An Evaluation of Money Market Fund Reform Proposals*

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Abstract

We analyze the leading reform proposals to address the structural vulnerabilities of money market mutual funds (MMFs). We take the main goal of MMF reform to be safeguarding financial stability. Specifically, MMF reforms should reduce the ex ante incentives for MMFs to take excessive risks and increase the ex post resilience of MMFs to system-wide runs. We argue that requiring MMFs to have capital buffers best accomplishes these goals. Capital provides MMFs with loss absorption capacity, lowering the probability that a MMF suffers losses large enough to trigger a run, and reduces ex ante incentives to take excessive risks. Using a methodology that is standard in bank capital regulation, we estimate that a capital buffer of 3% to 4% would reduce the probability of breaking the buck to 0.1%, the threshold commonly used in bank capital models. The riskiness of this capital buffer would be comparable to the riskiness of the long-term debt of an A-rated or BBB-rated financial firm. This implies that MMF capital would earn roughly 1.25% more than riskless short-term debt and MMF shareholders would earn 0.05% less in exchange for the protection provided by this capital. In summary, capital buffers would yield significant financial stability benefits, while maintaining the current fixed net asset value (NAV) structure of MMFs. Other leading reform alternatives such as converting MMFs to a floating NAV will be less effective in safeguarding financial stability. In practice, MMFs with a floating NAV would have all of the same vulnerabilities as MMFs have today. Introducing floating NAVs would not alter incentives for risk taking nor would it reduce incentives to run—investors would still attempt to exit early before illiquid assets have to be sold. Thus, we suggest that regulators adopt capital buffers for MMFs.

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I. Introduction

This paper evaluates the leading reform proposals to address the structural vulnerabilities of money market mutual funds (MMFs). These vulnerabilities were exposed during the global financial crisis starting in 2007 and culminating in the fall of 2008 when Lehman Brothers failed and the Reserve Primary Fund "broke the buck." This triggered widespread runs on prime MMFs, which led to unprecedented levels of government support for MMFs specifically and for money markets more generally, including the Treasury Department's temporary guarantee of outstanding MMF balances and a variety of Federal Reserve liquidity programs. While the Securities and Exchange Commission (SEC)—the primary regulator of MMFs—has been considering structural MMF reforms since 2010, the SEC has thus far failed to act. Recently, however, the Financial Stability Oversight Council (FSOC), with authority granted to it under the Dodd-Frank Act, has proposed that it "recommend that the SEC proceed with much needed structural reforms." The reform options include: requiring MMFs to float reported net asset values (Alternative 1); requiring MMFs to have a 1% capital buffer combined with a "minimum balance at risk" (MBR) provision whereby investors cannot immediately redeem all of their shares (Alternative 2); or requiring MMFs to have a 3% capital buffer (Alternative 3).[1]

In evaluating these reform proposals, we take the principal objective to be safeguarding financial stability while preserving the essential services that MMFs provide to savers. As we explain further below, prime MMFs, which mainly invest in paper issued by financial institutions, pose the principal threat to financial stability. Because they function mainly as intermediaries between savers and the financial system, runs on prime MMFs could cause system-wide runs on financial institutions. In order to protect the financial system, money market fund regulation should attempt to both reduce the ex ante incentives of MMFs to take risk and increase the ex post ability of MMFs to absorb losses without setting off runs. Given the central role that prime MMFs play in channeling funds to the financial system, unless otherwise noted, our analysis of reform proposals pertains largely to prime MMFs.

[1] See http://www.treasury.gov/initiatives/fsoc/Documents/Proposed Recommendations Regarding Money Market Mutual Fund Reform - November 13, 2012.pdf.

We argue that robust capital buffers best accomplish the goals of reform.[2] We argue that capital buffers should be in the range of 3% to 4% of "risk-weighted" assets—whether in the form of capital provided by MMF sponsors or the issuance of a subordinated share class. For instance, commercial paper would receive a risk weight of 100% and Treasury bills would receive a 0% risk-weight, so that the total capital buffer would depend on the risk of the underlying MMF portfolio. Furthermore, capital buffers should rise with the concentration of the underlying MMF portfolio.

Capital provides MMFs with loss absorption capacity, reducing the probability that a fund suffers losses large enough to trigger a run. Capital buffers also mean that there is an investor class that explicitly bears losses and has incentives to curb ex ante risk taking. Of the reform proposals, only capital-based solutions reduce ex ante incentives for risk taking. Capital-based solutions also maintain the fixed NAV structure and therefore best preserve the transactional services that many MMF investors value. Thus, capital-based solutions have significant financial stability benefits, while maintaining the current day-to-day user-experience for ordinary MMF investors.

In addition to making the economic argument for capital-based solutions, we calibrate the size of the capital buffer using the standard model of portfolio credit losses that underlies Basel II bank capital regulations. In particular, we estimate that the capital needed to reduce the probability that an MMF "breaks the buck" to less than 0.1% per year—the target probability of bank failure used in the Basel II calibration of bank capital requirements. The key input parameters to the model are the probability that any given issuer defaults on short-term paper, the loss given default, the correlation in defaults across issuers, and the concentration of the MMF portfolio. For a well-diversified portfolio, we estimate that MMFs should hold 3 to 4% capital against unsecured paper issued by financial institutions, the primary asset held by MMFs. For more concentrated portfolios, we estimate that the amount of capital should be considerably higher.

We also estimate the return that should be earned by providers of MMF capital. We estimate that the risk of providing 4% capital to a MMF is comparable to the risk of long-term unsecured debt in a large, A-rated or BBB-rated financial institution and thus should earn approximately the same return—about 120 basis points (1.20%) above short-term rates (e.g., LIBOR) based on current market conditions. In exchange for having the safer investment product made possible by the existence of subordinate capital, ordinary (i.e., senior) MMFs shareholders would see a

[2] Capital buffers were originally proposed in 2011 by the Squam Lake Group, a non-partisan, non-affiliated group of academics who offer guidance on the reform of financial regulation. See "Reforming Money Market Funds," at http://www.squamlakegroup.org/Squam Lake MMF January 14 Final.pdf.

corresponding reduction in yield of 5 bps (0.05%) in normal times. However, since ordinary MMF investors would be getting an even safer product, this small reduction in yield should *not* be considered a "cost" of requiring MMFs to have a capital buffer.

Finally, we analyze the two leading alternatives outlined in the FSOC report, floating NAV (Alternative 1) and 1% capital combined with a minimum balance at risk provision (Alternative 2). Advocates of floating NAV argue that investors will come to understand that MMFs are risky, and will be more cautious as a result. However, the evidence indicates that institutional investors fully understand the risks of MMFs and have proven willing to invest in risky funds because of their higher yield and the right to redeem shares on demand. Floating the NAV of a money fund does not change the incentive to chase risk. Moreover, given the illiquidity of the underlying assets of MMFs, in practice, eliminating the stable NAV product will result in little change in reported NAVs: floating NAV MMFs will continue to look like a stable NAV product. And, there will still be incentives for investors to run before illiquid MMF assets have to be sold at a loss.

The MBR proposal holds more promise but has some drawbacks. Because investors are required to leave up to 3% of their funds in the MMF for 30-days after redeeming the rest, and because these "minimum balance funds" become subordinate and take first loss should the MMF break the buck, the MBR is a form of capital. But it requires the most risk-averse money-market investors to provide this capital ex post, which may be inefficient, and raises the prospect that they will run to protect 97% of their investment. Moreover, MBR is likely to be disruptive to the end-user experience of MMF investors.

The remainder of the paper is organized as follows. In the next section, we provide some background on money market funds. Section III sets out the goals for MMF reform. In Section IV we make the case for requiring MMFs to have capital buffers, while Section V analyzes alternative reform proposals—floating NAVs, MBR, as well as several additional proposals. Section VI offers some concluding remarks.

II. Money Market Funds and Systemic Risk

A. Background on money market funds

A money market fund is a type of mutual fund that is required by law to invest in short-term, low-risk securities. Money market funds are regulated by the Securities and Exchange Commission (SEC) under Rule 2a-7 of the Investment Company Act of 1940. These funds have very low risks compared to most other mutual funds and typically pay dividends that reflect the level of short-term

interest rates. Critically, unlike a money market deposit account at a commercial bank, money market funds are not FDIC-insured.

Money market funds typically invest in short-term government securities, bank certificates of deposit, commercial paper issued by corporations, repurchase agreements, or other short-term, low-risk securities. MMFs attempt to keep their net asset value (NAV) at a constant $1.00 per share—only the fund yield goes up and down. Specifically, the "penny rounding" provisions of Rule 2a-7 allow MMFs to report a $1.00 net asset value as long as their "shadow NAV" has not fallen below $0.995. However, a MMF's reported NAV may fall below $1.00—an event known as "breaking the buck"—if the shadow NAV falls below $0.995.

According to data from the Investment Company Institute, MMFs managed approximately $2.60 trillion of assets as of November 2012. The bulk of all money fund assets, over $1.45 trillion, are in "prime" money market funds, which invest in paper issued by private, non-government borrowers. The remaining money-fund assets are in government money market funds ($0.87 trillion), which invest in Treasury bills and other short-term US government obligations, and tax-exempt money market funds ($0.27 trillion), which invest in tax-exempt short-term paper issued by states and municipalities.

Figure 1: Assets of Institutional and Retail Prime MMFs. This figure plots the total assets under management of institutional and retail prime MMFs based on weekly data from the Investment Company Institute.

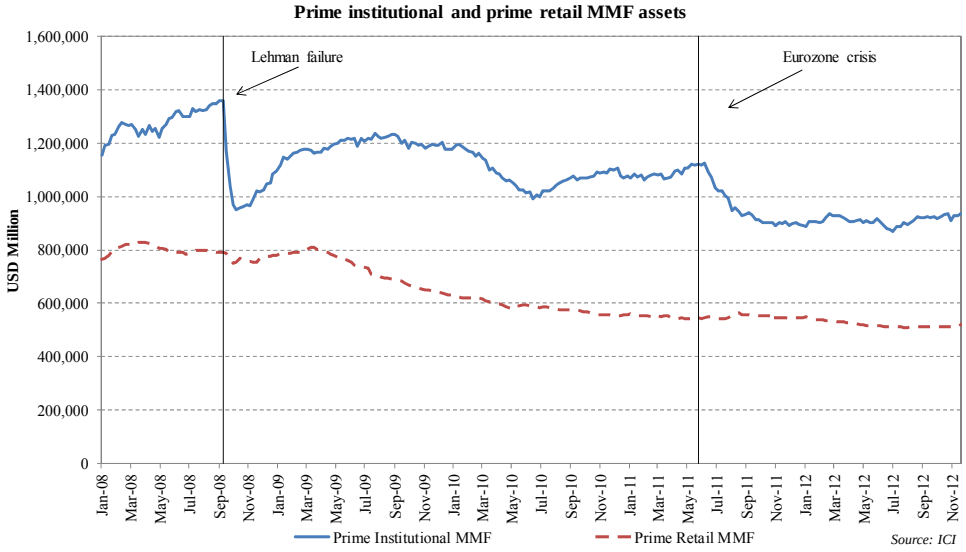


Figure 1 plots the assets under management of prime MMFs from 2008 to present, broken out into institutional and retail funds. Institutional MMFs are high minimum investment, low expense share classes that are marketed to nonfinancial firms, governments, and institutional investors. Retail MMFs are low minimum investment, higher expense share classes that are

marketed to households. Approximately $940 billion of prime MMF assets are currently in institutional funds and the remaining $520 billion are in retail funds. As Figure 1 clearly shows, the assets under management of institutional MMFs are far more volatile than the assets under management of retail funds, tending to fall sharply in times of system-wide financial stress.

B. MMFs are a critical funding source for large, global banks

Prime MMFs are a crucial source of short-term, wholesale dollar funding used by large financial firms. A rough estimate is that prime MMFs provide 35% of such funding.[3] Furthermore, prime MMFs mainly invest in money-market instruments issued by large, global banks—mostly in the form of commercial paper (CP), repo, and bank certificates of deposit (CDs). Table 1 lists the 50 largest non-government issuers of money market instruments held by prime MMFs as of May 2012.

Table 1: List of Top-50 Non-Government Issuers in Prime MMF Portfolios, May 2012. The table is based on data from Crane Data. Total prime money market fund (MMF) assets were $1,423 billion as of May 2012. Approximately $308 billion of these prime MMF assets were invested in Treasuries, Agency securities, or municipal securities, with the remaining $1,111 billion invested in non-government issuers.

