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November 1, 2022

VIA E-MAIL RULE-COMMENTS@SEC.GOV

Ms. Vanessa A. Countryman, Secretary
U.S. Securities and Exchange Commission
100 F Street NE
Washington, DC 20549-1090

Re: Comment Letter of Federated Hermes, Inc. on the U.S. Securities and Exchange Commission's Proposed Amendment to Rule 2a-7 Requiring the Use of Swing Pricing in Institutional Prime and Tax-Exempt Money Market Funds (SEC File No. S7-22-21)

Dear Ladies and Gentlemen:

Federated Hermes, Incorporated ("Federated Hermes'" or "FHI") appreciates the opportunity to file this supplemental comment letter. We do so first to discuss the classic 1983 paper by Professors Douglas Diamond and Philip Dybvig on bank runs, for which they were awarded the Nobel Prize in Economics in October. The Commission briefly references that 1983 paper by analogy in support of the proposed amendments. In this letter we distinguish bank runs described in their work from MMF shareholder redemptions in a financial crisis, as well as the implications of their work on de-linking MMF gates and fees from regulatory liquidity levels, and the importance of Federal Reserve secured lending facilities to unlock short-term credit markets in a crisis as is its statutory mandate.

Second, to the extent that the amendments were proposed as an adjunct to the Federal Reserve's Quantitative Easing policy ("QE"), we want to highlight that the Federal Reserve has now ended QE and that the context for the rule is now quite different than when proposed. Two subjects of current economic policy priority are (1) the paramount importance of achieving price stability as a prerequisite of sustainable economic growth, and (2) the role of money in controlling inflation.[1]

[1] Federal Reserve Board Chairman Jerome Powell, Speech: *Monetary Policy and Price Stability,* At the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming (August 26, 2022) available at

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Third, we express again our concern that the proposed amendments to Form N-MFP, stress testing requirements and imposing four-digit pricing on intermediaries will further harm MMFs and their investors and intermediaries without corresponding benefits. Finally, we express our concern that the Commission has not developed and put forward data to support the more radical aspects of its proposal, in particular swing pricing. Nor has the Commission addressed concerns that swing pricing tied to a specific metric could itself trigger mass redemptions or serve as an opening for market timers to game the rule.

Bank Depositor Runs Are Not Analogous to MMF Investor Share Redemptions

Professors Diamond & Dybvig were awarded the Nobel Prize in Economics on October 10, along with former Federal Reserve Board chair Ben Bernanke, for their work on bank runs and financial system instability.

The Nobel Committee referenced a 1983 paper on bank runs published by Professors Diamond & Dybvig ("D&D" or the "1983 paper").[2] The 1983 paper is cited once in passing in the Commission's proposing release as well as in certain of the economic papers cited in the proposing release, to suggest that redemptions from MMFs are analogous to bank runs.

The 1983 paper does not mention or discuss MMFs or MMF shareholder redemptions. It is just about banks, which are very different than MMFs.

The MMFs that the Commission is seeking to further regulate in the current proposed rulemaking (institutional prime MMFs) are subject to a floating NAV. Thus, they redeem at the next determined market price.[3] This is a completely different scenario than in D&D where

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www.federalreserve.gov/newsevents/speech/powell20220826a.htm . ("Without price stability, the economy does not work for anyone. Without price stability, we will not achieve a sustained period of strong labor market conditions that benefit all. The burdens of high inflation fall heaviest on those who are least able to bear them.")

[2] D.W. Diamond & P.H. Dybvig, "Bank runs, deposit insurance, and liquidity". Journal of Political Economy. 91 (3): 401–419 (1983). Attached are two 2013 comment letters that discuss D&D model in detail.

[3] We note that retail MMFs have not experienced mass redemptions in a financial crisis and US government securities MMFs tend to have significant net inflows of investment during a financial crisis, which is why the Commission has previously recognized that there is no purpose served by imposing a floating NAV on retail MMFs or US government securities MMFs to address investor flight.

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depositors can exit at fixed value that is not marked to market based on the value of the bank's assets. Had D&D assumed this, they likely would have found that it is not optimal to "run."

Other key features of banks that are described in the 1983 paper as creating conditions under which bank runs can occur do not exist at MMFs:

- A very wide gap between the duration of the bank's investment portfolio and the claims of depositors (maturity transformation at banks are measured in months and years, versus days and weeks at MMFs);
- Banks are highly leveraged (MMFs do not use leverage);
- Low and mixed credit quality of bank assets (MMFs are not allowed to purchase these types of credits);
- Bank portfolios consist predominantly of illiquid loans and other illiquid assets (MMF portfolio are required to be able to be sold relatively promptly at roughly the price at which they are carried on the financial statements, be of high credit quality and substantially all are short-term liquid assets with a large chunk having daily liquidity and 30-50% typically maturing within 7 days); and
- Bank portfolios are non-transparent (MMF portfolios are highly transparent and publicly reported in detail).

The 1983 paper makes the point that access to Federal Reserve lending window provides similar protection against runs as FDIC insurance because there is not a fear among depositors that the otherwise healthy bank will run out of cash, but notes that because banks are allowed to own risky assets and non-transparent assets, access to the lending window is less effective than deposit insurance at stopping depositor runs due to a combination of moral hazard on the banker to chase yield and take on portfolio risk and thereby incur significant portfolio losses and the fact that risky and illiquid assets are not eligible collateral at the discount window. MMFs are not allowed to own risky assets or non-transparent assets.

Notably, the Federal Reserve Act of 1913 specifically empowers the Fed to lend to the commercial paper markets to prevent these markets from locking up in a crisis, indeed this is part

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of the name of the Act and a central reason it was enacted. The 2008 and 2020 special lending facilities to the CP markets were not an anomaly but a clear part of the Federal Reserve's statutory mandate. We note that the Bank of England has also successfully used lending facilities to unlock short term asset markets, most recently to address market crisis issues for UK pension plans.[4]

The 1983 paper also states that discretionary gating of withdrawals at banks works to stop runs, but is politically unpopular. The linkage between regulatory liquidity ratios and gating created by the 2014 amendments was an important factor in MMF redemptions during the 2020 COVID-19 lockdown. If the two are delinked and MMFs allowed to use liquid assets for their intended purpose (*i.e.* meeting redemptions), discretionary gating authority would not be a MMF redemption trigger, but would instead be the effective tool that the D&D paper acknowledges.

We note that swing pricing requirements tied to specific redemption or other metrics has the potential to create a new trigger for mass investor redemptions in much the same way as the liquidity ratio trigger for gates and fees clearly did in 2020.

Professor Diamond has also described the key role that banks play in providing access to their borrowers by gathering information and performing credit analysis on their borrowers that is not generally available to other lenders ("relationship lending") and that these borrowers lose this access to financing and the information is lost when a bank fails, which intensifies the impact of a recession.[5] MMFs buy paper in the markets for which there are many investors and public disclosures. MMFs do not perform the same role as banks in generating information about and providing access to financing to non-public borrowers. The closing of a MMF does not create the same information gap or cut off market access to portfolio issuers. It means fewer market purchasers of the issuer's paper.

The structure of MMFs prior to the 2014 amendments to Rule 2a-7 did not pose any inherent "run" risk or systemic risk. Rather, as with other securities, in periods of extreme market

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[4]E. Smith, Pension fund panic led to Bank of England's emergency intervention: Here's what you need to know, CNBC (Oct. 6, 2022), https://www.cnbc.com/2022/09/29/pension-fund-panic-led-to-bank-of-englands-emergency-intervention.html.

[5] Douglas W. Diamond, Should Banks Be Recapitalized?, Federal Reserve Bank of Richmond Economic Quarterly Vol. 87 No. 4 pp 71-96 (Fall 2001).

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volatility and uncertainty investors may choose to redeem their shares and look for a safer haven such as cash, FDIC insured deposits, or Treasury securities. This has nothing to do with MMF structure or regulation, but represents instead investor risk preferences and prudent investing.

MMFs do not cause financial turmoil. The causes are often unanticipated, can start outside the financial markets and are therefore difficult to predict. The COVID-19 Pandemic and Russia's invasion of Ukraine are two good examples. Market crises occurred before MMFs existed, and will continue to occur regardless of whether the Commission regulates MMFs out of existence. Doing away with open markets to force investors to remain in unwanted assets during a crisis is directly contrary to the Commission's statutory mandate and will not work.

The COVID-19 financial crisis was unique in that investors were seeking cash to finance their business operations during a lockdown, and the driver for the "dash for cash" was less the financial markets and more the operating situation on the ground for each business. They also drew down and maxed out bank lines of credit to get cash to meet business operating needs.[6]

According to the Commission's proposing release, in March/April 2020, most (56%) of the redemptions from prime institutional MMFs were at prime MMFs advised by very large banks, even though those MMFs represented only 28% of prime institutional MMF assets at the time. What we believe occurred was not a "run" by MMF shareholders but a need by bank advisers to those MMFs to redeem and shift their clients' MMFs balances into bank deposits to finance a sharp increase in bank balance sheets as bank lines of credit were drawn down during the crisis. The Federal Reserve's emergency lending facilities allowed those MMF-adviser banks to buy portfolio assets from their MMFs to raise cash and speed the transfer of client balances into bank deposits.

Redemptions from MMFs do not have "run risk" in the classical sense of a bank run as described in the 1983 paper. MMFs do not intermediate in a meaningful way portfolio maturity and credit risk in the way banks do. MMF portfolios are very short term, highly liquid and very high credit

[6] The 2014 amendments' redemption gates and fees had the effect of making all non-government MMFs (retail as well as institutional) ineligible for use as sweep vehicles. Then, for purposes of FNAV, natural and non-natural persons were segregated in separate funds. Absent these changes to the structure of the system, more than enough cash from investors' sales of securities would have been swept into prime MMFs in March 2020 to offset redemptions by businesses and other organizations (non-natural persons) needing cash to make payroll and pay bills after being forced to close.

