportion of fund invested in default-free securities				
Threshold in basis points (b.p.)	0.00	0.25	0.50	0.75	1.00
Panel A. Mean time in days for $NAV - AC$ to fall below a threshold of X b.p.					
0.25	333.662	335.464	356.996	360.000	360.000
0.30	333.662	341.006	359.889	360.000	360.000
0.35	335.240	356.414	360.000	360.000	360.000
0.40	340.391	359.889	360.000	360.000	360.000
0.45	353.032	360.000	360.000	360.000	360.000
0.50	359.889	360.000	360.000	360.000	360.000
Panel B. Frequency (%) that $NAV - AC$ falls below a threshold of X b.p.					
0.25	13.781	12.721	2.120	0.000	0.000
0.30	13.034	9.629	0.177	0.000	0.000
0.35	12.898	2.385	0.000	0.000	0.000
0.40	9.982	0.177	0.000	0.000	0.000
0.45	3.799	0.000	0.000	0.000	0.000
0.50	0.177	0.000	0.000	0.000	0.000

Table 5: Pre-2010 Amendments Analysis. Summary statistics from Monte Carlo simulation. Portfolio duration is 90 days. The simulation is based on 2,500 draws.

	Proportion of fund invested in default-free securities				
Description	0.00	0.25	0.50	0.75	1.00
Panel A. Buy-and-hold return to fund at day 360 based on NAV					
Mean	0.0094	0.0094	0.0094	0.0094	0.0094
Standard Deviation	0.0030	0.0029	0.0029	0.0028	0.0028
Minimum	0.0014	0.0028	0.0035	0.0037	0.0036
1-percentile	0.0033	0.0038	0.0042	0.0044	0.0045
25-percentile	0.0072	0.0073	0.0073	0.0073	0.0073
Median	0.0091	0.0090	0.0090	0.0091	0.0091
75-percentile	0.0113	0.0112	0.0111	0.0110	0.0110
99-percentile	0.0174	0.0172	0.0175	0.0176	0.0175
Maximum	0.0210	0.0209	0.0207	0.0205	0.0203
Panel B. Buy-and-hold return to fund at day 360 based on amortized cost (AC)					
Mean	0.0093	0.0093	0.0093	0.0093	0.0093
Standard Deviation	0.0027	0.0026	0.0025	0.0025	0.0025
Minimum	0.0014	0.0027	0.0039	0.0042	0.0043
1-percentile	0.0036	0.0043	0.0047	0.0050	0.0051
25-percentile	0.0075	0.0074	0.0075	0.0075	0.0075
Median	0.0091	0.0090	0.0090	0.0091	0.0090
75-percentile	0.0110	0.0108	0.0108	0.0108	0.0108
99-percentile	0.0161	0.0160	0.0161	0.0163	0.0162
Maximum	0.0204	0.0202	0.0200	0.0199	0.0197
Panel C. Ratio of amortized cost to market value across all days					
Mean	1.0000	1.0000	0.9999	0.9999	0.9999
Standard Deviation	0.0006	0.0006	0.0006	0.0006	0.0006
Minimum	0.9952	0.9952	0.9952	0.9952	0.9952
1-percentile	0.9982	0.9982	0.9983	0.9982	0.9982
25-percentile	0.9996	0.9996	0.9996	0.9996	0.9996
Median	1.0000	1.0000	1.0000	1.0000	1.0000
75-percentile	1.0004	1.0004	1.0004	1.0004	1.0004
99-percentile	1.0014	1.0014	1.0014	1.0014	1.0014
Maximum	1.0058	1.0048	1.0039	1.0030	1.0030

Table 6: Pre-2010 amendments analysis of the difference between market value and amortized cost. Portfolio duration is 90 days. Panels A and B respectively report the mean time until a threshold is reached and the corresponding frequency that the threshold is reached. The simulation is based on 2,500 draws.