Rank	Issuer	May 2012 (USD billions)	Percent of MMF Assets	Rank	Issuer	May 2012 (USD billions)	Percent of MMF Assets
1	Barclays Bank	56.8	3.99%	26	HSBC	17.4	1.22%
2	Deutsche Bank AG	52.1	3.66%	27	DnB NOR Bank ASA	15.8	1.11%
3	Bank of Tokyo-Mitsubishi UFJ Ltd	45.4	3.19%	28	BNP Paribas	15.2	1.07%
4	Bank of Nova Scotia	42.9	3.01%	29	Skandinaviska Enskilda Banken AB	14.5	1.02%
5	Sumitomo Mitsui Banking Co	42.6	2.99%	30	Canadian Imperial Bank of Commerce	14.1	0.99%
6	National Australia Bank Ltd	41.4	2.91%	31	Australia & New Zealand Banking Group Ltd	13.7	0.96%
7	JP Morgan	40.4	2.84%	32	Credit Agricole	13.4	0.94%
8	Credit Suisse	40.2	2.82%	33	Straight-A Funding LLC	11.6	0.81%
9	RBC	37.8	2.66%	34	FMS Wertmanagement	11.4	0.80%
10	Rabobank	37.6	2.65%	35	ABN Amro Bank	10.4	0.73%
11	Bank of America	37.1	2.60%	36	Norinchukin Bank	10.3	0.72%
12	Westpac Banking Co	28.9	2.03%	37	Lloyds TSB Bank PLC	9.6	0.68%
13	Citi	28.5	2.00%	38	Toyota Motor Credit	9.2	0.64%
14	ING Bank	25.8	1.81%	39	State Street	9.1	0.64%
15	Mizuho Corporate Bank Ltd	25.7	1.81%	40	Wells Fargo	8.9	0.62%
16	RBS	23.5	1.65%	41	Natixis	7.7	0.54%
17	General Electric Capital Corp.	22.9	1.61%	42	NRW.Bank	6.6	0.46%
18	Bank of Montreal	22.6	1.59%	43	Morgan Stanley	6.3	0.44%
19	Svenska Handelsbanken	22.4	1.57%	44	Nestle	6.2	0.43%
20	Commonwealth Bank of Australia	21.6	1.52%	45	MetLife Insurance Company	5.5	0.39%
21	Toronto-Dominion Bank	20.9	1.47%	46	US Bank	5.2	0.36%
22	UBS AG	20.1	1.41%	47	Swedbank AB	4.9	0.34%
23	Societe Generale	19.6	1.38%	48	Coca-Cola Co	4.5	0.31%
24	Nordea Bank	19.4	1.36%	49	Branch Banking & Trust Co	4.3	0.30%
25	Goldman Sachs	17.5	1.23%	50	Oversea-Chinese Banking Co	4.1	0.29%

These 50 issuers account for 73% of total prime MMF assets and 93% of assets not backed by the government. Of the top 50 issuers, only two are nonfinancial firms. 93% of the claims issued by the

[3] This estimate is based on data from the Flow of Funds. Specifically, we compute the fraction of large time deposits, repurchase agreements, and financial commercial paper held by MMFs. We estimate MMF financial commercial paper holdings as their total commercial paper holdings, scaled by the fraction of total commercial paper outstanding that is financial commercial paper (i.e., we assume that MMFs hold the "market portfolio" of commercial paper).

top 50 issuers are claims on large global banks, of which 78% are claims on non-US banks. Altogether, only about 3% of prime MMF assets are invested in paper issued by nonfinancial firms.

Thus, prime MMFs are essentially vehicles to collect funds from individuals and nonfinancial firms to provide financing to large banks, which in turn use the proceeds to buy securities and make loans. Prime MMFs add a step in the chain of credit intermediation, since individuals and nonfinancial firms can (and do) directly invest in bank deposits and other short-term claims on financial institutions. The benefit of adding this step in the intermediation chain is that it provides MMF investors with a diversified pool of deposit-like instruments with the convenience of a single deposit-like account. Given the fixed costs of managing a portfolio of such instruments, MMFs provide scale efficiencies for small-balance savers (e.g., households and small and mid-sized nonfinancial corporations) along with a valuable set of transactional services (e.g., check-writing and other cash-management functions).

Set against these benefits are two potentially significant costs related to the stability of the financial system. First, MMFs undermine financial stability to the extent that they take excessive risk in their portfolios. Such risk-taking attracts yield-sensitive investors who run when they become uncomfortable with the risks of the funds. Second, because MMFs allow investors to redeem their shares on demand, they are vulnerable to runs when investors are concerned about the risk of the assets in the funds. This, in turn, can induce a run by MMFs on the global financial institutions that they finance. We now discuss these two sources of instability in more detail.

C. Incentives for MMF risk taking

There can be considerable credit risk in the portfolios of prime MMFs. For instance, as of September 30, 2011, almost 40% of MMF holdings were backed by firms (mainly banks) with a CDS spread above 200 basis points, far in excess of the average investment grade CDS spread of roughly 145 basis points. Nearly 5% of holdings were backed by firms with a CDS spread over 400 basis points. While these CDS spreads are for 5-year unsecured bonds—which tend to be riskier than the money market instruments in MMF portfolios (including both secured and unsecured short-term paper)—these statistics underscore the fact that a significant fraction of the instruments in prime MMFs were issued by relatively risky firms.[4]

[4] See "Money Market Mutual Funds and Financial Stability," a speech by Eric Rosengren at the Federal Reserve Bank of Atlanta 2012 Financial Markets Conference, Stone Mountain, Georgia April 11, 2012. The speech is available at http://www.bos.frb.org/news/speeches/rosengren/2012/041112/041112.pdf. Note that the CDX.IG CDS index, which

Why do funds hold money market instruments issued by such seemingly risky firms? Evidence from several studies shows that institutional investors actually *reward* MMFs for taking greater risk. Specifically, MMFs with riskier portfolio holdings, and hence with higher yields, are rewarded by investors with inflows of assets.[5] Thus, assets under management grow faster for riskier funds. These studies show that institutional investors can be extremely yield sensitive; they appear willing to move large sums between MMFs in order to gain as little as 10 basis points of yield.[6] Institutional investors likely seek out riskier MMFs with higher yields because they believe they can redeem their shares before bearing any losses associated with this risk taking. But when investors protect themselves in this way, they exacerbate stresses on MMFs. This threatens the ability of MMFs to provide financing to the banking sector and, consequently, to the real economy.

This yield-seeking behavior is particularly destabilizing because it induces MMFs to take excessive risk during times of system-wide financial stress. For instance, during the early stages of the global financial crisis, MMFs that invested in risky asset-backed commercial paper were able to offer higher yields and grow their assets by close to 60% from August 2007 to August 2008, while those that did not increase yields very much saw little or no asset growth. Similarly, during the European sovereign debt crisis of 2011, yields on instruments issued by Eurozone banks increased. This created an opportunity for MMFs to grow their assets under management by loading up on the riskier, higher-yielding securities of Eurozone banks. Many MMFs again took advantage of this opportunity by taking on excessive portfolio risk.

In this way, MMF incentives to take risks at times of system-wide stress may impede the orderly and healthy imposition of market discipline, whereby riskier banks are gradually deprived of funding at the early stages of a crisis. Instead, MMF's incentives for excessive risk-taking raise the likelihood that market discipline is imposed in a disorderly fashion with sudden runs on risky banks at the late stages of a crisis.

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includes 125 investment grade corporate bonds, had a 5-year CDS spread of 144 basis points on September 30, 2011. The reason the short-term paper in MMF portfolios is safer than longer-term bonds is that the former allows investors to quickly withdraw funding from firms. This protects short-term debt investors but creates the possibility of runs.

[5] Such yield-chasing is facilitated by portals that enable investors to move cash easily between MMFs. See, for example, the Liquidity DIRECT portal offered by BNY Mellon.

[6] See Marcin Kacperczyk and Philipp Schnabl, "How Safe are Money Market Funds?" Working Paper, Stern School of Business, New York University, April 2012 who study yield-seeking from August 2007 to August 2008. See Sergey Chernenko and Adi Sunderam, "Frictions in Shadow Banking: Evidence from the Lending Behavior of Money Market Funds," Working Paper, Harvard Business School, September 2012 who study yield-seeking during the Eurozone crisis.

D. Systemic run risk

MMFs also exacerbate the risk of widespread runs on the broader financial system. Since MMFs give investors demandable claims—they allow investors to redeem their shares on a daily basis—they can amplify run risk in the financial system. In order to understand the features of MMFs that make them prone to runs, we briefly discuss the economics of runs.

There are two broad theories of runs. The first emphasizes strategic interactions between short-term creditors.[7] The key insight is that runs happen in settings where each investor benefits from withdrawing earlier than other investors. Thus, the *mere threat of a run can generate a run.* In the context of MMFs, one impetus for a strategic run stems from Rule 2a-7, which allows MMFs to maintain a stable $1.00 NAV per share using amortized cost accounting and "penny rounding." This enables investors to redeem their shares at a fixed $1.00 share price even if the mark-to-market value is less than $1.00 per share. The stable NAV feature creates incentives for investors to beat others out the door before a MMF "breaks the buck" and can no longer allow redemptions at $1.00.

Another impetus for a strategic run stems from the illiquidity of the non-government assets of prime money market funds.[8] MMFs forced to liquidate commercial paper and bank certificates of deposits are likely to sell them at heavily discounted, "fire sale" prices. This creates run risk because early investor redemptions can be met with the sale of liquid Treasury bills, which generate enough cash to fully pay early redeemers. In contrast, late redemptions force the sale of illiquid assets at discounted prices, which may not generate enough revenue to fully repay late redeemers. Thus, each investor benefits from redeeming earlier than others, setting the stage for runs. Indeed, during the financial crisis, the Federal Reserve set up the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF) to address exactly this problem.[9]

The second broad theory of runs emphasizes the "panic" that can occur when "safe proves risky"—i.e., when highly risk-averse investors realize that they may suffer losses on assets they had previously regarded as "safe." This view frequently highlights the special role of "money-like" assets that are perceived as being absolutely safe stores of value. According to this view, risk-averse

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[7] See Diamond, Douglas and Philip Dybvig (1983), "Bank Runs, Deposit Insurance, and Liquidity," *Journal of Political Economy* 91(3), pp. 401-419.

[8] See Daniel Covitz and Chris Downing (2007), "Liquidity or Credit Risk? The Determinants of Very Short-Term Corporate Yield Spreads", *Journal of Finance*, Volume 62, Issue 5, pages 2303–2328.

[9] See Burcu Duygan-Bump, Patrick Parkinson, Eric Rosengren, Gustavo Suarez, and Pual Willen (forthcoming), "How Effective were the Federal Reserve Emergency Liquidity Facilities? Evidence from the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility," *Journal of Finance*.

investors treat assets that are classified as "safe" in a qualitatively different way than they treat assets that are classified as "slightly risky." As a result, this second view emphasizes the panic-driven runs that can occur when investors reclassify an asset from "safe" to "slightly risky." In the context of MMFs, this mechanism naturally generates runs. The MMF product is designed to be regarded as "safe" by investors in normal times. However, in times of financial stress, investors can quickly change their opinions if an MMF suffers losses, or has portfolio holdings that expose it to significant risk of loss.[10]

Runs are not just damaging to a single MMF in isolation, but are likely to damage the broader financial system and economy as a whole. A run at one MMF could precipitate runs on other MMFs if, as one might expect, investors are concerned that the factors leading to losses in one fund could affect other funds. In this case, many MMFs may become reluctant to roll over the securities in their portfolios, amplifying the funding stresses on financial institutions. As a result, an otherwise healthy bank might face funding difficulties because the failure of another bank leads to a run on the MMF sector. In this way, a widespread run on MMFs would destabilize the broader financial system, potentially triggering a credit crunch that would spill over into the real economy.

Systemic MMF runs have occurred twice in the past four years. When the Primary Reserve Fund "broke the buck" on September 16, 2008 after the failure of Lehman Brothers, it precipitated a massive run on prime MMFs, mainly by institutional investors who were concerned about MMF exposures to troubled financial firms. As illustrated in Figure 1 above, assets in institutional prime MMFs fell by 29% within just two weeks of Lehman's failure. Because large financial firms depend heavily on MMFs for short-term funding, the run on MMFs generated significant additional stresses on the financial system at the peak of the crisis. The run would likely have been far more severe had the Treasury not stepped in and temporarily guaranteed MMF balances on September 19, 2008.

Figure 1 also shows that a similar, but less extreme version of this story played out in the summer of 2011 as investors in institutional prime MMFs became concerned about the exposure of European banks to the debt of struggling Eurozone sovereigns. Given the large presence of Eurozone banks in MMF portfolios, this led to a 20% decline in institutional prime MMF assets from May 2011 to September 2011. These MMF outflows added to the stresses on Eurozone banks,

[10] There are multiple versions of this view. According to one version of this view, investors sometime neglect the possibility of certain rare events and mistakenly classify assets that are slightly risky as riskless. Significant dislocations ensue when investors realize these assets are risky, leading them to run for the exits. A second version argues that investors have a special demand for safe, liquid assets that function as a medium of exchange and that such "money-like" assets command a premium. In this telling, assets quickly lose this premium once they become slightly risky.

particularly on their ability to fund their dollar loans both in the US and abroad. Indeed, recent studies show that European banks that were particularly dependent on MMFs for funding cut their lending in the US significantly relative to their lending in Europe.[11]

Although a full review of the evidence is beyond the scope of this paper, our reading of the evidence on bank runs by depositors and the more recent runs by short-term creditors suggests that *both* the strategic view of runs and the panic-based view capture important aspects of reality. Thus, prudent policy makers should seek *robust* solutions that would work under either model of runs.