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quality. Bank portfolios are the opposite. Banks support much longer term and less liquid loans and are highly leveraged against deposits and otherwise use leverage in their capital structure, which is why banks are more subject to runs and why bank runs are problematic.

Nonetheless, since 2016, to address Federal Reserve concerns about potential for MMF "run risks" created by pricing shares to the nearest penny, institutional prime MMFs have been required to price shares for purchases and redemptions to the nearest one hundredth of a penny per share ($1.0000) which created at a floating net asset value per share ("FNAV"). In addition, when a MMF shareholder redeems, the price obtained is the "next determined price" as of the next fund pricing (cut-off) time. Any deterioration of value that might have been anticipated by the shareholder is borne by the shareholder in that next determined NAV.

The Federal Reserve and others voiced a concern during the 2014 rulemaking that requiring board consideration of a liquidity fee or redemption gate if weekly liquid assets fell below 30% could trigger redemptions out of investor anticipation that the board could restrict access to investor funds. In March of 2020, while business investors were not "running" from prime MMFs, the MMFs managed their funding of net redemptions (because the COVID-19 lock-down meant businesses did not have cash for purchases) to preserve 30% in weekly liquidity because of both the likelihood of greater redemptions and concern for putting fund boards in the position of making decisions to waive redemption fees. This form of "run" risk that affected funds during March of 2020 (managers fearing the consequences of their using ample liquidity) was not inherent to the funds themselves, but a self-imposed regulatory error by the Commission.

The Commission should be equally concerned that adding a swing pricing requirement that is not entirely at the MMF board's discretion and/or linking the imposition of swing pricing to a specific metric such as redemption volumes will create a new trigger for mass redemptions from MMFs in a crisis. Just like the threat of a redemption gate or fee, the threat of a very economically similar risk - a lower share price on redemption - tied to a somewhat anticipatable metric like redemption volumes, creates a strong incentive for nervous MMF investors to attempt to redeem ahead of the crowd to avoid the lower swing price and thereby trigger the very mass redemptions the rule seeks to deter.

Because of FNAV, prime MMFs are small in the aggregate as a part of the short-term high-quality money markets. Prime institutional MMFs are an immaterial amount of the cash in the system - $292 billion (of which nearly one-third is highly liquid and includes U.S. government

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securities) out of roughly $21.6 trillion of M2 (the Federal Reserve measure of the money supply which includes bank deposits and MMFs) as of September 2022.[7] Prime MMFs are too small individually or in the aggregate to have systemic risk.

Discretionary Liquidity Fees or Redemption Gates Can be used Without Triggering Preemptive Runs.

The 1983 paper noted that deposit withdrawal gates can be effective in preventing bank runs. Discretionary fees or gates at MMFs, however, must be de-linked from compliance with regulatory liquidity levels. The current linkage in Rule 2a-7 triggers runs and undermines the purpose of having those liquid assets to be used to meet redemptions.

A discretionary approach, based upon specific auditable procedures, would give fund boards the discretion to assess the current market conditions and determine a fee that best approximates the actual cost of liquidity. While there is no fixed formula, a fee not to exceed two percent of the value of the shares redeemed would serve as a cap, and that cap should give investors comfort and certainty. A fully discretionary fee approach not tied to a specific regulatory metric would make it difficult for shareholders to anticipate if or when a liquidity fee will take effect, thus avoiding serving as a new bright line trigger. A fully discretionary fee approach not tied to a specific regulatory metric would also help assure shareholders that fund boards will only impose redemption restrictions after exhausting all available liquidity and for the purpose of ensuring all shareholders are treated equally.

We are concerned that linkages to other available data will cause investors to try to anticipate the imposition of actions that would impair access to or the value of their investments such as liquidity fees, redemption gates or swing pricing (which under the Commission proposal would be triggered by redemption levels).

The Commission's swing pricing proposal will create a market timing opportunity for hedge funds and other astute investors to use AI and algorithms to find correlations, linkages and

[7] *Compare* Federal Reserve, Money Stock Measures - H.6 Release, Sep. 27, 2022 (M2 money supply data showing $21.6 trillion), available online at The Fed - Money Stock Measures - H.6 Release - September 27, 2022 (federalreserve.gov), *with* SEC Division of Investment Management Analytics Office, Money Market Fund Statistics, through Sep. 2022 (Oct. 20, 2022) (institutional public prime MMFs $292 billion), avail. online https://www.sec.gov/files/mmf-statistics-2022-09.pdf.

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market signals that improve their chances of investing on days when outflows exceed a trigger point and thus buy MMF shares at a reduced purchase price and redeem when they are most likely to receive full price.

In the Proposing Release, the Commission appears to doubt the integrity of fund boards:

> even if all institutional money market funds recognized the benefits of charging redeeming investors for liquidity costs, we believe there is a collective action problem in which no fund would want to be the first to adopt such an approach. We believe past experience with the existing liquidity fee regime supports a mandatory approach to dilution mitigation for institutional funds.[8]

If this underlying view is reasonably extrapolated to other similar board decisions, then the Commission is faced with justifying the entire governance structure of registered investment companies. Federated Hermes disagrees with these conclusions in every respect and the Commission should not further enshrine doubts about the integrity of fund boards in Rule 2a-7 or any other rule amendments.[9] Such a position by the Commission would open the door to challenges to numerous fundamental responsibilities of fund boards to fulfill their fiduciary responsibility and act in the best interest of shareholders.

Rules-based systems with linkages to specific metrics are easier for investors to anticipate and game, than are discretionary decisions made by a MMF board of directors based on the totality of circumstances and their fiduciary judgment. This is analyzed in great detail and summarized on p 30 of the Treasury Strategies March 31,2014, response to File Number S7-03-13, Money Market Fund Reform, a copy of which is attached to this letter.

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[8] Release at 47.

[9] When the optimal behavior of independent fund directors is analyzed using a methodology similar to D&D, the decision to timely apply a discretionary fee is their Nash Equilibrium strategy. The Commission arrives at its stated conclusion because it fails to correctly identify the actual incentives of independent directors; in particular, the fixed compensation for their services versus the significant reputational risks and potential liabilities associated with the failure to act in the best interest of shareholders.

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Reform Short-term Credit Markets.

The Commission has proposed to review short-term credit markets and propose reforms. Short-term credit markets are radically different today than before or during the 2008 Financial Crisis and even the 2020 COVID-19 market crisis. Credit markets and the financial system have been transformed by the Federal Reserve's zero interest rate policy ("ZIRP") and quantitative easing ("QE") monetary policies suppressing, or "administering", short- and long-term market rates, respectively.[10] Holding short-term policy rates at the zero-bound took away the traditional MMF role of fostering an efficient short-term credit market to determine "prices" (interest rates) through finding equilibrium between supply and demand. In other words, until very recently, there has not been a short term market rate that was materially higher than bank-administered deposit rates.

Together, ZIRP and QE have tripled the "cash in the system" or M2 money supply, from $6.7 trillion in 2005 to $21.5 trillion now (Q3 2022).

MMFs have also undergone substantial change from the 2010 and 2014 amendments to Rule 2a-7, as well as in response to the changes in credit markets. The 2014 amendments eliminated the ability of non-US government (prime and municipal) MMFs to provide daily liquidity at par to customers by imposing floating NAV ("FNAV") on institutional non-US government MMFs and imposing on retail and institutional non-US government MMFs the specter of gating and redemption fees linked to regulatory liquidity thresholds. In other words, the 2014 amendments impaired the utility of the non-government MMF product to most investors. At the same time, U.S. government MMFs were left unscathed – continuing to offer a stable share price without any redemption restrictions. Likewise for bank demand deposits.

MMFs operate as part of the financial system and are affected by the system to a far greater extent than vice-versa. The Federal Reserve has blamed MMFs for an array of sins where, in fact, the MMF is simply a victim, along with every other investor, of circumstances or events occurring elsewhere in the financial system. As part of its efforts to improve the workings of the short-term credit markets as discussed in the MMF rulemaking proposal, the Commission

[10] *See, e.g.,* Bernanke, Ben. "*Monetary Policy since the Onset of the Crisis," a* speech delivered at the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming (August 31, 2012), available at https://www.federalreserve.gov/newsevents/speech/bernanke20120831a.htm .

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should independently monitor and study the overall market and each part of the financial system that is a part of it.

The Federal Reserve Should Continue to Meet the Statutory Obligation to Fulfil its "Lender-of-Last-Resort" Function.

In our April 2022 comments, FHI identified a range of reforms that the Federal Reserve can take to improve market liquidity and prevent the need for the emergency facilities such as were implemented in March 2020. With the more recent creation of a standing bank repo facility for U.S. Treasury securities (to improve the functioning of the Treasury market) the Federal Reserve should extend the asset eligibility to high quality short term securities. Conforming amendments should also be made so that in a crisis, the Federal Reserve can waive the applicable bank capital and other coverage ratios (*e.g*. the common equity tier-1 leverage ratio ("CET1"), liquidity coverage ratio "LCR" and net stable funding ratio "NSFR") restrictions that such bank transactions would normally entail so that the market-stabilizing repo transactions are balance sheet neutral for the participating banks. These reforms are a means of creating *standing facilities* that would replace the Federal Reserve Act Section 13(3) emergency lending facilities that the Federal Reserve hesitates to employ, notwithstanding the original purpose and clear statutory directive of the Federal Reserve Act. Moreover, these measures would begin to undo the material decline in bank broker/dealer market-making caused by the Volcker Rule and numerous other capital, leverage and other restrictions on banks that have been implemented since the 2008 – 2009 Financial Crisis.