	Proportion of fund invested in default-free securities				
Threshold in basis points (b.p.)	0.00	0.25	0.50	0.75	1.00
Panel A. Mean time in days for $NAV - AC$ to fall below a threshold of X b.p.					
0.25	318.298	326.376	353.855	359.241	359.658
0.30	321.321	342.367	358.506	360.000	360.000
0.35	327.446	354.457	359.583	360.000	360.000
0.40	342.634	358.506	360.000	360.000	360.000
0.45	354.478	359.810	360.000	360.000	360.000
0.50	358.590	360.000	360.000	360.000	360.000
Panel B. Frequency (%) that $NAV - AC$ falls below a threshold of X b.p.					
0.25	22.018	17.344	3.976	0.437	0.262
0.30	20.577	10.266	1.005	0.000	0.000
0.35	16.863	3.539	0.175	0.000	0.000
0.40	10.179	1.005	0.000	0.000	0.000
0.45	3.495	0.087	0.000	0.000	0.000
0.50	0.917	0.000	0.000	0.000	0.000

Table 7: Current regulatory baseline. Summary statistics from Monte Carlo simulation. Portfolio duration is 60 days. Volatility rates for the interest and intensity rate processes have been doubled from the baseline estimates. The simulation is based on 2,500 draws.

	Proportion of fund invested in default-free securities				
Description	0.00	0.25	0.50	0.75	1.00
Panel A. Buy-and-hold return to fund at day 360 based on NAV					
Mean	0.0091	0.0091	0.0091	0.0091	0.0091
Standard Deviation	0.0057	0.0057	0.0056	0.0056	0.0056
Minimum	-0.0042	-0.0021	-0.0006	0.0008	0.0010
1-percentile	0.0003	0.0012	0.0017	0.0021	0.0024
25-percentile	0.0052	0.0052	0.0051	0.0051	0.0051
Median	0.0076	0.0075	0.0075	0.0075	0.0076
75-percentile	0.0115	0.0114	0.0114	0.0114	0.0114
99-percentile	0.0280	0.0278	0.0276	0.0276	0.0276
Maximum	0.0506	0.0505	0.0504	0.0503	0.0503
Panel B. Buy-and-hold return to fund at day 360 based on amortized cost (AC)					
Mean	0.0090	0.0090	0.0090	0.0090	0.0090
Standard Deviation	0.0054	0.0053	0.0052	0.0052	0.0052
Minimum	-0.0041	-0.0020	0.0000	0.0014	0.0024
1-percentile	0.0005	0.0012	0.0020	0.0026	0.0029
25-percentile	0.0054	0.0054	0.0054	0.0054	0.0053
Median	0.0077	0.0076	0.0076	0.0076	0.0076
75-percentile	0.0114	0.0113	0.0113	0.0113	0.0112
99-percentile	0.0261	0.0260	0.0262	0.0266	0.0263
Maximum	0.0487	0.0486	0.0486	0.0485	0.0484
Panel C. Ratio of amortized cost to market value across all days					
Mean	1.0000	1.0000	1.0000	1.0000	1.0000
Standard Deviation	0.0008	0.0008	0.0008	0.0008	0.0008
Minimum	0.9936	0.9936	0.9936	0.9937	0.9937
1-percentile	0.9976	0.9976	0.9976	0.9976	0.9976
25-percentile	0.9996	0.9996	0.9996	0.9996	0.9996
Median	1.0000	1.0000	1.0000	1.0000	1.0000
75-percentile	1.0004	1.0004	1.0004	1.0004	1.0004
99-percentile	1.0018	1.0018	1.0018	1.0018	1.0017
Maximum	1.0084	1.0068	1.0057	1.0057	1.0057

Table 8: Current regulatory baseline analysis of the difference between market value and amortized cost. Portfolio duration is 60 days. Volatility rates for the interest and intensity rate processes have been doubled from the baseline estimates. Panels A and B respectively report the mean time until a threshold is reached and the corresponding frequency that the threshold is reached. The simulation is based on 2,500 draws.

	Proportion of fund invested in default-free securities				
Threshold in basis points (b.p.)	0.00	0.25	0.50	0.75	1.00
Panel A. Mean time in days for $NAV - AC$ to fall below a threshold of X b.p.					
0.25	324.339	326.281	337.833	350.929	351.215
0.30	330.340	334.022	352.687	356.991	357.139
0.35	332.903	340.812	357.792	359.073	359.073
0.40	334.907	351.151	359.247	359.592	359.592
0.45	338.189	357.045	359.661	359.687	359.687
0.50	346.418	359.215	359.837	359.837	359.743
Panel B. Frequency (%) that $NAV - AC$ falls below a threshold of X b.p.					
0.25	19.256	18.293	12.385	5.996	5.733
0.30	15.361	13.567	4.158	1.926	1.882
0.35	13.873	9.803	1.357	0.613	0.613
0.40	12.910	4.814	0.525	0.263	0.263
0.45	4.160	1.663	0.219	0.175	0.175
0.50	2.090	0.525	0.088	0.088	0.088

Table 9: Pre-2010 Amendments Analysis. Summary statistics from Monte Carlo simulation. Portfolio duration is 90 days. Volatility rates for the interest and intensity rate processes have been doubled from the baseline estimates. The simulation is based on 2,500 draws.