III. The Goals of MMF Reform

Before proceeding with our analysis of reform proposals, it is critical to be precise about the motivation for and goals of MMF reform. In general, the goal of regulation should be to address well-defined market failures that private actors are unable to address themselves. Market failures typically arise in contexts where there is no private market for a good. In the context of MMF reform, the principal market failures involve financial stability: there is no market that enables private actors to purchase access to a stable financial system. However, the actions of individual financial actors can be systemically destabilizing, imposing externalities upon others. Sound "macro-prudential" financial regulations help to correct these market failures, discouraging individual financial actors from taking systemically destabilizing actions that may be in their private interest but harmful to the financial system and the economy as a whole.[12]

Prime MMFs pose the main threat to financial stability, so our analysis of proposals pertains largely to prime MMFs. What are the market failures that MMF reform should seek to correct?

1) MMF investors can withdraw funds on demand. The fact that MMF investors can redeem their funds at a moment's notice gives them strong protections if the MMF gets in trouble. However, it also means that the full economic costs of MMF risk-taking and runs are not borne by MMF investors in isolation. Some of these costs are borne by *other* parts of the financial system and economy. Specifically, runs on MMFs may destabilize the financial system and trigger a broader credit crunch. The existence of these external

[11] See Ivashina, Victoria, David S. Scharfstein and Jeremy C. Stein, "Dollar Funding and the Lending Behavior of Global Banks," FEDS paper 2012-74, Federal Reserve Board and NBER working paper 18528, October 2012. See also Correa, Ricardo, Horacio Sapriza and Andrei Zlate, "Liquidity Shocks, Dollar Funding Costs, and the Bank Lending Channel During the European Sovereign Crisis," IFDP paper 2012-1059, Federal Reserve Board, November 2012.

[12] For an overview of the macro-prudential approach, see Hanson, Samuel, Anil K Kashyap, and Jeremy C. Stein, "A Macroprudential Approach to Financial Regulation," *Journal of Economic Perspectives* 25, No. 1 (Winter 2011).

costs makes MMF investors more willing to invest in risky MMFs ex ante and more willing to run ex post than if they fully internalized these costs.

2) Implicit government guarantees. Given the turmoil that roiled US money markets following the failure of Lehman Brothers in September 2008 and the ensuing run on prime MMFs, investors may expect future policymakers to intervene to stabilize MMFs (or to stabilize money markets more broadly) if MMFs ever again faced such a large-scale run. The expectation of future taxpayer support—implicit government guarantees, which are provided to MMFs free of charge—encourages MMF managers and investors to take on excessive risk ex ante.[13]
3) Spillovers across funds. Since many MMF investors are relatively uninformed and have limited resources to process information about individual funds, trouble at one MMF can rapidly precipitate runs on other MMFs. However, an individual fund will rationally ignore the spillover costs of its own risk-taking on the stability of other funds and, hence, the stability of the financial system as a whole.
4) Excessive short-term funding of financial firms. The three market failures listed above lead to excessive risk-taking by MMFs. This in turn means that financial firms, which dominate MMF portfolios, can obtain short-term funding below its true economic cost to society. Financial firms are likely to respond to these lower costs by relying too heavily on short-term financing, which can result in significant spillovers to the rest of the financial system and economy when there is a run on short-term funding.[14]

Given these market failures, the overarching objective of reform should be to reduce the probability and impact of a large-scale run on prime MMFs. This broad objective can be refined into four more concrete goals. Below we evaluate the various policy proposals—capital, floating NAV, and redemption restrictions—based on the extent to which they help achieve these goals:

Goal 1: Reduce the incentive of MMFs to take on excessive portfolio risk ex ante.

Goal 2: Reduce the incentive for MMF investors to run ex post.

[13] After the failure of Lehman Brothers and the run on MMFs, the U.S. Treasury Department guaranteed MMFs using the Exchange Stabilization Fund. As part of the legislation authorizing the Troubled Asset Relief Program, Congress included a prohibition against using the Exchange Stabilization Fund for such guarantees. Of course, this does not prevent authorities from finding other ways to support MMFs or future Congresses from changing the law.

[14] See Jeremy C. Stein, "Monetary Policy as Financial-Stability Regulation," *Quarterly Journal of Economics*, 2012.

Goal 3: Reduce the impact of a MMF run on the broader financial system and economy if a MMF run does occur.

Goal 4: Reduce the incentive for large financial institutions to rely excessively on unstable, short-term funding from MMFs.[15]

In pursuing these goals, it is important to preserve the genuine benefits of MMFs—low cost access to a diversified portfolio of deposit-like instruments and a valuable set of transactional services. However, preserving these benefits is not the same as preserving the size of the MMF industry.[16] Instead, under a sound regulatory regime, the MMF sector should be allowed to freely adjust to a size where these benefits are properly weighed against the full set of costs MMFs create. We conclude this section by arguing that structural MMF reform is needed despite recent financial regulatory reforms, including the 2010 SEC amendments to Rule 2a-7, the passage of the Dodd-Frank Act of 2010, and the Basel III bank liquidity requirements that were proposed in 2010.

First, in February 2010, the SEC implemented the following changes to Rule 2a-7:

- Higher portfolio quality: Stricter limits on holdings of "second tier" securities—i.e., short-term paper with an "A-2" rating from S&P or a "P-2" rating from Moody's.
- Reduced reliance on credit rating agencies: MMFs must designate four Nationally Recognized Statistical Rating Organizations (NRSROs) to use each year.
- Stricter maturity limits: The maximum weighted average maturity of fund holdings was reduced from 90 to 60 days.
- Liquidity buffers: At least 10% of fund assets must be in "daily liquid assets," defined as the sum of cash, bank demand deposits, US Treasuries, and any security with a legal maturity of one day. At least 30% of fund assets must be in "weekly liquid assets," defined as the sum of daily liquid assets plus any security maturing in 5 days or less.
- Disclosure: MMFs must report portfolio holdings each month with a two month lag.

[15] As explained below, this should only be an objective for MMF reform to the extent that market failures associated with MMFs lead the market cost of short-term funding to fall below its true cost to society.

[16] This seems to be the goal of critics of MMF reform in the industry. See, for example, "Response to Treasury Secretary Geithner's letter to FSOC members," Federated Investors, October 1, 2012; "The Investor's Perspective: How individual and institutional investors view money market mutual funds and current regulatory proposals designed to change money funds," Fidelity Investments, February 2012; and criticisms by the Investment Company Institute on its website www.preservemoneymarketfunds.org.

- Gating: The MMF board of directors may suspend redemptions if they believe the fund's shareholders are at material risk. If redemptions are suspended, the fund must liquidate.

These recent Rule 2a-7 reforms are helpful in some respects, but may actually be harmful or ineffective in other respects, so that further structural reform is necessary. While the MMF liquidity buffers may help to reduce the likelihood and impact of a run, they actually increase the demand for short-term paper issued by large financial institutions and work against the broader macro-prudential goal of encouraging financial institutions to reduce their reliance on unstable, short-term funding.[17] Thus, even though this rule may make MMFs safer, it may make the financial system as a whole less safe. As we discuss in greater detail in Section V, optional gating (i.e., redemption restrictions) can actually exacerbate runs if investors fear that once the gates go down they will not have access to their money in the fund. Furthermore, these regulations do little to reduce the ex ante incentives for MMF risk-taking. Indeed, portfolio quality restrictions did not prevent MMFs from taking on risks in the run-up to the Lehman Brothers default or the Eurozone crisis.

Moreover, it is sometimes argued that the short-term financial paper held by MMFs will be riskless going forward since the new Orderly Liquidation Authority (OLA) under the Dodd-Frank Act is likely to protect the short-term creditors of US Systematically Important Financial Institutions (SIFIs) even if they are unsecured.[18] However, as shown in Table 1, MMFs hold large amounts of paper issued by non-US global banks, which are not subject to OLA. Thus, the existence of OLA would do nothing to temper the effect on MMFs of the failure of a large foreign bank. And, the operation of OLA is subject to a lengthy system of regulatory checks and balances, involving separate determinations by the Treasury Secretary as well as the boards of the both the Federal Reserve and the FDIC. Thus, there could be significant uncertainty about whether policymakers would in fact honor all short-term claims of a failed SIFI, leading MMF investors to run.

Finally, it has been argued that the recently proposed Basel III liquidity regulations alone are sufficient to reduce financial firms' over-reliance on unstable, short-term funding so that structural

[17] While these rules encourage MMFs to hold shorter-term paper, other regulatory initiatives have been encouraging large financial institutions to rely less heavily on short-term debt. These conflicting policies invite regulatory arbitrage. Indeed, at least one dealer created an investment vehicle that issues very short-term commercial paper to MMFs which is then invested in slightly longer term financial paper (specifically, repurchase agreements). While this meets the regulatory requirements of both regulators, this clearly does not make the financial system any safer.

[18] See speech by FDIC Chairman Martin Gruenberg at the Federal Reserve Bank of Chicago Bank Structure Conference, May 10, 2012. Available at: http://www.fdic.gov/news/news/speeches/chairman/spmay1012.html.

MMF reforms are unnecessary.[19] In the absence of market distortions associated with MMFs, bank liquidity regulations would arguably be sufficient to enhance financial stability. Bank liquidity regulations are useful since the *supply response* of financial firms who face a well-founded demand for truly riskless, money-like paper is likely to be excessive from a system-wide point of view.[20] However, market failures associated with prime MMFs (e.g., implicit government insurance) create *excessive demand* for "near riskless" paper that offers a slightly higher yield than truly riskless paper. To the extent that such excessive demand for near riskless assets continues to exist, large financial firms will have powerful incentives to circumvent the Basel III liquidity regulations. Thus, it is desirable to pursue both Basel III liquidity regulations as well as further MMF reform.[21]

IV. Preferred Solution: Capital Buffers for MMFs

In this section, we make the case for capital buffers in light of the policy goals described above. Requiring MMFs to have capital while maintaining the stable $1.00 NAV is likely to be the best policy solution. Our calibrations suggest that a capital buffer in the range of 3% to 4% of risk-weighted assets for a well-diversified MMF portfolio is consistent with the policy goals. In our approach, commercial paper would receive a 100% risk weight and Treasury bills would receive a 0% risk weight. Thus, the total amount of capital would depend on the risk of the underlying portfolio. Capital requirements should also rise with the concentration of the underlying portfolio.

One of the main benefits of capital buffers is that they reduce the likelihood of a system-wide run. Because capital providers absorb the first loss, the more capital a MMF holds, the lower the chance that ordinary MMF investors suffer a loss, holding asset portfolio risk constant. In other words, capital reduces both the strategic motive for runs and the probability of panic-based runs. Moreover, if an MMF has sustained a modest loss that has eroded some, but not all of its capital, an

[19] The Basel III liquidity regulations come in two parts. First, the Liquidity Coverage Ratio (LCR) requires a bank to hold enough high-quality, liquid assets that can be converted into cash to meet its needs over a severe 30-day liquidity stress scenario specified by regulators. Second, the Net Stable Funding Ratio (NSFR) establishes a minimum amount of stable funding based on the liquidity characteristics of a bank's assets, with the aim of limiting "over-reliance on short-term wholesale funding during times of buoyant market liquidity." See Basel Committee on Banking Supervision, "Basel III: International framework for liquidity risk measurement, standards and monitoring," December 2010.

[20] This is because individual financial firms will take the probability and severity of a liquidity-induced financial crises as a given. By contrast, policymakers will recognize that the probability and severity of crises are not given, but instead will depend on the aggregate liquidity/maturity mismatch of the financial system. See Stein 2012, *op. cit*.

[21] This is similar to the logic in Greenwood, Robin, Samuel G. Hanson and Jeremy C. Stein, "A Cpmparative-Advantage Approach to Government Debt Maturity," mimeo, 2012, which argues that, to the extent that bank liquidity regulation is either costly or imperfect, it may be useful for the government to also pursue policies that reduce the temptation for "private money creation" in the first place.

ordinary MMF shareholder is still protected by the remaining capital, and thus has less cause for concern—both that his shares will be impaired and that others will be concerned that their shares will be impaired. Thus, capital means that the threat of a run is less likely to become a self-fulfilling prophecy, in which investors strategically choose to run because they worry that others will run.

Another benefit of capital is that it reduces the incentive of MMFs to take excessive risk, and thereby precipitate a run when the risk materializes. If the sponsor provides capital directly and bears first loss, it has a direct incentive to reduce risk. Alternatively, if capital is provided by the market through, say the issuance of subordinate shares (as we describe below), then there is an indirect incentive to reduce risk, as subordinated shareholders require higher yields to bear first loss on a riskier pool of assets. This, in turn, lowers the yield that can be offered to ordinary MMF investors. Thus, the strategy of increasing risk with the goal of increasing yields and attracting assets is less effective when there are capital buffers. The idea that capital buffers serve as a brake on risk taking is not new: it is a key tenet of the Basel II bank regulatory framework and of the prudential regulation of financial institutions more generally.