The 2014 Amendments to Rule 2a-7 (implemented in October 2016) shrank prime institutional MMFs dramatically and further shrank their CP portfolio assets, while M2 grew dramatically. Between ZIRP, QE and disabling MMF rule changes, the past 14 years have seen the Federal Reserve, FSOC and the Commission, in effect directing most of the cash in the system into bank deposits and U.S. government MMFs as the only remaining cash management vehicles offering daily liquidity at par. As a direct result of these policy actions:

- Domestic bank deposits have grown from $6.2 trillion in 2005 to $18.1 trillion now.
- U.S. government MMFs have grown from $400 billion in 2005 to $4 trillion now.

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- Institutional prime MMFs have dropped dramatically in absolute size and a large part of that is now effectively required to be invested in US government securities to meet regulatory liquidity requirements. From year-end 2015 (before the 2014 amendments went into effect in October 2016) prime institutional MMFs have declined in size from $926.3 billion in assets to $231.7 billion as of September 6, 2022, a decrease of roughly 75%.

Considering ZIRP, QE and prior rule changes, today's "run risk" is in the classical sense of a bank run as described Professors Diamond and Dybvig; namely, the Federal Reserve's exposure to uninsured bank deposits, most of which are institutional deposits. Of the over $18 trillion in bank deposits, $8.2 trillion are uninsured. Uninsured bank deposits are over 20 times the assets of prime MMFs. If, as the Federal Reserve, President's Working Group and the Commission assert, prime MMF investors "ran" from CP risk in 2008 and 2020, will uninsured depositors fear the credit risk of their banks in the next crisis?

At $8.2 trillion (45% of all U.S. bank domestic deposits), uninsured deposits are more than double the level of bank reserves at the Federal Reserve. If uninsured depositors flee the banking system, the banks may have to "run" on the Federal Reserve by withdrawing their reserves to make up the shortfall. At $8.5 trillion, uninsured deposits are nearly four times the level of bank equity capital ($2.25 trillion). With so little capital, is there a first mover advantage for uninsured bank depositors who "run"? Will the FDIC, Federal Reserve and Treasury be able to fund this outflow?

Former Chair Bernanke and Current Disruption Caused by Federal Reserve's Quantitative Easing (QE), Zero Interest Rate Policy ("ZIRP") and Large-Scale Asset Purchases ("LSAP").

Although much criticism has been unfairly directed at the actions of the Federal Reserve in establishing short-term secured emergency lending facilities during both the 2008-2009 Global Financial Crisis and the 2020 COVID-19 crisis, those facilities were very effective, promptly repaid at a profit to taxpayers and very clearly within the statutory mandate and Congressionally-intended function of the Federal Reserve.

In contrast, the much longer-term actions taken by the Federal Reserve over the past 14 years in an extended experiment in expanding its balance sheet through Quantitative Easing (QE) and

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Large-Scale Asset Purchases (LSAP), and maintaining interest rates of near zero for over a decade through the Zero Interest Rate Policy (ZIRP) were unprecedented, previously untested, skewed market pricing and capital allocations for years, and are now generally recognized as the cause of our current financial problems. This should remind the Commission that the Federal Reserve can be wrong on policy. Their policy suggestions on the regulation of securities markets and investment funds should not constrain the Commission, and certainly not in this case.

Then-Federal Reserve Chair Bernanke's 2012 Jackson Hole speech announced QE as a primary Federal Reserve "tool" in the wake of ZIRP. QE contained the seeds of its own destruction, as foreseen by Chair Bernanke in a 2012 speech, in which he outlined in broad strokes what the Federal Reserve was doing, and four key things that could go wrong.[11]

The extraordinary actions taken by the Federal Reserve during the 2008 Financial Crisis were to drive interest rates essentially to zero and to dramatically expand the Federal Reserve's balance sheet for an extended period of time by buying longer-term government securities, including mortgage-backed agency bonds.

> [In early 2009] "with the financial crisis in full swing, the FOMC had lowered the target for the federal funds rate to nearly zero, thereby entering the unfamiliar territory of having to conduct monetary policy with the policy interest rate at its effective lower bound."
>
> "In using the Federal Reserve's balance sheet … the FOMC has focused on the acquisition of longer-term securities-- specifically, Treasury and agency securities…Imperfect substitutability of assets implies that changes in the supplies of various assets available to private investors may affect the prices and yields of those assets."

[11] Federal Reserve Board Chairman Ben S. Bernanke, Speech: *Monetary Policy since the Onset of the Crisis,* At the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming (August 31, 2012) available at www.federalreserve.gov/newsevents/speech/bernanke20120831a.htm (citations omitted).

> "LSAPs have been found to be associated with significant declines in the yields on both corporate bonds and … MBS yields and retail mortgage rates. LSAPs also appear to have boosted stock prices…."

The four things that could go wrong with this nontraditional and untested QE strategy, as outlined by then-Federal Reserve Chair (and now Nobel laureate) Bernanke in 2012 were:

> "One possible cost of conducting additional LSAPs is that these operations could impair the functioning of securities markets. … [I]f the Federal Reserve became too dominant a buyer in certain segments of these markets, trading among private agents could dry up, degrading liquidity and price discovery."
>
> "A second potential cost of additional securities purchases is that substantial further expansions of the balance sheet could reduce public confidence in the Fed's ability to exit smoothly from its accommodative policies at the appropriate time. Even if unjustified, such a reduction in confidence might increase the risk of a costly un-anchoring of inflation expectations, leading in turn to financial and economic instability. … The FOMC has spent considerable effort planning and testing our exit strategy and will act decisively to execute it at the appropriate time."
>
> "A third cost to be weighed is that of risks to financial stability. For example, some observers have raised concerns that, by driving longer-term yields lower, nontraditional policies could induce an imprudent reach for yield by some investors and thereby threaten financial stability."
>
> "A fourth potential cost of balance sheet policies is the possibility that the Federal Reserve could incur financial losses should interest rates rise to an unexpected extent."

In a contemporaneous critique of the actions of the Federal Reserve, James Grant, publisher of Grant's Interest Rate Observer newsletter, predicted that the eventual unwind of these actions by the Federal Reserve would result in a serious wave of inflation.[12] While Grant could see it at the time, it is now easy for everyone else to see, in 2022 hindsight, from the data, facts and current events that central bankers have been wrong in predicting they could stick the soft landing. QE is

[12] Grant's Interest Rate Observer, Vol. 30, No. 17 (Sep. 7, 2012).

being unwound now, fourteen years after it was implemented. And it is not going well. Now unfolding is a serious, QE-induced international economic and market crisis which will be unique in that it cannot be contained by simply unleashing unlimited fiscal and monetary stimulus (witness the U.K.). Simply, it was not possible to engage in prolonged QE on this scale without eventual inflation. Bernanke himself laid out the systemic risks of QE in his 2012 speech. Those risks have now materialized.[13] The systemic problems generated by QE and its unwind dwarf the run risk of what little is left of nongovernment MMFs as the Federal Reserve now confronts its mistakes in an effort to reduce inflation.

It is long past time for the Commission to recognize that the Federal Reserve is not the best oracle of policy when it comes to regulation of MMFs, investment companies and securities markets generally. The Commission has no specific mandate relating to systemic risk. Congress conveyed the role of securities regulation by statute on the Commission with a very specific directive on what to consider in shaping the rules in these markets: competition, capital formation, market efficiency and access, and investor protection through transparency and fair and efficient markets.

Some of the Proposed Revisions to Form N-MFP Would Place an Undue Burden on MMFs and Fail to add Value or Enhance the Usefulness and Safety of MMFs.

It is reasonable for the Commission to collect certain information from MMFs to be able to assess the effectiveness of its rulemaking and to be able to follow developments in the industry. At a minimum, the Commission should collect the information it needs to assess MMF compliance with Rule 2a-7. We believe the Commission does presently collect sufficient information for this purpose.

The Commission should not, however, request highly detailed and specific information where the likelihood of the agency being able to effectively collect and interpret the data in a meaningful way is not high. We oppose many of the proposed revisions on the grounds that it would be costly for MMFs to meet the reporting requirements and where the value to the Commission would be minimal, or where the potential for misinterpretation is high absent intimate knowledge of the fund or current market conditions. For example, disclosing beneficial

[13] M. Derby, Fed on track for tens of billions in losses amid inflation fight, Reuters (Oct. 28, 2022); L. Feiner, Palihapitiya blames Fed for 'perverted' market conditions he benefited from, CNBC (Oct. 26, 2022); Congressional Budget Office, How the Federal Reserve's Quantitative Easing Affects the Federal Budget at 3 (Sep. 2022).

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owners greater than 5% of a share class would require manual input or costly programming as the systems that typically house portfolio and trading information often differ from those that store shareholder specific data, and would be of limited informational value in the context of the overall portfolio. In some cases, the proposed reporting requirements would reduce competitiveness in the market, by publicly disclosing lot-based or transaction-based data with little delay without providing a measurable benefit to the Commission. With advances in technology, many in the industry are able to access N-MFP data either directly or through third party services. The informational benefit that the Commission may derive from additional details disclosures could be more than offset by the potential of incorrect interpretation of the data by others, which could lead to increased volatility in the money markets and MMFs.