	Proportion of fund invested in default-free securities				
Description	0.00	0.25	0.50	0.75	1.00
Panel A. Buy-and-hold return to fund at day 360 based on NAV					
Mean	0.0093	0.0093	0.0093	0.0092	0.0092
Standard Deviation	0.0055	0.0055	0.0054	0.0054	0.0054
Minimum	-0.0016	-0.0004	0.0006	0.0009	0.0007
1-percentile	0.0012	0.0017	0.0022	0.0023	0.0023
25-percentile	0.0054	0.0054	0.0054	0.0054	0.0054
Median	0.0079	0.0079	0.0079	0.0079	0.0079
75-percentile	0.0115	0.0115	0.0115	0.0115	0.0114
99-percentile	0.0269	0.0268	0.0267	0.0265	0.0264
Maximum	0.0504	0.0502	0.0500	0.0499	0.0497
Panel B. Buy-and-hold return to fund at day 360 based on amortized cost (AC)					
Mean	0.0092	0.0092	0.0092	0.0092	0.0092
Standard Deviation	0.0048	0.0047	0.0047	0.0047	0.0046
Minimum	-0.0008	0.0004	0.0016	0.0029	0.0033
1-percentile	0.0020	0.0027	0.0033	0.0036	0.0036
25-percentile	0.0059	0.0058	0.0058	0.0058	0.0058
Median	0.0081	0.0080	0.0079	0.0079	0.0079
75-percentile	0.0112	0.0112	0.0112	0.0111	0.0112
99-percentile	0.0251	0.0250	0.0249	0.0249	0.0251
Maximum	0.0431	0.0429	0.0428	0.0426	0.0424
Panel C. Ratio of amortized cost to market value across all days					
Mean	0.9999	0.9999	0.9999	0.9999	0.9999
Standard Deviation	0.0013	0.0013	0.0013	0.0013	0.0013
Minimum	0.9907	0.9906	0.9906	0.9906	0.9906
1-percentile	0.9957	0.9957	0.9957	0.9957	0.9957
25-percentile	0.9993	0.9993	0.9993	0.9993	0.9993
Median	1.0001	1.0001	1.0001	1.0001	1.0001
75-percentile	1.0007	1.0007	1.0007	1.0007	1.0007
99-percentile	1.0031	1.0030	1.0030	1.0030	1.0030
Maximum	1.0096	1.0086	1.0076	1.0075	1.0075

Table 10: Pre-2010 amendments analysis of the difference between market value and amortized cost. Portfolio duration is 90 days. Volatility rates for the interest and intensity rate processes have been doubled from the baseline estimates. Panels A and B respectively report the mean time until a threshold is reached and the corresponding frequency that the threshold is reached. The simulation is based on 2,500 draws.

	Proportion of fund invested in default-free securities				
Threshold in basis points (b.p.)	0.00	0.25	0.50	0.75	1.00
Panel A. Mean time in days for $NAV - AC$ to fall below a threshold of X b.p.					
0.25	284.147	289.368	301.129	307.889	308.995
0.30	305.075	314.245	326.997	330.003	330.252
0.35	320.130	332.605	341.240	343.573	343.637
0.40	332.720	345.583	349.466	350.927	350.724
0.45	343.445	352.251	355.379	355.641	355.531
0.50	351.634	355.800	357.601	357.606	357.606
Panel B. Frequency (%) that $NAV - AC$ falls below a threshold of X b.p.					
0.25	40.275	37.394	32.089	28.946	28.291
0.30	30.452	25.999	19.908	18.075	18.009
0.35	22.331	16.241	11.722	10.544	10.413
0.40	15.586	9.103	6.680	5.959	6.090
0.45	9.758	5.043	3.405	3.143	3.209
0.50	5.501	2.881	1.965	1.965	1.965