Recent research supports the idea that capital can serve as a check on risk taking. In particular, large sponsors that offer a wide array of financial products in addition to MMFs (e.g., large mutual fund complexes or large banking firms) have historically been willing to support troubled MMFs in order avoid the broader reputational loss that might arise if their MMF broke the buck. These sponsors attempt to limit MMF risk-taking because they know that their own capital—both in the form of financial resources and franchise value of their other businesses—is effectively at risk. Among all of the alternatives, capital buffers appear to be the only that would help to curb excessive ex ante risk-taking by MMFs.[22]

A. Implementing capital buffers

The capital buffer could be achieved using a variety of different contractual mechanisms. The basic idea of all of these alternatives is that each $1 of ordinary MMF shares would effectively be backed by more than $1 of assets. Since ordinary MMF shares would effectively be over-collateralized, the MMF could suffer credit losses on some portfolio assets without ordinary MMF shareholders suffering a loss. Such capital requirements are often expressed as a percentage of total

[22] See Kacperzyck and Schnabl 2012, *op. cit*.

assets: each \$1 of assets would be financed by \$$K$ of first-loss subordinated capital and \$(1 – K) of ordinary (senior) MMF shares.

In Appendix A, we discuss the mechanics of several different proposed versions of capital buffers, including a subordinated share class (i.e., perpetual closed-end first-loss shares), a standby liquidity facility backed by a dedicated pool of US Treasuries (i.e., an escrow account), or a standby support agreement from a highly-rated financial institution (e.g., a third party or the fund sponsor). Conceptually, the key to all the proposals is that capital simply divides the risks and rewards of MMF portfolio assets between two distinct securities. The ordinary MMF shares are protected from the risk of loss by the capital buffer. In return, the ordinary shares receive slightly lower yields, while the capital buffer earns higher returns. Since the capital buffer is relatively small and it bears risks associated with relatively safe assets, the decrease in yield to ordinary MMF shareholders is quite small. For instance, if holders of a K = 4% capital buffer require returns of 120 basis points greater than the total yield of the portfolio assets, this means the yield to the ordinary shares must be reduced by 5 basis points (= 4% × 120 ÷ 96%). We detail these calculations below.

While the main benefit of capital buffers is that they are likely to have significant financial stability benefits, they also best preserve the status quo user experience for ordinary MMF shareholders. Specifically, firms and households who use MMFs as a safe store of value—i.e., for cash management—would have a very similar, albeit safer stable-value product. And borrowers who rely on MMFs for funding would benefit from the more stable access to funding markets that would flow from increased financial stability.

What should happen when an MMF suffers a credit loss and its capital buffer falls below the required minimum? Existing proposals, including the FSOC's capital buffer proposal, adopt the "prompt corrective action" approach from traditional banking regulation. Specifically, a MMF whose capital buffer fell below the required minimum would be immediately required to restrict its new investments to cash and Treasuries until its capital buffer was restored to the minimum ratio of risk-weighted assets.[23] While there is little problem with this approach when a single MMF suffers an idiosyncratic loss, serious problems arise when many MMFs suffer a credit loss at the same time—e.g., due to a default by a major money-market issuer. In the latter case, this would discourage MMFs from drawing down on their capital buffers precisely when they should be encouraged to do so from a system-wide perspective. From a macro-prudential point of view, the

[23] See FSOC 2012, op. cit., p. 39. By only making new investments in 0% risk-weight cash and Treasuries, an MMF's risk-weighted assets would decline, thus raising its ratio of capital to risk-weighted assets.

primary purpose of MMF capital buffers is to allow MMFs to sustain a modest loss without triggering a widespread run on MMFs—a run that in turn leads MMFs to withdraw short-term funding from large financial firms. This "prompt correct action" approach would indirectly bring about the very outcome—a destabilizing withdrawal of funding from large financial firms—policy should be trying to avoid in the first place. Instead, following a system-wide event when multiple MMFs suffer a loss, it would be desirable to allow MMFs to gradually rebuild their capital buffers—preferably by raising new junior capital.[24]

B. Sizing MMF capital requirements

How large should the capital buffer be? One approach to calibrating the size of an MMF capital buffer is to use the workhorse model of portfolio loss which underlies the Basel II bank capital framework.[25] This procedure, explained in Appendix B, allows us to compute the amount of capital such that the probability of "breaking the buck" is only 0.1% per annum. The procedure requires as inputs assumptions on the probability of default and loss given default for the typical issuer in an MMF portfolio, as well as the correlation between issuers. Given these inputs, we calculate the probability of realizing portfolio losses of various sizes and then find the amount of capital needed to protect ordinary (senior) MMF shareholders from suffering any loss 99.9% of the time. The inputs used in our calibration are meant to capture the properties of highly-rated, non-government unsecured paper. The capital requirements our calibration delivers should be only applied to such assets. Secured exposures such as repo would receive lower capital charges, and holdings of government-backed assets could be exempted from capital requirements completely.

Our calibration suggests that a capital requirement in the range of 2% to 6% would be reasonable for a *well-diversified portfolio* of prime, unsecured, non-government 2a-7 assets, with our preferred inputs yielding a capital requirement of 3% to 4%. A requirement of 3% to 4% for MMFs might initially seem surprisingly high given that bank assets are far riskier than MMF and bank capital requirements are approximately 10%. Two differences between bank and MMF portfolios explain the gap. First, loss given default is higher for issuers in MMF portfolios because they are largely financial firms, which typically sustain larger losses in default than non-financial

[24] See Hanson, Kashyap, and Stein 2011, *op. cit*., which makes a similar argument about bank capital regulation.

[25]See Vasicek, Oldrich 2002, "Loan Portfolio Value." Risk 15, 160-162. The application to Basel II is described in Michael Gordy 2003, "A Risk-Factor Model Foundation for Ratings-Based Bank Capital Rules," Journal of Financial Intermediation, vol. 12, no. 3, pp. 199-232.

firms. Second, the correlations between issuers in MMF portfolios are higher because they are largely financial firms, while banks tend to lend to a set of firms that is diversified across industries.

While the calibration above is for a well-diversified portfolio, in practice many MMF portfolios are relatively concentrated. As in the Basel II bank capital framework, there should also be a capital surcharge for undiversified portfolios. Thus, MMFs would face a schedule of capital buffers depending on their portfolio concentration. Our estimates suggest that the appropriate surcharge should be substantial for an equal-weighted portfolio of 25 private issuers—it could be as large as 4%, for a total capital requirement of 8%. However, the add-on would shrink rapidly and would be very small (only 0.10%) for an equal-weighted portfolio of 75 issuers. Thus, there is potential to reduce the amount of required capital by tightening the portfolio concentration limits on MMFs, which currently limit them to investing 5% of their assets in any one issuer. At a minimum, the goal should be for an MMF to survive at least one portfolio default, so the capital buffer should be larger than the concentration limit.

Overall, our approach to calibrating the size of the capital buffer suggests a substantial benefit from a relatively small 3 to 4% buffer. Using the most plausible parameter estimates, our calibration suggests that a 4% capital buffer would reduce that probability that a well-diversified MMF breaks the buck to the targeted 0.1% per annum. By contrast, the same MMF with only 0.5% capital would have a 1.14% chance of breaking the buck.[26]

C. How much would capital cost?

Opponents of capital for MMFs frequently claim that subordinated MMF shares or standby liquidity facilities for MMFs will be extremely expensive or impossible to sell. This objection is hard to square with basic finance principles. Since MMFs assets are thought to be quite safe, MMF capital, even in a first loss position, should also be safe and relatively cheap.[27] Moreover, as more

[26] Another approach to calibrating the capital requirement would be to study sponsor support events as in Brady, Steffanie A., Ken E. Anadu and Nathaniel R. Cooper, 2012, "The stability of prime money market mutual funds: sponsor support from 2007 to 2011," No RPA 12-3, Risk and Policy Analysis Unit Working Paper from Federal Reserve Bank of Boston. 78 of the 341 funds they studied received support in the financial crisis, and the *average* level of support for the 78 funds was 90 bps. With 90 bps of capital, roughly half (39) of the 78 funds would have still failed in the absence of sponsor support. Using the distribution of support events from this study, 3 to 4% capital would be sufficient to prevent failures in many but not all cases. However, note that the extent of sponsor support may be understated due to other government support of the money markets (CPFF, AMLF, the Treasury guarantee).

[27] In the debate over bank capital, academics and policymakers consistently argue that the banking industry tends to significantly overstate the costs of having more equity capital. MMF assets are much safer than bank assets so there is even less reason to think that MMF equity capital will be expensive.

capital is added, equity becomes even safer and equity investors should require even lower returns. Our calibration exercise helps to clarify this point. It suggests that subordinate MMF shares would have default risk—i.e., the risk of a significant capital impairment—that is comparable to an A-rated or BBB-rated long-term bond issued by a financial firm. Appendix B details this calculation. The basic logic starts with the observation that MMF capital is long-term and cannot be withdrawn, while MMF portfolio assets are largely exposures to financial firms. Thus, MMF capital essentially bears the long-term risk that any firm in the MMF portfolio defaults on its short-term paper. Using this logic, current market data on long-term financial company debt suggests that a reasonable estimate of the spread that subordinated MMF shares would need to offer investors is in the range of 100 to 150 basis points (i.e., 1.00% to 1.50%) over default-free short-term government debt.

Those who argue that MMF capital would be very expensive typically make the mistake of assuming that MMF capital would require similar returns to bank equity, perhaps in the range of 10% to 15%. This assumption fails to account for the fact that MMF assets are much safer than bank assets. One way to see this is to consider an MMF that only invests in money market instruments issued by a single bank. While the equity holders in the bank are directly exposed to the risk of loss on the loans the bank makes—they are in a first loss position—MMF capital providers are only exposed to a loss after the bank's equity is completely wiped out. Thus, it is better to compare MMF capital to long-term bank debt, than to bank equity.

D. Common objections to requiring MMF capital buffers

In this section we briefly address some common criticisms of capital-based reforms for MMFs. A first objection to MMF capital buffers is that capital will not stop a run once the run is already in progress—i.e., once the MMF suffers a crippling loss and capital has been wiped out. While this may be true, capital can still have significant value. For one, it reduces the ex ante probability that investors ever suffer such a major loss in the first place. Moreover, capital reduces ex ante incentives for MMFs to take risk. And, finally, a capital buffer, while not eliminating the possibility of a run, helps to weaken run incentives following modest MMF losses.

A second objection to MMF capital requirements is that they may cause a consolidation of the industry because smaller sponsors will have difficulty raising capital. However, it is worth noting that the MMF industry is already highly concentrated: the 20 largest MMF sponsors account

for 90% of aggregate MMF assets under management.[28] And to the extent that competition encourages excessive risk-taking by MMFs, additional consolidation might even be beneficial.

Third, some argue that the market for subordinated MMF shares would be relatively small and that there are no "natural buyers" for this security. In that case investors would demand a premium to buy this new product, raising the cost of capital beyond what risk alone would suggest. Suppose this extra cost is 100 bps. Assuming a 4% capital requirement for MMFs, this very sizable mispricing of 100 bps would only raise the total cost of capital for MMFs by 4 bps (= 4%×100 bps). This extra cost would likely be shared by MMF investors and sponsors, as well as money market issuers. It is difficult to argue that this extra cost, even if it exists, would have a noticeable impact on any of these market participants.

Finally, part of the reason critics of MMF capital might perceive it as being expensive is that capital would reduce the value of implicit government guarantees. The fact that future policymakers might again extend broad guarantees to MMFs in a crisis effectively provides MMF investors with a form of free insurance. Capital buffers would substantially diminish the value of this implicit insurance, perhaps leading to a slightly higher overall cost of capital for MMFs. While MMF managers might perceive this as a cost, it is not a cost from the perspective of society as a whole. Rather, requiring MMFs to have capital simply reduces the expected value of future transfers that MMFs may receive from taxpayers.

V. Evaluation of Alternative Reforms

MMF sponsors, industry groups, government agencies, and academics, have proposed a variety of MMF reforms as alternatives to requiring MMFs to have capital. In this section, we briefly discuss the main alternatives to capital requirements and evaluate them in light of the goals for reform developed in Section III.

The alternatives fall into three broad categories:

1) Floating NAV: These proposals would require MMFs to publish market-based net asset values and to allow investors to redeem their shares at this "floating" NAV every day, just as all other mutual funds currently do.

2) Minimum balance at risk: This proposal would require investors to leave up to 3% of their funds in the MMF for 30-days after redeeming the rest. These "minimum balance

[28] See FSOC 2012, *op. cit.*, p. 18.

funds" would be subordinated to the claims of other shareholders and therefore function as a form of capital.

3) Other measures:

   a. Increased transparency: These proposals would require MMFs to disclose information on their portfolio holdings more frequently and in greater detail than is currently required under Rule 2a-7.

   b. Gating rules: These proposals impose fees or restrictions on investor redemptions under certain conditions (i.e., in times of crisis).

We now evaluate each of these options in turn.