Much of the information and data the Commission needs to assess the effects of its rules is not MMF specific and is readily available from other existing government and market sources. For example, the effect of the 2014 amendments in causing an 75% shrinkage in non-government MMFs is apparent in relative asset and flow data over time. The effect of marginalizing prime MMFs on the commercial paper ("CP") market similarly easily ascertainable. Midway in 2007, $2.2 trillion of CP was outstanding. Only $1.2 trillion is outstanding today. Another example is the recent Commission study of the role of MMFs in the broader Treasury market, concluding that MMFs are important purchasers and holders of U.S. government debt. The Commission performed this study using existing available data and sources.

The Commission should review Form N-MFP periodically to ensure the information that it is requesting is useful and timely, and remove reporting requirements for data where it is clear that the information derived is no longer of value. Because the markets and economy are dynamic and constantly changing in response to diverse events and forces, it is clearly good for the Commission to periodically review the data it collects to ensure it has useful and timely information.

The primary purpose of N-MFP data should be to ensure compliance with regulatory requirements, giving the Commission the ability to reach out to individual MMFs in the circumstances where a fund may appear to be out of compliance. In addition, N-MFP data can be used by the Commission to inform itself of trends in the industry, and to prompt a dialogue between the staff and the industry where additional information can be obtained. In the event of

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market uncertainty, the Commission could be in a better informed position to provide guidance to the industry should it be necessary.

The Proposed Amendments Would Add Unnecessarily to the Existing Stress Testing Requirements for MMFs.

FHI's understanding is that Commission staff reviews stress tests during examinations but otherwise does not review the test results.

While the stress testing required of money market funds under Rule 2a-7 may be effective in terms of raising awareness of the risks that a fund could potentially face to the fund's manager and board of directors, when faced with an actual stressed market environment the results themselves are of little value. Moreover, experienced MMF managers understand how each variable affects MMF price and liquidity alone and in conjunction and do not need a model to tell them what will occur and how to address it. This was the case in March 2020, where events put an unprecedented strain on market liquidity. No amount of stress testing could have predicted the rapid-fire events triggered by a global pandemic that took place nor the market reaction to those events. In such an environment FHI relied on real-time tools to manage through the challenging environment.

Stress testing was not effective in March of 2020 because the markets were frozen. What would have helped would have the ability to use the 30% Weekly Liquid Assets to meet redemptions without triggering investor fears of gating and exacerbating redemption activity in an already panicked market.

Because stress testing results have a higher perceived value than actual value, and because stress testing requirements under the Commission regulations are not standardized from firm to firm – indeed, our stress testing assumptions vary by fund type and often at the individual portfolio level in response to certain fund characteristics – it is difficult to see what informational value the Commission would get from receiving stress testing reports on a regular basis, other than to confirm that fund companies are going through the exercise as required. Making these results available to the public would be counterproductive, as the public would not have the expertise to understand the outputs of such tests and could easily misinterpret the results.

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Providing stress testing information to investors on a real time basis would put another complex, difficult to understand data point in the hands of investors who might misinterpret the information and "run" from the fund.

RDM is More Workable than Four Digit Pricing by MMF Intermediaries.

The Commission proposal to require intermediaries of MMFs to be able to calculate a four-digit net asset value ("NAV") even for retail and US government securities MMFs where that is not a normal pricing requirement (out of concern for a potential negative interest rate environment) has the potential to significantly and negatively impact the short-term funding market for the US Treasury. This is because up to $2 trillion in US Government MMF assets are invested through cash sweep systems that cannot transact at a four-digit NAV. We understand that it would be prohibitively expensive for many intermediaries to upgrade these legacy systems and that their likely response would be shift their cash sweep vehicles from US Government MMFs to bank deposit products. This would adversely impact the government funding market and hurt investors who would likely receive a much lower yield on their cash.

There is an alternative that could alleviate this issue in the extremely remote event we enter into a negative rate environment. It's called the reverse distribution mechanism or "RDM." RDM basically allows a fund to do a reverse stock split so that the MMF would be able to maintain a stable dollar value per share would reflect the decline in value through a reduction in account value by reducing the number of shares. This method is similar to how a bank checking account will need to charge depositors for negative rates by reducing the dollars in the account, but each dollar will be worth $1.00.

We have provided information to the Commission on how this could be accomplished in a manner that would reduce the risk of investor confusion. RDM should be an option for a MMF board to elect to use in a negative rate environment. Mandating that Government and retail MMFs move to a four-digit NAV in a negative rate environment would likely cause the assets invested in such products to shift into other investment vehicles like bank deposit accounts, thereby disrupting the liquidity and function of the market and would also deprive investors of a market rate of return.

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The Data Do Not Support the More Radical Parts of the Proposed Amendments, Such as Swing Pricing.

In its proposed rulemaking, Commission's economic analyses are largely qualitative and generally do not indicate whether the benefits of the proposed reforms or alternatives outweigh their costs. According to Commission, the reason is because it lacks the data to quantify benefits and costs. Data does, however, exist for the Commission to analyze quantitatively the benefits and costs of the reforms to a much greater extent than it has.

There is, for example, a great deal of data on MMF purchase and redemption activity over time. The Commission has access to all of this data. Information on the costs/benefits of rule-making is also available. FHI has laid out in our earlier comment letters some of those costs to investors in and borrowers from MMFs as well as to MMFs and their services providers and intermediaries, and the Investment Company Institute ("ICI") in its comments and white papers has also provided substantial MMF data and analysis. The current rulemaking requires a much more deliberate, data-driven and considered process than the Commission appears to be pursuing.

There is no data to support the proposition espoused by the Commission that investors remaining in MMFs are systematically disadvantaged by redemptions in stressed periods. There is no data supporting that Commission position because it is not an actual phenomenon. The few academic studies cited by the Commission, as discussed in our comment letters, show the opposite. If it occurred, it would have been observable in a declining NAV over time of MMFs which had net redemptions in periods of stress. A decline in MMF NAVs did not happen.

The most simple and obvious question that the Commission could and should have asked is: do institutional prime MMF shareholders actually experience the dilution that swing pricing is meant to prevent? The data to examine this question is readily available and the analysis itself is quite simple. Based on FHI's own data and industry experience, no such dilution is actually experienced. The reasons are outlined in detail in FHI's April 2022 comment letters, and relate to the Know-Your-Customer requirements of Rule 2a-7 and professional MMF management practices that have developed over many years.

A threshold issue for the viability of the proposed swing pricing rule is the US institutional structure for reporting MMF trades. As outlined in our prior comment letters, it is common in

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the US for fund intermediaries to act as agents for the funds. The intermediaries receive MMF trades from their clients during the day, and warrant to the MMF that these trades are "in good order," primarily meaning that they were received before the fund "cut off," or the time as of which the fund NAV is determined. While this process runs smoothly, the fund adviser does not actually discover what the volume of trades (and thus the net redemptions pertaining to the time T+0 pricing) until the following day (T+1) because these trade notices are transmitted through the National Securities Clearing Corporation ("NSCC"). Thus, the MMF's adviser lacks the fund flow information necessary to determine the magnitude of net redemptions in the fund in order to calculate the "swing price factor" required by the rule proposal to be applied to the T+0 NAV to get the "swung price."

We support a data-driven approach to regulation that will enhance the safety and resilience of MMFs. The problem, however, is that other than delinking, the other current proposals, including increasing required liquidity or implementing a highly destructive mandatory swing pricing mechanism (when less cataclysmic options are available), are not supported by the data or the Proposal's cost benefit analysis. There is no evidence which supports the proposition that swing pricing would have reduced or avoided the problems of March 2020. Any new MMF reform must be supported by data, backed-up by a proper cost/benefit analysis and reflect the positive and negative impacts that the proposals will have on MMFs.

CONCLUSION

Thank you for this additional opportunity to comment on the Proposal. As we have outlined, policy decisions based on inaccurate assumptions and false narratives as to the underlying cause and effect of market events inevitably lead to poor regulatory policy and unintended consequences. The final rule as adopted should be limited to (1) delinking compliance with daily and weekly liquidity levels to considerations on imposition of fees and gates, (2) requiring FNAV MMFs to use bid prices on portfolio assets to calculate NAV and purchase and redemption prices, and (3) specifying criteria upon which a MMF's board's independent directors could impose a discretionary liquidity fee or redemption gate.

The remaining aspects of the Proposal should not be adopted, including in particular the swing pricing proposal, as they will not result in the desired results to reduce investor redemptions in stressed market conditions, but instead will be harmful to investors in MMFs, those who use

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MMFs to obtain short-term financing, and will interfere with capital formation and the stability and efficiency of short-term markets. As such, they conflict with the statutory mandates of the Commission that apply to rulemakings under the federal securities laws to promote efficiency and the functioning of markets, enhance capital formation, protect investors, and not undermine competition.

In addition, the other aspects of the Proposal are based on flawed assumptions, are contrary to the empirical studies that the Commission cites and are not supported by any meaningful cost/benefit analysis. It therefore would be arbitrary and capricious for the Commission to adopt the other aspects of the Proposal. The Commission should instead work with the Federal Reserve, Treasury and other relevant agencies on a proposal to improve the functioning of the short-term funding markets in times of market stress, as is suggested by the OFR's 2020 Annual Report and in a manner consistent with the statutory text of the Federal Reserve Act and the federal securities laws.

We appreciate your consideration of our views on this important subject and look forward to working with the Commission to enhance the safety and resilience of MMFs.