A. Floating NAV

One of the most commonly discussed reforms for MMFs is to eliminate the so-called "penny rounding" provisions from Rule 2a-7, which allow MMFs to report their net asset value as $1.00 so long as their shadow NAV has not fallen below $0.995. Under such proposals, MMFs would be required to disclose their exact net asset values each day, just as other mutual funds currently do. In addition, the recent FSOC proposal would multiply that share price by 100 and then round to the nearest penny, so, for instance, a fund with a shadow NAV of $0.9995 and a reported price of $1.00 under the current regime would instead report a price of $99.95. Furthermore, under the recent FSOC proposal, sponsors would not be permitted to provide support to MMFs.[29]

Proponents of the floating NAV option point to three main benefits. First, they argue that a floating NAV lowers the probability of runs by reducing the strategic motive for runs. For example, consider a MMF that has two investors each of whom owns shares with a face value of $1.00. Under the stable NAV system, if the fund's true net asset value declines to $0.997, the investor who redeems first will receive $1.00, while the investor who redeems second will receive only $0.994 (= 2×$0.997 – $1.00). Therefore, redeeming first allows an investor to avoid portfolio losses, strongly encouraging investors to run. According to proponents of a floating NAV, eliminating the stable NAV eliminates the incentive for such strategic runs.

[29] See FSOC 2012, *op. cit.*, p. 31. Specifically, the FSOC has proposed eliminating Rule 17a-9 of the Investment Company Act which provides an exemption to the Act's general prohibitions against related-party transactions in the case where an affiliate of an MMF purchases portfolio securities so as to support the MMF's stable NAV.

Second, advocates of the floating NAV proposal argue that it would reduce the probability of panic-based runs. The stable $1.00 NAV of MMFs encourages investors to believe that they are completely risk free, but under a floating NAV system, the argument goes, daily fluctuations in the reported NAV in normal times would lead investors to recognize the inherent riskiness of MMFs. Essentially, a floating NAV would force risk-averse MMF investors to permanently reclassify MMF shares from "safe" to "slightly risky," thus making investors less likely to panic in a crisis.

Third, proponents of the floating NAV proposal argue that it would remove the government imprimatur of safety that MMFs currently enjoy, thus reducing the likelihood of future government support for MMFs and eliminating any implicit guarantees that may exist today.

However, existing floating NAV proposals are unlikely to enhance the stability of the financial system and may actually be worse than the status quo. First, and most importantly, a floating NAV system would work in similar fashion to the existing stable NAV system because secondary markets for commercial paper and other private money market assets such as CDs are highly illiquid. Therefore, the asset prices used to calculate the floating NAV would largely be accounting or model-based estimates, rather than prices based on secondary market transactions with sizable volumes. In this regard, MMFs are more similar to banks, which must make accounting-based assessments of loan portfolio value, than they are to equity mutual funds, which can easily mark their portfolios to market each day.

This means that moving to a floating NAV system is unlikely to eliminate investor incentives to run in bad times. Consider the above example of an MMF that has two investors each of whose shares has an initial value of $1.00. Suppose that under a floating NAV regime the fund announces that by accounting-based measures its NAV has declined to $0.997, but the investors believe that the true economic NAV is only $0.990. In this case, the investor who redeems first receives $0.997, while the investor who redeems second receives only $0.983 (= 2×$0.99 – $0.997). Thus, each investor still has an incentive to redeem early.

Moreover, to the extent that a floating NAV regime would rely on market prices, the illiquidity of secondary markets for commercial paper and other money fund assets creates the possibility of fire-sale market spirals. If a distressed MMF were forced to sell its holdings into an illiquid market, this would lower the market prices of these assets. Other MMFs would then be forced to publish lower NAVs, which could lead to additional investor redemptions and more forced sales. Anticipating this market spiral, MMF investors would continue to have strong incentives to redeem their shares early at the slightest hint of trouble. Run risk stems from the illiquidity of the

underlying assets and the demandable nature of MMF shares. By way of analogy, moving from a fixed to a floating NAV will not eliminate MMF runs any more than a move from accrual to mark-to-market accounting for bank loan portfolios would eliminate bank runs. The economic problem of runs goes much deeper than GAAP accounting conventions or SEC-sanctioned NAV reporting practices; it is the consequence of funding illiquid assets with demandable claims.

As a practical matter, current SEC rules would essentially allow MMFs in a floating NAV system to operate with fixed NAVs. Existing SEC rules for *all* mutual funds allow the use of amortized cost (i.e., stable NAV) accounting for investments that mature in 60 days or less, which encompasses the vast majority of MMF assets.[30] According to SEC form N-MFP filings, in August 2011 more than 80% of prime MMF assets had maturity of less than 60 days. This means that MMFs would have to replace less than 20% ($300 billion) of their assets with shorter maturity holdings in order to operate *exactly as they do now*.[31]

Another important problem with floating NAV reform proposals is that the NAV would fluctuate very little in normal times. As noted by BlackRock, "The NAV of these funds generally oscillates in a tight range of +/− 10 bps around par for 99.9% of the time."[32] That is, the share price would almost always be between $99.90 and $100.10. Thus, it seems quite unlikely that moving to a floating NAV regime would meaningfully alter investor perceptions about the risks inherent in MMFs. Specifically, investors would continue to treat floating NAV MMFs as "safe" in normal times and would quickly redeem their shares in a crisis when MMF were reclassified as "slightly risky", thereby destabilizing the financial system.

Indeed, the recent financial crisis provides strong evidence that tiny fluctuations in market prices in normal times do not change investor perceptions of risk. Figure 2 below shows the price for AAA subprime mortgage-backed securities (MBS) from late 2005 to late 2008. Although there were small fluctuations in price before the onset of the crisis in August 2007, these were clearly

[30] See FSOC 2012, *op. cit.,* particularly footnote 69 on p. 30. Specifically, all mutual funds are allowed to value short-term paper at amortized cost unless the fund's board of directors determines that fair value differs from amortized cost.

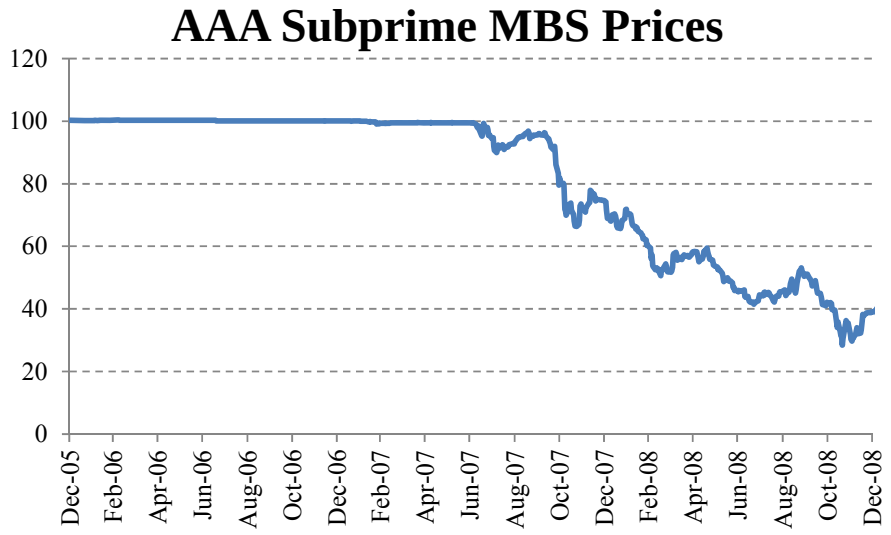
[31] Of the approximately $300 billion of MMFs assets with maturities of over 60 days, over 80% is either CDs or long-term CP, two important sources of term wholesale funding for banks. Thus, moving to a floating NAV system would give MMFs strong incentives to reduce the maturities of all assets to 60 days or less, which runs counter to the macro-prudential goal of encouraging financial institutions to fund themselves with longer term, more stable liabilities.

[32] Money Market Funds: A Path Forward, BlackRock Viewpoint, 9/27/2012: https://www2.blackrock.com/webcore/litService/search/getDocument.seam?venue=PUB_IND&source=GLOBAL&contentId=1111173537.

insufficient to change investor (or rating agency) perceptions of risk in a meaningful way. Investors treated these AAA-rated assets as though they were virtually risk-free until the crisis began.

It is also worth noting that institutional investors are the ones who most aggressively seek out yield in normal times and most aggressively withdraw their funds in a crisis.[33] Presumably, these more sophisticated investors are already aware of the risks involved in investing in MMFs and are tempted to take on the tail risks embedded in higher-yielding prime MMFs on the expectation that either (i) they will be able to withdraw their funds before losses are realized in a crisis or (ii) the MMF industry will receive government support in crisis because of its close links to the rest of the financial system. Furthermore, since the vast majority of prime MMF assets receive "cash and equivalent" status under current FASB accounting rules, it seems extremely likely that floating NAV MMFs would continue to receive the cash and equivalent accounting treatment that is of crucial importance to institutional investors.[34] Therefore, the floating NAV reform option is unlikely to change the behavior of institutional investors.

Figure 2: Market price of AAA-rated subprime MBS. The figure shows the chained price series for the ABX.HE AAA tranche, a basket index of subprime MBS, and the trailing volatility of price changes (computed as the annualized trailing 30-day volatility).



Moreover, floating NAV MMFs would still carry a significant government imprimatur of safety so long as Rule 2a-7 remains in effect. As currently contemplated (see FSOC 2012), reform

[33] Kacperzyck and Schnabl 2012, Chernenko and Sunderam 2012.

[34] Cash and equivalent investments must satisfy a number of criteria: they should mature in less than three months; they should be highly liquid and readily convertible to known amounts of cash; and the risk of a decline in their market value should be minimal. In practice, short-term certificates of deposits, repurchase agreements, and commercial paper are almost always accorded cash and equivalent status.

proposals would abolish the fixed NAV while maintaining all current Rule 2a-7 restrictions on the quality, maturity, and concentration of MMF holdings. Thus, Rule 2a-7 prime funds would continue to be a "government-certified safe product", making it unlikely that simply allowing the NAV float to between $99.90 and $100.10 would substantially change investor perceptions of risk and behavior. Investors would still chase yield with the expectation that they could rapidly redeem their shares in a crisis; financial institutions would still have incentives to rely excessively on short-term financing from these funds; and policy makers would find it no easier to stand by and watch a large-scale run on prime MMFs without intervening to guarantee MMF shareholders.

Finally, a key part of the FSOC's floating NAV proposal is that sponsors would not be permitted to support their MMFs. Otherwise, sponsor support could be used to keep the NAV stable, defeating the purpose of floating the NAV in the first place. However, if sponsors were no longer permitted to support MMFs, existing floating NAV proposals may be far worse than the status quo. Specifically, if, as argued above, it turns out that floating NAV MMFs are still subject to runs, sponsors will have less ability to quickly step in and protect shareholders. Thus, a move to a floating NAV could actually increase the probability and severity of MMF runs.

To summarize, the floating NAV reform option is unlikely to meaningfully change the status quo. Under the floating NAV system contemplated by the FSOC, NAVs would fluctuate very little, if at all, in normal times, incentives for investors to run in a crisis would remain strong, and incentives for funds to take risk in normal times would remain strong. Thus, at best, moving to a floating NAV would not eliminate any of the existing structural problems with prime MMFs. And, at worst, current floating NAV proposals would undermine financial stability by tying sponsors' hands ex post.

If floating NAV reforms are pursued, the best course would be to simply revoke Rule 2a-7 in its entirety and allow MMFs to operate as ordinary mutual funds. In addition, the SEC should reconsider the broader provisions allowing mutual funds to value short-term paper at amortized cost. Instead, the SEC should consider new valuation techniques for measuring the credit risk of the illiquid paper held by prime MMFs.[35] Such a suite of actions—rather than maintaining 2a-7 while simply dropping the penny-rounding provision—would be needed to remove the government imprimatur of safety that MMFs currently enjoy and to significantly change investor perceptions about the risks inherent in MMFs. Furthermore, since sponsors would still be likely to provide

[35] For instance, one possibility would be to use model-based valuation techniques linked to the longer-term CDS spreads of the underlying issuers.

support to ultra-short-term bond funds,[36] bank regulators should require bank sponsors to hold capital in expectation of such future support. While this approach would be preferable to existing floating NAV proposals, it would not eliminate the financial stability threat posed by non-bank affiliated MMFs and would clearly be inferior to capital-based reforms.

B. Minimum balance at risk

Researchers at the Federal Reserve Board and Federal Reserve Bank of New York have recently put forward a proposal for MMF reform, which they call minimum balance at risk (MBR).[37] The basic idea is that some fraction of each investor's investment in a fund serves as loss-bearing subordinate capital. The key innovation is that even if the investor redeems shares, that fraction of the initial investment must remain as subordinate capital in the fund for 30 days. The MBR proposal effectively requires MMF investors to provide capital for the fund, and therefore has many of the positive attributes of outside capital discussed above. The key difference between the proposals is where the capital comes from. In the MBR proposal, the capital comes from traditional MMF investors, while in capital buffer proposals, the subordinated capital is likely to come from a different set of investors (or the fund sponsor).

There are two dimensions along which it is likely to matter *which* investors provide the capital and *when* they provide it: (i) ex ante incentives for investor yield-chasing, and hence, MMF risk-taking and (ii) ex post reactions to losses.

Both capital buffers and MBR should help to reduce ex ante incentives for risk taking because subordinated capital providers should exercise market discipline on fund managers. This is analogous to the idea that bank capital requirements reduce incentives for bank managers to take excessive risks because those risks are borne by bank equity holders. Evidence on the effectiveness of external market discipline from bank equity holders is mixed. So while market discipline from junior capital providers is no panacea for excessive risk taking, it could arguably play a useful role.

Under the MBR approach, incentives for ex ante risk taking could be reduced in an additional way: investors would be directly discouraged from chasing yield across MMFs because they themselves would bear the losses generated by the resulting risk taking. Furthermore, under the

[36] The SEC would still be likely to permit sponsor support in a crisis on a one-off basis under Section 17b of the Investment Company Act of 1940.

[37] See Patrick McCabe, Marco Cipriani, Michael Holscher, and Antoine Martin (2012), "The Minimum Balance at Risk: A Proposal to Mitigate the Systemic Risks Posed by Money Market Funds," Finance and Economics Discussion Series 2012-47. Board of Governors of the Federal Reserve System (U.S.).

MBR approach, the operational costs of chasing yield across funds would increase because investors would be required to leave behind some subordinated capital when they transfer funds to another MMF. Thus, MBR might be expected to make investor balances more "sticky" in normal times. However, it is worth noting that by placing restrictions on ordinary MMF shareholders, MBR does alter the product from their perspective, potentially reducing its transactional value to them.

A second key consideration in choosing between capital buffers and MBR concerns differences in the ex post reaction of capital providers to losses under the two schemes. Financial systems work best when the rules that allocate losses are set in a transparent manner that is clearly understood by investors in advance. Under capital buffer proposals, the risk of loss is primarily borne by more sophisticated, risk-tolerant investors who should clearly understand that their capital may be impaired in bad times. In contrast, under the MBR proposal, losses would be primarily borne by traditional MMF investors. These investors presumably choose to invest in MMFs in the first place because they are averse to bearing losses. These highly risk-averse investors may be somewhat less sophisticated and may not fully understand the complexities of the MBR mechanism—particularly following a long period of financial market tranquility when it has largely been inoperative. Thus, it is possible that suddenly assigning losses to them in bad times could set off system-wide runs: the stability of the financial system in bad times is likely to be best protected by assigning losses to the least loss-averse investors, not the most loss-averse. In summary, MBR could make funds more run-prone in bad times than a regime using a capital buffer.

Overall, however, capital buffer schemes and the MBR proposal are quite similar. While capital buffers are preferable because they transparently allocate losses to more risk tolerant investors, the MBR proposal could also largely achieve the goals of MMF reform.

C. Other measures

C.1. Increased transparency

Another commonly proposed MMF reform is increased disclosure of fund portfolios. The argument made by proponents of such reform is that increased disclosure will enable investors to more closely monitor fund risk taking. In the event that the fund is taking too much risk, investors could then discipline the fund by redeeming their shares.

There are two main problems with such proposals. First, MMFs already publish a near-perfect measure of their risk taking every day: *the gross yield on their assets*. Due to the strict limitations on portfolio risk dictated by Rule 2a-7, nearly all differences in gross yield across MMFs

are due to differences in risk taking. Unlike other types of mutual funds, there is virtually no scope for skilled managers to generate excess risk-adjusted returns through careful portfolio selection.

Second, as discussed above, sophisticated institutional investors already monitor fund portfolios carefully. However, the behavior of institutional investors suggests that they *want their MMFs to take risk* because they believe they can redeem their shares before losses are realized in a crisis. Moreover, the SEC's 2010 enhancements to Rule 2a-7, which required funds to disclose their portfolio holdings monthly, have virtually done nothing to discourage this yield chasing behavior—investors rewarded MMFs that invested in risky Eurozone banks with inflows in early 2011, even though these transparency measures were in place.

C.2. Gating rules

A third set of commonly proposed MMF reforms are so-called gating rules. These proposals allow MMFs to operate as they currently do in normal times, but would impose fees or restrictions on redemptions if certain conditions are met. For instance, BlackRock has proposed that investors pay a liquidity fee for redemptions when a MMF's NAV falls below $0.9975 or when its 1-week liquidity level falls below 7.5% (well below the current regulatory minimum of 30%).[38] Advocates of such conditional restrictions argue that they will help to discourage investor redemptions and control runs in the event of a crisis.

We have three main concerns about gating rules. First, gating rules have an inherently micro-prudential focus. They are based on the condition of individual funds and aim to control the behavior of investors in individual funds. However, gating rules can have significant macro-prudential consequences. Specifically, news that one MMF has initiated redemption restrictions could set off a system-wide run by panic-stricken investors who are anxious to redeem their shares before other funds also initiate restrictions.

Second, Rule 2a-7 already contains a gating rule, which has proven to be ineffective. In particular, the fund may suspend redemptions if its NAV falls below $0.995—i.e., if a fund "breaks the buck". This rule incentivizes investors to redeem their shares at the first indication of trouble out of fear that their cash could be trapped in the fund if it suspends redemptions. New gating rules will simply exacerbate the incentives for investors to redeem early by setting a threshold for redemption fees or restrictions closer to $1.00 than the existing threshold of $0.995. For instance, in the

[38] Money Market Funds: A Path Forward, BlackRock Viewpoint, 9/27/2012: https://www2.blackrock.com/webcore/litService/search/getDocument.seam?venue=PUB_IND&source=GLOBAL&contentId=1111173537.

BlackRock gating proposal, investors would have an incentive to redeem their shares early to avoid paying liquidity fees if they believed that their fund's NAV could drop below \$0.9975.[39]

Furthermore, in order for gating rules to be effective at mitigating a run once it has begun, they need to be stringent. However, stringent gating rules only amplify the ex ante incentives to withdraw early, before the gating rule is applied. For instance, suppose a fund's NAV fell to \$0.997 under the BlackRock liquidity fee scheme. Consider the problem of an investor who believes he will only receive \$0.970, the recovery value for investors in the Reserve Primary fund, if he leaves his money in the fund. This investor will redeem his shares unless he faces a liquidity fee of at least 3%. However, if liquidity fees were set to 3% or more, this would exacerbate the early withdrawal problem. Knowing that he could face a future liquidity fee of 3%, the investor would have strong incentives to redeem his shares long before the fund's NAV ever fell to \$0.997.

Gating triggers based on the liquidity of fund assets pose additional problems. Such triggers would discourage MMFs from drawing down on their buffers of liquid assets precisely when they should do so from a system-wide perspective, i.e., in a system-wide liquidity crisis. The purpose of maintaining buffers of liquid assets is to allow funds to meet large redemption requests without withdrawing financing from private issuers. In addition, liquidity-based triggers would encourage MMFs to demand shorter maturity commercial paper, making the financial system as a whole less stable. In particular, liquidity-based triggers would encourage MMFs to keep their buffers of liquid assets very high to avoid concerns about triggering redemption fees or restrictions. Thus, they would demand commercial paper that matures in five days or fewer, which qualifies as a liquid asset. As a result, financial institutions would be forced to fund themselves with shorter term financing, making them more vulnerable to destabilizing runs. This undermines the broader macro-prudential goal of encouraging financial institutions to use longer-term, stable funding.

VI. Conclusion

The primary objective of MMF reform should be to safeguard the stability of the financial system. Specifically, reforms should be designed to curb ex ante incentives for excessive risk-taking and to bolster the ex post ability of MMFs to absorb losses without setting off system-wide runs, which would destabilize the financial system and damage the economy as a whole. Requiring

[39] Moreover, the lack of liquid secondary markets for commercial paper and other MMF assets means that there could be substantial uncertainty over when restrictions would be triggered, again making investor more prone to withdraw at the slightest hint of trouble.

diversified MMFs to have a capital buffer equal to 3% to 4% of risk-weighted assets would best accomplish these goals. Less diversified MMFs should be required to have larger capital buffers. At the same time, retaining the fixed $1.00 NAV would preserve the transactional services that MMFs provide to savers and would maintain the current day-to-day user-experience for ordinary MMF investors. Alternate reform proposals, such as moving to a floating NAV, would not achieve these critical financial stability objectives and could diminish the transactional services that MMFs provide. Thus, we suggest that the Financial Stability Oversight Council should recommend that the SEC adopt capital buffers for MMFs (Alternative 3).

Appendix A: Contractual Mechanisms for Providing a Capital Buffer

A. Types of capital

The capital buffer could be achieved using a variety of different contractual mechanisms. The basic idea of all of these alternatives is that each $1 of MMF shares would effectively be backed by $(1+*X*) dollars of MMF assets. In other words, the MMF could suffer $*X* of credit losses before ordinary MMF shareholders were forced to bear losses. Equivalently, each $1 of assets would be financed by $*K* = $*X*/(1 – *X*) of first-loss subordinated capital and $(1 – *K*) of ordinary (senior) MMF shares.

Below we discuss several different variations on capital that have been proposed. All the variants provide the major benefits of capital discussed above, and all would achieve the goals of reform. Below we briefly describe how each variant would work, and discuss the economically important differences between them.

A.1 Subordinated share class

For every $1 of MMF 2a-7 assets, the MMF would issue $*K* of subordinated shares. Ordinary MMF shareholders would have the option to redeem on a daily basis at a $1.00 NAV. Thus, ordinary shares would be open-ended mutual fund shares exactly as they are today. Subordinated shareholders would not have the right to redeem on demand. Instead, subordinate shares would closed-end (i.e. perpetual) shares with a floating dividend tied to portfolio credit losses. These subordinated shares could either be held by the fund sponsor or by third-party investors.[40] MMFs would need to define a priority rule that allocates credit losses between ordinary MMF shares and subordinated shares. Specifically, one can think of this as specifying a transfer $t = t(L_A)$ where t is a decreasing function of portfolio losses, L_A. If the total return on portfolio assets is R_A and credit losses are L_A, ordinary MMF shares would earn a dividend of $R_A - t(L_A)$ and subordinate shareholders would earn a dividend of $R_A + t(L_A) \times (1-K)/K$.[41] As a result, the subordinate shares would earn a higher return in good times in exchange for agreeing to absorb a disproportionate share of portfolio losses in bad times. The ordinary shares would be even safer and would correspondingly earn a slightly smaller return.

Example: Suppose K = 4% and that t = 0.05% in normal times and $t = -R_A K/(1-K)$ in bad times when the portfolio of 2a-7 assets suffers a credit loss. In this example, ordinary MMF shareholders would receive a yield of R_A – 0.05% < R_A in normal times and a yield of

[40] In the case where subordinate shares are held by third-party investors, they would be closed-end mutual fund shares. Of course, investors would be allowed to buy and sell subordinated shares in the secondary market. Thus, there would be a near perfect analogy with open-ended bank deposits and closed-end bank equity.

[41] Thus, we have $(1-K) \times \big(R_A - t(L_A)\big) + K \times (R_A + t(L_A) \times (1-K)/K) = R_A$, so that the weighted average dividend to ordinary and subordinated shares equals the return on the underlying assets. Technically, we would also require that $-R_A K/(1-K) \leq t(L_A)$ so that dividend payments to subordinated shareholders never be negative.

$R_A/(1-K) = 1.04 \times R_A$ in bad times. Conversely, subordinated shareholders would receive a yield of R_A + 1.20% in normal times and a yield of 0% in bad times.

One technical question is how this structure would work dynamically. As above, the guiding analogy would be with open-ended bank deposits and closed-end bank equity. Suppose an MMF starts with $\$(1-K)$ of ordinary shares and $\$K$ of subordinate shares. In this first period, payouts would be given by $(1-K) \times \left(R_A - t(L_A)\right) + K \times (R_A + t(L_A) \times (1-K)/K) = R_A$. Suppose there is an outflow of ordinary MMF shares so that there only $\$N < \$(1-K)$ of ordinary shares. The ordinary shares would still receive $R_A - t(L_A)$, but subordinate shares would now only receive $R_A + t(L_A)N/K < R_A + t(L_A) \times (1-K)/K$. However, we can always operate this rule as the N moves up and down since $N \times \left(R_A - t(L_A)\right) + K \times (R_A + t(L_A)N/K) = (N+K) \times R_A$. However, to satisfy the capital requirement, MMFs would need to raise more subordinate shares following significant inflows into ordinary open-ended shares. Specifically, following an inflow into ordinary shares, an MMF would be required to raise additional money by selling new closed-end subordinated shares and these new funds would be invested in 2a-7 eligible assets.[42]

A.2 Standby liquidity facility or escrow account

MMFs would pay a premium for a standby liquidity facility whereby the MMF can sell some fraction of its portfolio at par when those assets become impaired. This liquidity facility could either be purchased from a fund sponsor or from a third-party insurer so long as the sponsor or third-party meets a regulatory standard for creditworthiness and liquidity. And the liquidity facility provider should have to hold an appropriate amount of equity capital against this commitment.[43] Alternately, this standby facility should itself be backed by a dedicated buffer of highly liquid assets such as Treasury-bills that can be sold at a moment's notice in order to finance the purchase of impaired assets from the MMF.