Sincerely,

/s/
J. Christopher Donahue J.
Chairman, CEO & President

/s/
Deborah Cunningham
CFA Executive Vice President, Chief Investment Officer of Global Liquidity Markets and Senior Portfolio Manager

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Attachments:

Money Market Funds, Bank Runs and the First Mover Advantage (Jan. 2013)
Letter from Treasury Strategies, Inc., File No. S7-03-13 (Mar. 31, 2014)

cc: Gary Gensler, Chair, Securities and Exchange Commission
Hester M. Peirce, Commissioner, Securities and Exchange Commission
Caroline A. Crenshaw, Commissioner, Securities and Exchange Commission
Mark T. Uyeda, Commissioner, Securities and Exchange Commission
Jaime Lizárraga, Commissioner, Securities and Exchange Commission
Dan Berkovitz, General Counsel, Securities and Exchange Commission
William A. Birdthistle, Director, Division of Investment Management
Sarah ten Siethoff, Deputy Director, Division of Investment Management

Money Market Funds, Bank Runs and the First-Mover Advantage

Mark Hannam

Institutional Money Market Fund Association

v.2 January 2013

Abstract

Several recent reports from regulatory bodies have recommended that money market funds should be required to move from stable to variable net asset valuation pricing, to reduce the risk of first-mover advantage and the risk of a run on the fund. Most money market fund sponsors doubt that this proposal will reduce either run risk or first-mover advantage.

Thirty years of academic research on bank runs has concluded that the best protections against bank runs are retail deposit insurance or the suspension of convertibility. There are no arguments within the academic literature in favour of changing the terms of the demand deposit contract, from stable to variable value: it is quite remarkable that the preferred solution for MMFs is one without precedent in banking regulation.

Money market funds are different from banks in four fundamental respects. These differences concern their legal form but also, importantly, their economic function. Money market funds do not engage in fractional reserve banking and they do not perform liquidity creation. Money market funds, like other capital markets products, are vulnerable to the unanticipated actions of investors during periods of market distress. At such moments there is a risk that money market funds might contribute to the amplification of systemic risk.

In a period of heightened systemic risk, the ability of money market funds to suspend the standard terms under which shareholders are able to redeem fund units for cash, is the mechanism most likely to eradicate the possibility of a first mover advantage and thereby to reduce the risk of a run. In the absence of a credible deposit insurance policy for the money market fund industry, suspension of convertibility should be the preferred option: for regulators, for fund sponsors and for investors.

Keywords: Money market funds, bank runs, first mover advantage

JEL: G15, G18, G21, G23.

Money Market Funds, Bank Runs and the First-Mover Advantage

Introduction

The Final Report of The Board of the International Organization of Securities Commissions, entitled "Policy Recommendations for Money Market Funds" (October 2012) states that one of the residual vulnerabilities of money market funds (MMFs) that could have broader consequences for the financial system is the so-called "first-mover advantage":

> ... where investors have an incentive to redeem from a troubled MMF or at the first sign of market distress, since investors who redeem shares early will redeem on the basis of the stable NAV leaving the cost of any loss to be borne by the remaining shareholders. Such advantage is also present, albeit less prominent, in variable NAV funds, as managers may sell more liquid assets first, shifting the risks of selling less-liquid assets to remaining shareholders. (IOSCO, 2012)

Concerns about run risk and the first-mover advantage within the MMF sector are, taken together, identified as the specific grounds for Recommendation 10 in the IOSCO Report, namely that regulators require MMFs to convert from stable to variable net asset value (NAV) or to introduce a range of alternative structural safeguards to mitigate these risks. (IOSCO, 2012, p.15-16).

Subsequently, further reports published in November 2012 by the US Financial Stability Oversight Council ("Proposed Recommendations Regarding Money Market Mutual Fund Reform") and by the Basel based Financial Stability Board ("Strengthening Oversight and Regulation of Shadow Banking Entities") have made similar claims about the vulnerability of MMF[1] to run risk, and have made similar proposals to reform the structure of MMFs (FSOC, 2012 and FSB, 2012).

The argument upon which Recommendation 10 is based - namely that run risk in MMFs is connected to the pricing structure of the fund and therefore that stable NAV MMFs are more vulnerable to run risk than variable NAV MMFs - is regarded with considerable scepticism within the industry. Most sponsors of MMFs doubt that conversion from stable to variable NAV will reduce either run risk or first-mover advantage.

[1] The debate about the vulnerability of MMFs to run risk has not been helped by a lack of a clearly defined and commonly accepted meaning of the term "money market fund". In this paper we adopt the definition proposed by IOSCO in an earlier paper: "an investment fund that has the objective to provide investors with preservation of capital and daily liquidity, and that seeks to achieve that objective by investing in a diversified portfolio of high-quality, low duration fixed-income instruments." The term MMF should therefore be taken to include both variable and stable NAV funds unless otherwise specified in the text.

The concept of the "first-mover advantage" was originally developed in the business management literature to describe a variety of mechanisms that confer advantages on firms that are first to exploit an initial asymmetry among competitors in a particular sector (Lieberman & Montgomery, 1988). There is continuing debate as to how such mechanisms work and the extent to which first-mover advantages are predictable *ex ante* rather than merely observable *ex post*. In some cases it is clear the first-mover suffers a disadvantage.

In the literature on bank runs, however, it is always assumed that there is an advantage to investors of moving early rather than late: early withdrawals take place at par whereas later withdrawals might do so, depending on the ability of the bank to remain liquid; but they might not take place at all, if the bank runs out of funds, at which point the value of a demand deposit falls to zero (or thereabouts). In the standard account of a bank run the first-mover will always be at least equally advantaged compared with the last-mover, and might be very significantly advantaged.

The questions this paper addresses are, What can be done to reduce the risk of bank runs and to limit the first-mover advantage for bank deposit holders? And, by analogy, what can be done to reduce the risk of runs in MMFs and to limit the first-mover advantage for MMF shareholders? Based on an assessment of recent academic research on bank runs the answer would seem to be that, in the absence of a government-funded insurance scheme for MMF shareholders, and lacking direct access to central bank liquidity support, the optimal regulatory solution should be based around the suspension of convertibility. In a period of market distress and heightened systemic risk, the ability of MMFs to suspend the standard terms under which shareholders are able to redeem shares for cash, is the mechanism most likely to eradicate the possibility of a first-mover advantage and thereby to reduce the risk of a run.

Explaining Bank Runs

Understanding the causes of bank runs and finding ways to prevent them or to mitigate their effects has long been a pre-occupation of economists and policy makers (see, for example, Bagehot, 1873 and Sprague, 1908), not least because bank runs have been a recurring feature of modern economic life. In the US, the establishment of the Federal Reserve System (FRS) in 1913 and the establishment of the Federal Deposit Insurance Company (FDIC) in 1933 - were policy responses to bank runs (in 1907 and 1933). The FRS was empowered to provide additional funds for banks through its discount window, as the lender of last resort, and the FDIC provided insurance protection for retail depositors (Friedman & Schwartz, 1963; Calomiris, 1990).

The standard model for analysing the causes of a bank run and, consequently, assessing the likely success of both preventative and remedial measures, is that published in the *Journal of*

Political Economy by Douglas Diamond and Philip Dybvig in 1983. They propose a simplified, formal model to explain both why banks are able to attract depositors and why these depositors might, in certain circumstances, run from the bank.

Diamond and Dybvig start by setting out the social and economic benefits of the banking system: the transformation of illiquid assets into liquid liabilities. This transformation can be achieved by the use of demand deposit contracts between the bank and its depositors. Under one equilibrium, in which depositors maintain confidence in the bank, efficient risk sharing is achieved and social and economic benefits are secured. Under an alternative equilibrium, confidence is not maintained and a bank run ensues, as depositors rush to redeem their deposits. In this equilibrium they are rational to rush because banks operate under a sequential service constraint, meaning that the payoff to each depositor depends solely on the place of that depositor in the queue. If the bank run continues, first the liquid and then the illiquid assets are sold, most likely at below their long term value, leading to capital losses for the depositors towards the end of the queue. The wider economy suffers from a loss of production and a consequent decline in social welfare. The question Diamond and Dybvig pose is, What can be done to enhance the deposit contract such that the risk of a bank run is reduced and an optimal equilibrium state of risk sharing is achieved?

One possible solution is the suspension of convertibility: if withdrawal requests are too numerous, the bank might put a stop to the conversion of the deposit contract into cash. The threat of suspension is shown to be successful in lowering the risk of bank runs *ex ante*; however, if a run does take place then, *ex post* suspension can be both socially inefficient and unpopular. Another possible solution is the provision of deposit insurance, guaranteeing that the full value of the deposit will be paid to all who wish to withdraw. While such insurance might be offered by a private company, the scale of the unconditional guarantee required for deposit insurance to be both comprehensive and credible suggests that the government should underwrite the insurance cover, paid for by an increase in tax revenues. Diamond and Dybvig argue that government deposit insurance provides the best protection against bank runs, allowing banks to manage asset liquidation policies in an optimal manner, thereby increasing economic and social welfare. If the promise to provide insurance is credible the promise will never need to be fulfilled because bank runs will not occur: a costless Pareto-improved equilibrium will therefore be secured (Diamond & Dybvig, 1983).

In a subsequent article Diamond and Dybvig discuss the moral hazard problem associated with the provision of fixed rate deposit insurance by, for example, the FDIC:

> ... it is well known that the bank may have an incentive to select very risky assets since the deposit insurers bear the brunt of the downside risk but the bank owners get the benefit of the upside risk. Since fixed-rate insurance is necessarily underpriced for banks taking large enough risks, banks can have an incentive to pay above-market rates of return to attract large quantities of deposits to scale up their investment in risky assets. If there were no regulation,

> much of the risk in the entire economy would be transferred to the government via deposit insurance. (Diamond & Dybvig, 1986, p. 59).