For every \$1 of 2a-7 eligible assets and \$1 of MMF shares the MMF would need to have access to $\$X = \$K/(1+K)$ in standby liquidity facilities. Here the facility a state-contingent net payment stream (premium minus policy payouts) of $t = t(L_A)$ so that the MMF shareholders receive a net yield of $R_A - t(L_A)$ and the facility provider would received a net payment of $t(L_A)$.

B. Comparison between types of capital

Obviously, at high level, there is a very tight link between subordinated shares and standby liquidity facility. In either case, one has purchased a put against MMF assets from either the MMF sponsor or a third party. In return for this put, MMF shareholders will receive a slightly smaller return than they otherwise would in normal times in exchange for the additional safety this put offers in bad times.

[42] This could be done by "tapping" an outstanding series of subordinated shares trading at a premium or discount to "par value" or by issuing a new series of subordinated shares with a coupon set at the current market-going rate.

[43] Otherwise, one would worry that the liquidity provider would not be able to honor its commitment in a crisis, or that in so honoring its commitment the liquidity provider would exhaust in non-dedicated buffer of liquid assets or its capital buffer, thus comprising its own ability to engage in credit intermediation.

Appendix B: Calibrating the Size of MMF Capital Buffers

In this Appendix, we use a simple model of credit portfolio losses to calibrate the size of MMF capital requirements. Specifically, we adopt the workhorse Vasicek (2002) model of portfolio loss. The Vasicek model is simply a tool for translating the common sense insights of modern portfolio theory into the credit portfolio context where losses on individual positions tend to be binary in nature. Given the central role it plays in the Basel II bank capital framework (Gordy 2003), the Vasicek model has the convenient feature of being well understood by private risk managers, policymakers, and academics alike.

A. Analytical framework

Assume that the return on assets for each obligor *i* in a credit portfolio is

$$r_i^A = \sqrt{\rho} f + \sqrt{1-\rho}\varepsilon_i, \tag{1}$$

where $f \sim N(0,1)$ is a common economic factor affecting all obligors in the portfolio and $\varepsilon_i \sim N(0,1)$ captures idiosyncratic obligor-specific factors (we assume $Cov[\varepsilon_i, \varepsilon_j] = 0$ for $i \neq j$). Thus, we have $r_i^A \sim N(0,1)$ and $Corr[r_i^A, r_j^A] = \rho$ for $i \neq j$.

Assume each obligor defaults with probability π. Specifically, obligor *i* defaults if $r_i^A < \Phi^{-1}(\pi)$. Letting $D_i = \mathbf{1}\{r_i^A < \Phi^{-1}(\pi)\}$ be a default indicator for obligor *i*, we have

$$E[D_i] = \Pr[r_i^A < \Phi^{-1}(\pi)] = \pi. \tag{2}$$

This implies that the *default correlation* between any pair of distinct firms *i* and *j* is

$$\rho^* = \frac{\Phi_2[\Phi^{-1}(\pi), \Phi^{-1}(\pi), \rho] - \pi^2}{\pi(1-\pi)}, \tag{3}$$

where $\Phi_2[\cdot,\cdot,\cdot]$ denotes the standard bivariate normal cumulative distribution function. For instance, assuming $\pi = 0.03\%$ and $\rho = 0.50$, equation (3) implies that the default correlation is 3.45%.

Consider a credit portfolio of *N* obligors each with portfolio weight 1/*N*. Assume the loss-given-default for each obligor is $\lambda \in (0,1]$. Thus, the realized portfolio loss is given by

$$L_N = \lambda \times N^{-1} \sum_{i=1}^{N} D_i. \tag{3}$$

Obviously, the expected portfolio credit loss is given by $E[L_N] = \lambda\pi$. Since the each firm's default is a binary outcome, the variance of portfolio loss is

$$Var[L_N] = \lambda^2 \pi(1-\pi)\left(\frac{N + N(N-1)\rho^*}{N^2}\right) = \lambda^2 \pi(1-\pi)\left(\rho^* + \frac{(1-\rho^*)}{N}\right), \tag{5}$$

which is decreasing in the number of obligors in the portfolio, *N*. As the number of obligors increases, idiosyncratic default risk is diversified away, meaning that the portfolio only reflects systematic default risk. For instance, assuming λ = 1, π = 0.03%, and ρ = 0.50, we have

$\sqrt{Var[L_{40}]} = 0.40\%$ and $\sqrt{Var[L_{\infty}]} = 0.32\%$. As discussed below, other moments and quantiles of the loss distribution for small *N* can be obtained via simulation.[44]

We can derive convenient analytical expressions for the portfolio loss distribution in the limiting case where the number of obligors *N* grows large. To derive the limiting distribution, we condition on the realization of the common factor linking firm returns, *f*. Specifically, we have

$$E[D_i \mid f] = \Pr[r_i^A < \Phi^{-1}(\pi) \mid f] = \Pr\left[\varepsilon_i < \frac{\Phi^{-1}(\pi) - \sqrt{\rho} f}{\sqrt{1-\rho}} \mid f\right] = \Phi\left(\frac{\Phi^{-1}(\pi) - \sqrt{\rho} f}{\sqrt{1-\rho}}\right). \quad (5)$$

Equation (5) shows that the *conditional probability of default* is decreasing in the realization of the common factor, *f*—i.e., firm default is less likely in good times when *f* takes on higher values. As the number of obligors in the portfolio becomes arbitrarily large, the law of large numbers then implies that portfolio losses are almost surely equal to

$$L_{\infty} = \lambda \times \Phi\left(\frac{\Phi^{-1}(\pi) - \sqrt{\rho} f}{\sqrt{1-\rho}}\right), \quad (6)$$

when the realization of the common factor is *f*. Using equation (6), we can then derive the cumulative distribution of portfolio losses as

$$\Pr[L_{\infty} < \ell] = \Pr\left[f > \frac{\Phi^{-1}(\pi) - \sqrt{1-\rho}\Phi^{-1}(\ell/\lambda)}{\sqrt{\rho}}\right] = \Phi\left(\frac{\sqrt{1-\rho}\Phi^{-1}(\ell/\lambda) - \Phi^{-1}(\pi)}{\sqrt{\rho}}\right). \quad (7)$$

Finally, using equation (7) we can solve for the p^{th} percentile of the loss distribution—i.e., the value $K(p)$ such that $\Pr[L_{\infty} < K(p)] = p$. Specifically, we have

$$K(p) = \lambda \times \Phi\left(\frac{\sqrt{\rho}\Phi^{-1}(p) + \Phi^{-1}(\pi)}{\sqrt{1-\rho}}\right). \quad (8)$$

The natural approach would then be to calibrate the size of the capital buffer using equation (8) for some value such as p = 99.9% set by policymakers—i.e., policymakers would choose a capital buffer such that the probability that an MMF breaks the buck is less than 0.1%.

B. Calibrating the capital requirement

We now compute the capital requirement for unsecured corporate exposures. We first impose the simplifying assumption that the number of borrowers in the portfolio, *N*, is large. We revisit this concentration assumption below. We use the following inputs in our calibration:

- Loss-given-default, $\lambda = 1$. There is a strong rationale for assuming $\lambda = 1$ on MMF claims against unsecured paper. Studies suggest that loss-given-default has historically been higher for defaults on the financial debt that dominate MMF portfolios than for non-financial bonds. Indeed, the loss-given-default in recent cases of the Lehman Brothers and Icelandic bank defaults was over 90%. Irrespective of the actually loss-

[44] A slight generalization of this result to a portfolio with a non-homogenous set of obligors weights, $\{w_i\}_{i=1}^N$, is $Var[L_N] = \lambda^2\pi(1-\pi)(\rho^* + (1-\rho^*)\sum_{i=1}^N w_i^2)$. In other words, the granularity add-on is proportional to the Herfindahl index of portfolio weights. In the case of an equal-weighted portfolio, the Herfindahl is simply 1/*N*.

given default, it is likely highly risk averse MMF shareholders are and likely to *react* to portfolio defaults under a 100% loss-given-default assumption. Since the systemic risk posed by MMF losses has to do with the reaction of MMF shareholders, we believe that $\lambda = 1$ is an appropriately conservative assumption in this context. [45, 46]

- Asset correlation, $\rho = 0.50$. The average pairwise correlation between any two stocks in the US is roughly 0.25. However, since the vast majority of MMF obligors are financial firms, they are likely to be far more correlated with each other. Thus, there is a strong argument for assuming a higher asset correlation when calibrating MMF capital requirements. One simple approach to estimate this correlation is to examine the average pairwise correlation between the unlevered stock returns of financial firms. Doing so, our estimates of the average pairwise correlation between the unlevered stock returns of financial firms is roughly $\rho = 0.50$. And, this is significantly higher than the average pairwise correlation between all corporations which we estimate to be roughly 0.25.[47, 48]

- Annual probability of obligor default, $\pi = 0.03\%$. The minimum annual probability of default for corporate issuers under Basel II is 0.03%.[49] As shown in Table 2, this 0.03% probability is in-line with Moody's (2010) estimates of the probability that a commercial paper with the highest short-term rating (i.e., P-1) defaults in the following year.

- Annual probability that an MMF does not "break the buck", $p = 99.9\%$: This is not a parameter than can be estimated. Instead, this is an input that must be chosen by policymakers based on an assessment of (i) the costs of the financial instability that would be unleashed if an MMF "broke the buck" versus (ii) the costs, if any, of imposing higher capital requirements on MMFs. For simplicity, we use $p = 99.9\%$ which is the annual probability of bank survival adopted by policymakers under the Basel II Internal Risk-Based calibration (see BCBS (2006)).

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[45] See Altman, Edward I. and Vellore M. Kishore (1996), "Almost Everything You Wanted to Know about Recoveries on Defaulted Bonds," *Financial Analysts Journal*, Vol. 52, No. 6, pp. 57-64. This paper estimates that loss-given-default for financials is 64% versus just 30% for utilities.

[46] See Duffie, Darrell (2010), "The Failure Mechanics of Dealer Banks," *Journal of Economic Perspectives*, Vol. 24, pp. 51-72 who explains how the actions of secured counterparties of large banks can consume liquidity and destroy franchise value in the run-up to failure, potentially resulting in significant losses for unsecured creditors.

[47] Suppose that $\bar{r}^A = \sqrt{\rho} f$ is the return on assets for a large equal weighted portfolio of financial firms. Since $Corr(r_i^A, \bar{r}^A) = \sqrt{\rho}$, one way to estimate the average pairwise correlation is to look at the the average of the R^2 statistic from regressions on r_i^A on $\bar{r}^A$. To implement this idea, we compute $r_i^A = (E/(E+D))r_i^E$ where E is the market value of equity, r_i^E is the company's stock return, and D is the book value of liabilities for all publicly-traded financial firms in the CRSP-Compustat sample. For each financial firm *i*, we then regress r_i^A on the equal-weighted asset return for all financial firms, $\bar{r}^A$. Our estimate of ρ is the average R^2 from these firm-level regressions.

[48] The estimated correlation of 0.25 for all firms is also in-line with the correlations assumed in pricing corporate CDOs.

[49] See, for instance, pg. 67 of Basel Committee on Banking Supervision (2006), "International Convergence of Capital Measurement and Capital Standards".

Table 2: Commercial paper default probabilities: This table shows Moody's (2010) estimates of the probability of default on highly-rated (i.e., P-1 rated) commercial paper between 1972 and 2009 (see Exhibit 7 of Moody's (2010)). These probabilities are estimated at various daily horizons, H. We then convert these to an annual horizon (assuming time-series independence) using $PD(365) = 1 - (1 - PD(H))^{365/H}$. The annual *PD*s implied from *PD*s measured over longer horizons are larger since Moody's attempts to downgrade obligors, leading them to lose their P-1 rating, as they approach default.

Horizon in Days (H)	Horizon $PD(H)$	Implied Annual $PD(365)$
30	0.003%	0.036%
60	0.006%	0.036%
90	0.009%	0.036%
120	0.013%	0.040%
180	0.021%	0.043%
270	0.033%	0.045%
365	0.045%	0.045%

Using equation (8), these parameter values yield a capital requirement of $K = 3.9\%$.[50] Thus, this calibration exercise suggests that reasonable input values are consistent with a capital buffer in the neighborhood of the FSOC's recent 3% and 4% proposals.

Table 3: Required Capital Buffer for MMFs: This table shows the capital buffer needed to ensure that the probability that ordinary MMF shares sustain a loss is less than 0.1%, assuming $\lambda = 100\%$.