Moreover, the presence of deposit insurance relieves depositors of the burden of monitoring the risk profile of the bank with which they make deposit contracts. If deposit insurance is comprehensive, it aligns the interests of depositors and bank managers: both sets of agents have an incentive for the bank to acquire a portfolio of high-risk assets, increasing the probability that bank profits and bank deposit rates are higher. The downside risks are covered by taxpayers' money. For example, the Savings & Loans crisis in the US, during the 1980s, saw transfers in the order of $130bn from taxpayers to bank depositors (Cooper & Ross, 2002).

Various proposals have been made to design deposit insurance in such a way that the moral hazard problem is reduced to acceptable levels. One proposal would be to replace fixed-rate deposit insurance with a risk-adjusted rate, such that banks undertaking more risky activities are forced to pay higher premiums, set by regulators who have privileged access to the bank's loan book. Monitoring bank risk is a difficult and imprecise art, so rather than tailor the level of the premium to the risk profile of each bank another idea would be to disallow banks that benefit from deposit insurance from engaging in certain high risk lending practices. Once again, the difficulty for the policy maker is knowing *ex ante* the precise risk profile associated with a certain type of lending activity. If there is a clear social and economic benefit from the liquidity transformation that banks achieve, then any constraint of this activity has a social cost: if the financial fragility of banks is beneficial, then we should be careful not to constrain this fragility unduly (Diamond & Rajan, 2001).

Other proposals to deal with the question of moral hazard include banks holding additional capital to fund the first loss on any defaults (Cooper & Ross, 2002); the introduction of contingent demand contracts for depositors, which limit the amount that they could withdraw from the bank according to the current volume of other depositors also seeking to withdraw funds (Postlewaite & Vives, 1987); the abandonment of fractional-reserve banking and a requirement that banks hold Treasury securities equivalent in value to 100% of customer deposits (Kareken, 1986); and limiting the coverage of government deposit insurance to, say, 90% of the deposit and encouraging depositors to self-insure the residual 10% (McCulloch, 1986).[2]

Academics have also considered the problem of bank runs in a different way. Rather than looking at the policies that make bank runs less likely, and the impact these policies might be expected to have on agents' incentives, they have considered what might be done to mitigate the damage caused by a bank run once it has started. Examples include the use of

[2] At the time of the run on Northern Rock Bank in the UK in September 2007, UK bank deposits were fully insured up to £2,000 with additional insurance of 90% of the value of the deposit, up to a ceiling of £35,000.

time inconsistent policies such as the replacement of an *ex ante* "tough" stance on the wholesale suspension of convertibility with an *ex post* "moderate" policy of partial convertibility (Ennis & Keister, 2009); and giving regard to the wider institutional structure of the economy and in particular the strength of the contracting environment (Demirgüç-Kunt & Kane, 2002).

Another problem concerns the appropriate policy response to a run on a financial market rather than a specific financial institution, that is a run on the banking sector rather than a run on a particular bank. One recommendation is the assurance of provision of sufficient liquidity for the market as a whole by the government, equivalent to the US government's strategic petroleum reserves held in the Gulf of Mexico, which are rarely released, but whose presence is itself thought to reduce the risk of a run on petrol supplies (Bernardo & Welch, 2004). Related to this question is the need to distinguish between the case when a bank run is based on a lack of information - the depositors do not know the true nature of the bank's assets, but run from the bank because of the first mover advantage - and the case when a bank run is based on the presence of good information - the depositors do know the true nature of the bank's assets, and run from the bank for that very reason:

> ... what our finding suggests is that bad prospects for the banking system as a whole do not necessarily lead to a flow of funds out of the system in the absence of alternative stores of value. In a multibank system in which there may be bad news about individual banks in an economy with other inter-temporal markets, information-based runs will obviously exist regardless of the risk aversion of depositors. (Jacklin & Bhattacharya, 1988, p588.)

In other words, the question of bank runs should not be considered in isolation from the question of what else depositors might do with their cash: what do they switch into when the switch out of bank deposits?

The risk of runs on MMFs

Having reviewed the academic literature on the causes of bank runs and what might be done to prevent or mitigate them, we now turn to the question of what might cause runs in MMFs and what might be done to prevent or mitigate them. To address this question requires four steps: first, a brief comparison between banks and MMFs to make clear their similarities and differences; second, a review of the reasons why MMFs might be subject to runs and what the consequences might be for the wider financial system; third, a recognition of the beneficial role that MMFs play in the money markets, in particular by making the banking system less risky; finally, a discussion of three possible policy responses and the likelihood that they might reduce the risk and the impact of runs on MMFs.

a) Banks and MMFs: a comparison

Banks, as Diamond and Dybvig argued, are companies that create liquidity by converting illiquid loans into liquid deposits. In the absence of a banking system, loans to businesses would be made directly by owners of capital, whose investment would reflect the character of the business, i.e. many of the loans would be long-term and illiquid. When a bank intermediates this process, using its balance sheet to fund the loans by gathering deposits, the loans remain illiquid but the deposits are available on demand. The bank has created liquidity: it is this activity that is the source both of the economic value and the fragility of the banking system. By contrast MMFs do not create liquidity in this sense; rather, they manage their investors' extant liquidity. MMFs convert short-dated, high credit quality and highly liquid loans into liquid equity. There is a modest maturity transformation and a modest liquidity transformation in a MMF, but these are immaterial when compared with the activities of banks. The basic question that Diamond and Dybvig ask - how is it possible to achieve a Pareto optimal equilibrium in the deposit contract between the depositor and the bank? - does not arise for a MMF, because the MMF is not creating liquidity for the investor (Diamond & Dybvig, 1983 and 1986).

Second, while the demand deposit contract that characterises bank activity is standard and has existed in the same form for many years (Postlewaite & Vives, 1987) the contract between an investor in a MMF and the sponsor of the MMF is different. First, it is an equity contract not a deposit contract: the investor buys shares in a mutual fund rather than depositing cash with a bank. Second, the contract is a contingent demand contract: MMF sponsors seek to preserve capital, to provide liquidity, and to offer a return on investment in line with money market rates, but none of these is guaranteed in the contract. The MMF sponsor might be unable to re-pay the capital in full, might be unable to provide liquidity on demand, and might fail to offer a return that was in line with money market rates. These failures might damage the business reputation of the MMF sponsor but they are not breaches of contract.

Third, it is characteristic of banks that information on the quality and riskiness of their assets is not publicly available; indeed this information is hard to ascertain even for well-informed financial observers, which is why risk-adjusted deposit insurance premiums would be difficult to introduce in practice, notwithstanding their theoretical appeal (Diamond & Dybvig, 1986). By contrast, information on the assets of a MMF is readily available: there are clearly defined regulations that stipulate what sort of assets may be owned in the fund, and MMF sponsors provide lists of asset holdings to regulators.[3] Whereas the risk profile of a bank is obscure to its depositors, the risk profile of a MMF is transparent to its shareholders.

[3] In the US, new disclosure standards require that a MMF report details every month on every security it holds, every piece of collateral backing repurchase agreements, its mark-to-market NAV, and a wide range of other salient information. In Europe such information is also made available to regulators and, frequently, to investors too.

This difference is important, as we will see later, because it means that fund-specific, risk-adjusted contingency measures are possible for MMFs in a way that is not possible for banks.

Fourth, modern banks use a fractional reserve model, which means that the size of their capital reserves (usually a mix of equity and debt) is much smaller than the size of their portfolio of loans, the balance being comprised of deposit liabilities. By contrast, the capital structure of MMFs is comparable to a "narrow bank", that is a bank that holds reserves equal to 100% of its loans. This importance of this point is emphasised by Diamond and Dybvig:

> Existing open-ended mutual funds (and especially money market funds) are essentially 100% reserve banks. They issue readily cashable liquid claims, but, unlike existing banks, they hold liquid assets, as would 100% reserve banks. The mutual fund claims are cashable at a well-defined net asset value. They provide the "law of large numbers" service and to some extent they provide transaction clearing services. Given the success and stability of mutual funds, it is tempting to conclude incorrectly that they would be a good substitute for banks. Of course, this incorrect conclusion ignores the value of the transformation services (creation of liquidity) provided by banks. (Diamond & Dybig, 1986, p.65).

The reason why MMFs have a different capital structure to banks is because they perform different tasks. MMFs provide their investors with an aggregation service and professional credit risk management, but they do not perform the liquidity or maturity transformation services that make banks so important to the wider economy.

The similarities between MMFs and banks are, therefore, essentially superficial. It is important to emphasise the substantive differences between MMFs and banks because the authors of the FSB report argue that economic functions matter more than legal form:

> [The economic function-based perspective] ... allows the extent of non-bank financial entities' involvement in shadow banking to be judged by looking through to their underlying *economic functions* rather than *legal names or forms*. (FSB, 2012, p8).

However, first it is quite clear from the academic literature that when we consider the economic functions of MMFs these are plainly not the same as banks: MMFs do not engage in liquidity creation and they do not engage in fractional reserve banking activities. Second, as will become clear later in the paper, the difference in legal form between banks and MMFs is important since it provides MMFs with strategies to mitigate run risk that are not available to deposit taking banks: the contract MMFs offer is a contingent equity contract and their asset holdings are transparent and low risk. In other words, when markets are in distress and systemic risk is rising, the legal form of an financial entity matters a great deal.

b) Risks associated with MMFs

For many years MMF sponsors have been criticised for using the "penny rounding" pricing technique to value their MMFs at a stable NAV of 1.00 (for example, McCulloch, 1986, p80, fn.1). It is claimed that the fund's price should reflect the real value of the assets in the fund and that even when the real value is only marginally different from the 1.00 stable price, a variable price would better reflect economic reality.[4] More recently, it has been claimed that by using a pricing structure similar to insured deposit contracts MMFs trade on an implicit promise that the equity contract is insured in the same way that a bank deposit is insured: the backstop support for the MMF industry, provided by the US government in September 2008, made explicit this promise at tax-payers' expense (Gorton & Metrick, 2010).