Correlation (ρ)	Obligor Default Probability (π), % per annum				
	0.01%	**0.02%**	**0.03%**	**0.04%**	**0.05%**
30%	0.77%	1.36%	1.88%	2.36%	2.81%
40%	1.14%	2.03%	2.83%	3.55%	4.23%
50%	1.50%	2.77%	3.90%	4.93%	5.90%
60%	1.81%	3.49%	5.04%	6.47%	7.81%
70%	1.92%	4.07%	6.12%	8.06%	9.90%

Of course, one's answer to this calibration question will only be as good as one's assumptions about the relevant inputs. It is extremely difficult to estimate the inputs with great precision and reasonable people will disagree. Therefore, Table 3 presents the required capital buffer when we vary our assumption about the probability of obligor default (π) and the correlation between obligor asset returns (ρ). Table 3 suggests that reasonable assumptions on π and ρ yield capital requirements between 1% and 6%, with a central tendency of perhaps 3% to 4%. Furthermore, equation (8) shows that the requirement is linear in the assume loss-given-default, λ. Thus, holding all other parameters besides λ at their baseline levels, we obtain capital requirements of 3.12% (= 80%×3.90%) and 2.34% (= 60%×3.90%) if we assume that $\lambda = 80\%$ and $\lambda = 60\%$, respectively. Note, however, that this is the capital that MMF would be required to hold against unsecured paper which would be assigned a 100% risk weighting. For instance, commercial paper would receive a risk weight of 100% and Treasury bills would receive a 0% risk-weight.

[50] Alternately, we can redo this analysis assuming a 30-day probability of default of 0.003%, but now requiring a monthly probability of MMF survival of 99.9917% = $(99.9\%)^{(1/12)}$. This yields a required capital buffer of 2.8%.

It is worth contrasting this calibration with a back-of-the-envelope calibration for the C&I portfolio of a typical banking firm—i.e., for exposures that receive a 100% risk weight under Basel. As above, we require that $p = 99.9\%$. For a bank portfolio of C&I loans, one might assume $\lambda = 60\%$ based on average corporate recovery rates, $\rho = 25\%$ due to more diverse set of firms in banking portfolios (and in line with the standard assumption in corporate CDO pricing), and $\pi = 1\%$ reflecting an average BB-rating of bank borrowers. These inputs yield $K = 11.0\%$ which is in line with current Basel capital requirements. Specifically, Basel III would require banks to hold 10.5% total capital as a fraction of risk-weighted-assets. Thus, despite the fact that MMFs assets are far less risky than banks loans, MMFs would still require about half of the capital of banks because (i) loss-given-default on financial paper is likely to be high and (ii) because the default correlations are far higher than in a banking portfolio.

C. Pricing subordinate MMF shares

How risky would subordinate MMF shares be? Many criticisms of MMF capital requirements seem to assume that subordinated shares would be very risky and that investors would thus require substantial "equity-like" returns to hold subordinate MMF shares. However, this perspective runs counter to the common sense logic of Modigliani and Miller (1958) which forms the cornerstone of modern corporate finance. The combined risk of first-priority shares and subordinate shares is the same—and equal to the total risk of the underlying portfolio assets—irrespective of the mix between first-priority and subordinate shares. The Modigliani-Miller logic suggests that subordinate MMF shares would not be all that risky because they are claims—albeit subordinate ones—against safe 2-a7-eligible assets. And since total risk must always be conserved, Modigliani-Miller logic suggests that *both* subordinate shares and first-priority shares would become safer as one increased the fraction of portfolio assets financed with subordinate shares.

To illustrate the first point, i.e., that subordinate MMF shares would not be particularly risky, assume that the capital buffer has been set at $K(p)$ as in equation (8) and let $Q_\infty = \min\{L_\infty / K(p), 1\}$ denote the percentage loss on the subordinated capital. We can compute the probability that a subordinate capital provider will suffer a percentage capital loss greater than q%, corresponding to a portfolio loss of $\ell = qK(p)$, using

$$\Pr[Q_\infty > q] = 1 - \Phi\left(\frac{\sqrt{1-\rho}\,\Phi^{-1}(qK(p)/\lambda) - \Phi^{-1}(\pi)}{\sqrt{\rho}}\right). \qquad (9)$$

Using equation (9), the probability that the holders of a 3.9% a subordinate tranche holder would lose more than 60% of their capital is approximately 0.21%. A 60% loss on the subordinated tranche is in-line with the average loss-given-default in corporate bonds and, thus, might loosely correspond to an "economic default" on the subordinated shares. [51] Table 4 uses equation (9) to compute the probability that holders of a 3.9% subordinated tranche would realize a range of alternative percentage capital losses.

[51] One might loosely associate smaller losses on subordinate MMF shares with transitions to lower, non-default corporate bond ratings—e.g. a transition from BBB to B.

Table 4: Probability of various losses on a subordinated tranche: Using equation (9), we compute the probability that holders of subordinated shares suffer various percentage losses, q. We assume $\lambda = 1$, $\pi = 0.03\%$, $\rho = 0.50$, and $p = 99.9\%$, so the subordinate tranche has thickness $K = 3.9\%$.

Loss on Subordinated Capital	Corresponding Total Portfolio Loss	Probability of Loss on Subordinated Capital
20%	0.78%	0.75%
40%	1.56%	0.35%
60%	2.34%	0.21%
80%	3.12%	0.14%
100%	3.90%	0.10%

By way of comparison, Table 5 lists Moody's estimates that the annual probability of default and loss-given-default for corporate bonds of various credit ratings from 1920-2011. Thus, Table 5 suggests that the probability that a MMF subordinated capital provider would suffer a 60% loss of capital is in-line with default probability—and hence a 60% loss of capital—for a low investment grade corporate bonds, e.g., A-rated or BBB-rated bonds.

Table 5: Corporate default probabilities and loss-given default by credit rating: This table shows Moody's (2012) estimates of the annual probability of default and loss-given default on corporate bonds of various ratings. See of Moody's (2012), "Annual Default Study: Corporate Default and Recovery Rates, 1920-2011." Default probabilities are from Exhibit 26 and loss-given-default is one minus the 1-year recovery rate on unsecured exposures from Exhibit 21.

Bond Rating	Default Probability, 1920-2011	Loss-Given Default, 1982-2011
AAA	0.00%	N/A
AA	0.07%	62.76%
A	0.10%	68.23%
BBB	0.28%	58.61%
BB	1.27%	52.89%
B	3.67%	62.12%
CCC	11.97%	64.28%
CC-C	24.05%	62.21%

What would be a reasonable market-based estimate of the credit spread that investors would demand for bearing the risk inherent in subordinate MMF shares? To get a rough sense of the likely credit spread, in Table 6 we examine data on the average 5-year generic bonds spreads over LIBOR from 1994-2012 using data from Barclay's Capital.

As noted by Coval, Jurek, and Stafford (2009), investors should not care simply about expected credit losses. Investors should also care about the *systematic risk* reflected in those credit losses—i.e., the tendency for losses to occur in bad economic times where losses on other financial assets are also high—and should charge a risk premium on bonds that tend to default in bad times.[52] The Coval, Jurek, and Stafford (2009) logic argues in favor of using financial spreads as opposed to spreads for all corporate bonds as a benchmark for subordinate MMF shares. Specifically, since

[52] See Coval, Joshua D., Jakub W. Jurek, and Erik Stafford (2009), "Economic Catastrophe Bonds," *American Economic Review* Vol. 99, No. 3, pp. 628-666.

financial firms own diversified portfolios of claims against others corporations, the idea is that losses on financial debt will tend to cluster in bad economic times. Thus, financial debt should contain a higher amount of higher systematic risk than non-financial debt which will reflect a large mix of idiosyncratic default risk.

Table 6: Corporate bond spreads (in basis points): This table shows corporate bonds spreads (on a swapped equivalent basis over LIBOR) from Barclay's Capital. We use monthly data on 5-year bonds spreads for all corporate bonds and corporate bonds by the subset of financial firms.

Rating, Sector	Avg. Spread, 5/94 to 11/12	Avg. Spread, 5/94 to 12/07	Avg. Spread, 1/08 to 11/12	Current Spread, 11/12
AA-rated, All	49.7	24.1	120.2	48.2
AA-rated, Financial	57.0	26.3	141.8	61.0
A-rated, All	70.0	42.0	147.5	70.1
A-rated, Financial	101.1	46.4	252.3	106.0
BBB-rated, All	126.0	79.6	254.1	139.0
BBB-rated, Financial	164.6	91.0	367.8	171.0
BB-rated, All	316.5	241.7	523.3	386.7
BB-rated, Financial	417.6	312.0	709.5	414.9

Table 6 suggests that a spread on subordinated shares in the neighborhood of 120 bps would be consistent with current market data. Seen in this light, claims by industry critics that investors would require returns on the order of 10% over the risk-free rate for holding subordinated MMF capital seem like quite a stretch. And given a 3.9% capital requirement, this suggests that ordinary MMM shareholders would offer a yield that is approximately 4% × 1.20% ÷ 96% = 0.05% less than the underlying 2a-7 assets. Critically, one must recall that this reduction in yield is not a "loss" for ordinary MMF shareholders, but is simply a consequence of the normal positive relationship between risk and return. With the introduction of a subordinate share class, first-priority MMF shares will become even safer. And risk-averse MMF investors should therefore require a slightly smaller return for holding these shares. Of course, any investor who wants to accept more risk can simply purchase the combination of first-priority and subordinate shares, enabling her to recover the risk of the underlying assets (i.e., 96.1% first-priority shares and 3.9% subordinate shares). However, a major benefit of a system with subordinate shares is that this makes it transparent that one cannot get something (more return) for nothing (no additional risk) as some MMF investors might be tempted to assume.[53]

D. Adjusting the capital buffer for concentrated portfolios

For simplicity, we calibrated the capital requirement using equation (9) which assumes that each obligor is only a tiny fraction of the underlying credit portfolio. This in turn implies that idiosyncratic default risk has been completely diversified away, so the portfolio is only exposure to

[53] Here is another approach to estimating the cost of MMF capital that yields a similar number. Suppose the market beta on short-term debt issued by financial firms is 0.009. For instance, if financial firms are leveraged 10 to 1, have a asset beta of 0.1, and an equity beta of 0.92, then their debt beta is 0.009= (0.1 – 0.10×0.92)/0.90. The assets of MMFs are simply this very low-risk debt. If there is enough MMF capital so that ordinary MMF shares are riskless, the market beta on MMF capital is 0.23 (= 0.009/0.04). Assuming a market risk-premium of 5%, this implies that the expected excess return on MMF capital must be 1.13%. Assume that MMF capital defaults with probability 0.20% and suffers a loss of 60%. Then MMF capital must pay a coupon of 1.25% (= (1.13% + 0.2%×60%)÷99.8%) in normal times.

systematic default risk that is driven by the economy or market as a whole. Of course, real world MMF portfolios are not perfectly well diversified and remain exposed to some idiosyncratic default risk. Fortunately, the exact same issues arise when calibrating risk-based Basel II capital requirements for banks, so there is ample knowledge in both the regulatory and practitioner communities for dealing with these issues.

To explore this issue, we now simulate the loan loss distribution in the case where N is small. Specifically, in Table 7 where we compute the 99.9th percentile of the loss distribution for various values of N. We use equation (3) to simulate portfolio losses. First, we first draw a value of the common economic factor, f. We then independently draw the idiosyncratic, obligor-specific component of returns ε_i for each of the N firms. We can then compute the firm default indicators and realized portfolio loss. Repeating this exercise many times, we can derive the loss distribution for a portfolio with N obligors.

Table 7: Required Capital for Concentrated Portfolios: This table reports the 99.9th percentile of the loss distribution for various values of N. We simulate the portfolio loss distribution L_N using 25,000,000 replications.

N	$K(0.999)$
25	8.00%
50	6.00%
75	4.00%
∞	3.90%

Table 7 suggests that the appropriate granularity adjustment for MMF portfolios may be sizeable. For instance, a MMF portfolio of only 50 obligors would require a capital buffer of 6.00% in order to achieve the 0.1% probability of "breaking the buck" that a more diversified portfolio could achieve with 4.00% capital. Thus, as discussed in the main text, we propose that MMFs face a simple schedule such as that in Table 7 that would specific their required capital as a function of portfolio concentration. As discussed by Gordy (2003), a simple way to approximate the capital requirement foir a non-equal-weighted portfolio of N obligors is to impose the capital requirement that would be appropriate for an equivalent equal-weighted portfolio of N^* obligors where $1/N^* = \sum_{i=1}^{N} w_i^2$ —i.e., one equates $1/N^*$ with the portfolio Herfindahl index. Thus, funds would be subjected to requirements based on N^* as opposed to the number of firms in their portfolio.

The portfolios of prime MMFs are have historically been quite concentrated. Based on form NMFP data from August 2011 for non-government holdings, the average share of an obligor in an MMF portfolio is 2.7%, the median is 2.4%, the 10th percentile is 1%, and the 90th percentile is close to the 5% limit. The mean Herfindahl index for non-government holdings is 5% (corresponding to $N^* = 20$) and the median is 3.5% ($N^* = 29$). Thus, assuming no change in MMF portfolios, the granularity add-ons could be quite substantial.[54] However, the add-ons would fall substantially if MMFs reduced the concentration of the portfolios—a step that would enable them to meet the core objective of providing savers with a *diversified* portfolio of deposit-like instruments.

[54] In our NMFP data the average portfolio share of Treasuries and Agencies is 30%, which would scale the overall capital down substantially: a 6% capital requirement on risky assets is a 4.2% capital requirement on total assets.