These criticisms of stable NAV pricing link the pricing structure with the vulnerability of MMFs to run risks. The argument - which, as we saw earlier, now informs IOSCO's proposals for reform of the MMF sector - assumes that investors believe that MMF shares are just like insured bank deposits; and for all the same reasons that in a time of market distress investors might run from a bank, so MMF investors might have reason to run from a MMF. In this scenario the first-movers - the investors who get to the front of the queue to withdraw their cash - are more likely to repaid in full, and so are advantaged.

There are several problems with this argument. First, the "penny rounding" price structure has been used for many years because it accurately reflects the fact that there is very little price volatility in the value of the assets held by MMFs in normal circumstances. The majority of assets held in MMFs are not traded; they are bought and then held to maturity. Further, for many of these assets there are not active two-way markets from which realistic mark-to-market prices could be obtained, so amortised-cost accounting is used because it provides the most accurate measure of the asset's value. From an accounting point of view the stable NAV pricing policy is appropriate given the sorts of assets held in MMFs: it is a true and fair pricing policy.

Second, what makes MMFs attractive to institutional investors is not an implicit guarantee or promise that MMF shares will always be redeemed at 1.00 and that the investor's capital is protected by insurance (or underwritten by the taxpayer); it is, rather, that MMFs are convenient as a way of managing short-term cash holdings. By aggregating cash holdings across a wide range of investors, MMFs provide economies of scale which many investors (both retail and institutional) are not able easily to secure for themselves, in particular the provision of professional credit risk analysis.

Third, the argument that MMFs benefit from being seen as "insured demand deposits in disguise" fails to explain the attraction of MMFs to institutional investors, who currently

[4] In both the US and Europe, MMFs that use stable NAV pricing are obliged to move to a market price only if the Fund value falls below 99.50 (or, rises above 100.50).

represent around three-quarters of all MMF shareholdings worldwide (FSOC, 2012, p.21). The size of the cash holdings of institutional investors is such that only a small fraction of their holdings would be eligible for deposit insurance were they to make use of demand deposits provided by banks instead of MMFs.[5] While for retail investors, using a MMF means giving up deposit insurance for other benefits, such as a higher return, for institutional investors there is no meaningful deposit insurance benefit to be given up, because it is not available to them from either demand deposits or MMFs.

Finally, it is simply not clear that the reason investors withdrew cash from MMFs in September 2008 was connected in any way to their stable NAV pricing structure. Nor is it clear that the withdrawals should be characterised as a run, in the classic sense of the term. This point is made by Andrei Shleifer, in his comments on the Gorton & Metrick paper:

> Following Douglas Diamond and Philip Dybvig (1983), economists often use the term "run" to describe a multiple-equilibrium situation, in which a bad equilibrium with a run can occur despite solid fundamentals. Such a run does not seem to be a good description of what happened to Lehman and other banks in 2008. The withdrawal of short-term finance surely undermined bank balance sheets, but it seems to me at least as plausible that this withdrawal was a response to an already incurable situation rather than its cause. And if that is the case, regulating short-term finance might not be as high a priority as Gorton and Metrick indicate. (Gorton & Metrick, 2010, p.300).

Data on redemptions from MMFs during the autumn of 2008 supports Shleifer 's argument. First, while there were significant withdrawals from prime MMFs, which own a mix of bank and government debt, at the same time there were large inflows into government MMFs, which own only government debt (McCabe, 2010). This suggests that there was a widespread asset allocation shift, as investors moved out of bank and into government credit in response to the evident and systemic problems in the banking sector: less of a run, more of an information-based asset allocation (Jacklin & Bhattacharya, 1988). The data also suggests that most of those who withdrew assets from MMFs during this period were institutional investors not retail investors (McCabe, 2010). In other words, these were not investors who ran from MMFs to banks because they realised that they lacked deposit insurance and decided they wanted it; rather, these were investors who were ineligible for deposit insurance and who switched to government credit to reduce their investment risk.

A second, more persuasive account of the risks associated with MMFs draws on the ideas of an "amplifying mechanism" and a "loss spiral" (Brunnermeier, 2009). When a financial market is shocked, or enters a period of distress, there is often a fall in the price of assets, which leads to a withdrawal of liquidity, which in turn amplifies the risks and depresses prices further. Many market participants make use of assets as collateral, whether in repo transactions or for margin calls. As asset prices fall and margin calls and repo haircuts

[5] The $100,000 limit on deposit insurance in the US was raised to $250,000 in 2008 (initially as a temporary measure, but later on a permanent basis). Limits in Europe are of similar size.

increase, so too there are sharp falls in the availability of funding liquidity. Consequently, banks and brokers respond by deleveraging to reduce the funding requirement for their positions. If many market participants seek to sell assets for cash concurrently this creates further downward pressure on prices, which in turn causes a further increase in margin calls and haircuts. What follows is a spiral of losses, as each write-down of asset prices leads to a further round of deleveraging.

This looks to be a much more promising analysis of what happened in financial markets in 2008 and provides a clearer explanation of why liquidity dried up in many markets, including the market for the kinds of short-term assets held by MMFs. It would also help to explain why the pressures on asset prices and the impact of deleveraging varied market by market, and currency by currency, with the US dollar market experiencing significantly greater pressures that the Euro and Sterling markets. When investors started to sell shares in MMFs, managers sought to restore the natural liquidity of their MMFs by selling assets. The secondary market for assets was already overwhelmed by sales of similar assets by banks and brokers, seeking to lower their risk exposure and to reduce the cost of funding their residual asset positions. MMF managers that sought to sell into falling markets consequently risked crystallised losses for their shareholders; at the same time their actions risked amplifying the existing downward pressure on asset prices.

In summary, the standard criticism of MMFs that the pricing structure misleads investors into thinking that they have an implicitly insured deposit (or equivalent) turns out to be highly implausible. First, according to the Diamond and Dybvig model, if investors really believed that their MMF share was insured they would not need to run. Second, most of the investors who moved from prime to government MMFs were institutional investors for whom deposit insurance is irrelevant; they did not run from MMFs, they switched from bank credit to government credit within a MMF structure. Third, the real systemic concern about MMFs is that, at times of market distress, their ability to create liquidity by selling assets is compromised by the loss spiral that is already taking place in asset markets; and if they succeed in selling, they also (unintentionally) amplify the level of market distress.

c) Benefits of MMFs

MMF sponsors have marketing teams that can provide long lists of the benefits of MMFs for their investors. In this paper we are more interested in the benefits that MMFs bring to the wider financial system, through lowering the overall risk profile of the banking system. These are benefits that regulators should be interested in preserving.

The first benefit accrues from considering the effect that MMFs have on the retail deposit market, by providing an investment choice to retail investors. McCulloch describes a period, in early 1983, when MMFs in the US lost around 25% of their assets. Retail investors

had previously been able to choose between insured demand deposits, on which the payment of interest was prohibited owing to Regulation Q, and MMFs, which paid interest but lacked deposit insurance. In 1983 a number of banks and thrifts introduced a new Money Market Deposit Account (MMDA) which paid some interest but was also covered by deposit insurance. As McCulloch notes:

> Although MMDAs are even safer than MMFs from the depositors' point of view, they are much riskier from the point of view of the economy as a whole since they may be used to finance loans of very long maturity, very low quality, or very high default risk. (McCulloch, 1986, p.80, fn2).

In other words, if retail depositors invest the majority of their cash in insured bank deposits then the size of the moral hazard problem grows, as does the problem of the largest banks being perceived as "too big to fail". However, if retail depositors move some or all of their cash to MMFs, then the size of the liability to be covered by deposit insurance (and under-written by taxpayers) reduces.

One of the arguments against providing deposit insurance for institutional investors is the huge size of the potential liability; the second argument is that institutional investors, such as banks and MMFs, provide a useful service in monitoring the riskiness of the activities of the banks to whom they lend (Demirgüç-Kunt & Kane, 2002). The difficulties of well-informed judgements concerning the risk profile of a bank's loan portfolio was mentioned earlier, as a reason why the introduction of risk-adjusted deposit insurance premiums would be problematic. Banks need to raise deposits to fund their lending activities: if a bank is unable to secure sufficient funds from retail investors (who are insured and have little incentive to worry about the risk profile of the bank's loans) then it must rely on other banks or MMFs who will require more and better disclosure about the risk profile of the borrowing bank's loans. The proprietary credit research that institutional investors undertake to inform their investment decisions acts as a deterrent to banks when it comes to risk-taking: bank's that take higher risks will have to pay more for deposits.

Third, as has been noted, around two thirds of assets in MMFs are now held on behalf of institutional rather than retail investors. In recent years there has been significant growth in the size of the pools of institutional assets held in highly rated and highly liquid instruments (Pozsar, 2011). The investors' primary concern is to achieve security and liquidity for their asset holdings and, in many cases, they make use of MMFs as an alternative to direct investment in bank debt. By using pooled investment vehicles that benefit from the bespoke credit research carried out by the managers of the MMFs, shareholders are able to mitigate some of the risk that arises from the absence of deposit insurance for institutional investors. MMFs provide a standardised, transparent and clearly-regulated vehicles with which these large, liquid and uninsurable balances can be managed.

From the regulators' point of view, the important question is this: if MMFs did not exist in their present form and at their present scale, what would happen to these large pools of cash? If the investors are seeking security and liquidity, and if MMFs were no longer able to provide these services due to regulatory reform, then these pools of cash are likely to flow into the banking system directly, or indirectly via some other form of investment vehicle. Given the investors' known preference for high credit quality, the wider banking system would thus become even more dependent upon interbank funding mechanisms to recycle surplus cash from higher rated banks to lower rated banks which were unable to attract deposits. In the absence of MMFs, the banking system would remain vulnerable to rapid asset allocation shifts from low to high credit, and from bank to sovereign credit, but the visibility of such movements would be significantly lower because they would no longer occur in standardised, transparent and clearly-regulated vehicle.

MMFs therefore make three valuable contributions to the wider safety of the financial system. First, they take retail deposits away from the insured deposit sector, reducing both the moral hazard and costs of the insured deposit system. Second, the credit analysis they undertake on banks helps to improve the quantity and quality of the monitoring of risk-taking in the financial system. Investors pay MMF managers to provide this credit management service, but the signalling function that results is of benefit to the wider market, including the regulators. If MMFs show aversion to a particular bank or group of banks - by refusing to lend or by demanding higher interest rates to lend - then the regulators are quickly made aware of problems which they might otherwise not have discovered until too late.[6] Third, they provide an investment vehicle for the sizeable cash pools owned by risk averse institutional investors, which allows for greater transparency and regulatory control over the manner in which this cash is invested. For these reasons it is clear that a world in which MMFs did not exist would be a riskier world.

d) Policy responses

The academic literature suggests two potentially advantageous regulatory policy responses to address the problem of runs on banks: suspension of convertibility and deposit insurance. Currently regulators, with support from some academics, are proposing a third option to deal with the perceived threat of runs on MMFs, namely a change in the price structure of MMFs from stable NAV to variable NAV(see Gorton & Metrick, 2010; however Gordon & Gandia, 2012 question the validity of this proposal). This section assess the merits of each of these policies with respect to MMFs.

[6] Arguably the decision of MMFs to reduce investment in Eurozone banks in the summer of 2011 made clear to regulators and policy makers the seriousness of the risk profile of this group of banks and the need to act quickly to repair their credit quality.

According to Diamond and Dybvig the optimal solution to prevent a run on a bank is the introduction of deposit insurance, provided by a public authority and backed by funds provided from taxpayers. Theoretically, since the government can impose taxes after the withdrawal of cash from the bank, it can base the tax level that is imposed on an agent who withdraws cash according to the total value of withdrawals made at any particular time. The net value to early withdrawers is thereby adjusted to take account of the cost of any asset liquidations. Tax surpluses are returned to the bank to preserve liquidity for future withdrawers. It is this process that defeats the first mover advantage since, as Diamond and Dybvig write:

> ... for all possible anticipated withdrawal policies of other agents it never pays to participate in a bank run. As a result, no strategic issues of confidence arise (Diamond & Dybvig, 1983, p.415).

In practice, most deposit insurance schemes use a fixed-rate premium which is not adjusted to the riskiness of the bank's asset portfolio, which introduces the problem of moral hazard, and non-optimal tax raising schemes, which introduce further distortions into the model. It is for these reasons - the imperfections of policy solutions in the real world - that academics have suggested that deposit insurance should only be available for retail demand deposits and that the credibility of the scheme will depend on the perceived ability of the government to fund the insurance liabilities.

These caveats suggest that deposit insurance would not be an attractive solution to the problem of runs from MMFs. Institutional deposit insurance would relieve institutional investors from the requirement to carry out their own credit assessment of the riskiness of banks to whom they lend, which would increase the problem of moral hazard, and the potential size of the liabilities that the government might need to cover. In turn, this would reduce the credibility of the deposit insurance scheme: there are few governments in the world that are capable of standing fully behind the deposit liabilities of their domestic banking system: the US and the UK have managed this in recent years;[7] whereas Iceland and Ireland found the burden crippling and bank bailouts turned into sovereign bailouts. Moreover, since in some cases the institutional investors that own shares in MMFs are not themselves domiciled in the same tax jurisdictions as the MMFs, there is a risk that tax-payers in one jurisdiction would become liable for the actions of agents from another tax jurisdiction, raising political problems of fairness and accountability.

If deposit insurance is inappropriate and impractical for institutional investors, what of the current proposal to change the price structure of MMFs, so that stable NAV is replaced by variable NAV? The first argument in favour of this change - about which we have already

[7] Interestingly, the MMF back-stop fund introduced by the FRS in the US in September 2008 ended up costing the taxpayer nothing. Once the promise to support MMFs had been made, so the need to provide support disappeared.

expressed considerable scepticism - is that it would make clearer to investors that their equity holding in a MMF was unlike an insured demand deposit. A second argument is that the price variation of a MMF during normal times would make it less likely that investors would perceive that there was a first mover advantage to be gained by redeeming early from a MMF. Variable NAV funds, it is said, are more resistant to bank runs than stable NAV funds because the first mover advantage is reduced. However, when subjected to critical scrutiny this argument can be seen to be quite as implausible as the first.

It is true that the "penny rounding" price structure gives MMFs a cosmetic resemblance to bank demand deposits, notwithstanding the four important differences between the two contracts that were described earlier. From which it follows that, if requiring MMFs to abandon the stable par value of investors' equity in favour of variable pricing would signal a reduction in the first mover advantage and thereby reduce the risk of a run on a MMF, then, by parity of reasoning, it should also be the case that requiring banks to abandon the par value of demand deposits in favour of a variable price that reflected the bank's internal risk-model estimate of the value of its asset portfolio, would signal a reduction in the first mover advantage and thereby reduce the risk of a run on the bank. When comparing banks and MMFs, if what matters is their economic function rather than their legal form then it must be the case that what would deter a run in a MMF would also deter a run in a bank. It is to the great demerit of this proposal that in the extensive literature on bank runs there is no recommendation that the par value of demand deposits be changed. Given the length and depth of academic research on bank runs, by comparison with the rather recent interest shown by regulators and policy makers into research on MMF runs, it is quite remarkable that the preferred solution for MMFs is one without precedent in banking regulation.

As has already been noted, most of the withdrawals from MMFs in September 2008 were from institutional investors not retail investors. Likewise, and contrary to popular perception, when there was a run on Northern Rock Bank in September 2007, the retail branch deposits were the most stable of all deposits and the wholesale deposits (from banks, MMFs and other institutional investors) were the most prone to run (Shin, 2009). Yet, it is clear that these institutional investors were not "running" because they perceived a first mover advantage in so doing. They withdrew cash because of their need to deleverage and/or de-risk their portfolios, as a response to deteriorating conditions in the markets:

> ...when a crisis strikes, risk constraints bind and lenders cut back their exposures in response. But whatever the reason for the prudent cutting of exposures by the creditors to Northern Rock, their actions will look like a "run" from the point of view of Northern Rock itself. In this sense, the run on Northern Rock may be better seen as the tightening of constraints on the creditors of Northern Rock rather than as a coordination failure among them (Shin, 2009, p.110).

The key point here is that regulatory policy makers need to take account of what the process looks like from the depositor/investor point of view (i.e. a prudent cutting of exposures)

rather than what it looks like from the bank or MMF point of view (i.e. a run). If the regulatory policy is supposed to work by changing the motivations of the depositor/investor, then it helps to understand the sources of these motivations. In the case of Northern Rock the run by wholesale investors was not based on a perception of first mover advantage but on the desire to reduce credit exposures.

To make this point clearer, consider the difference in the outcomes to first movers and last movers during and after a run on a bank and a MMF. (In this case we are assuming the investors are institutional and therefore not covered by deposit insurance). As Table 1 shows, the outcomes for first movers are the same regardless of the product: early withdrawal from a bank and a MMF both secure the full value of the deposit/investment at par. However, whereas last movers from a MMF risk a value slightly below the full value of their investment,[8] last movers from a bank risk losing access to the full value of their deposit pending insolvency proceedings, with the eventual recovery of only a small percentage of the value of their deposit when creditors are finally paid out (possibly some years later).

Table 1

	Bank demand deposit	**MMF share**
First mover	Par value	Par value
Last mover	Par value *or* residual payment after insolvency	Par value *or* just below par value after the fund is wound up

From the investors' perspective, the benefit of being a first mover rather than a last mover is significant if they hold a demand deposit, but is marginal if they own a share in a MMF. This reflects the fundamental economic difference between the two products, adverted to earlier. Banks hold fractional reserves, issue standard demand deposit contracts and operate under a sequential service constraint. If there is a run on the bank, creditors form a queue and those at the front of the queue get paid back until the bank declares itself insolvent, at which point no creditors get anything back until the outcome of a lengthy insolvency process. From an investors' point of view the outcomes are binary: you are paid back in full or you are not paid back at all. This is why it makes sense to run to the front of the queue: the first mover is significantly advantaged.

MMFs are equivalent to 100% reserve banks that issue constrained equity contracts. They do not guarantee the full repayment of capital and they do not guarantee daily liquidity: these benefits are provided on a "best endeavours" basis and while the MMF sponsor might suffer reputational damage if they cannot repay equity shares in full and on demand, they are not contractually obliged to do so. Further, the equity contract is not a sequential service

[8] For example, investors in the Reserve Fund, the MMF that "broke the buck" in September 2008 and subsequently closed, received 99.1 cents on the dollar.

contract: MMF sponsors might decide to suspend or limit redemptions from their funds in order to protect the interests of all shareholders.[9] Where an investor stands in the queue does not determine how much of their investment is repaid. The outcome for investors in MMFs is not binary: they might be paid back in full immediately, or they might be paid back in full after a delay, or they might be paid back slightly less than the full value of their investment if the fund "breaks the buck". Therefore it makes far less sense to run to the front of the queue, because the first mover secures at most only a modest advantage.

Not only is it the case that MMFs, properly understood, are less vulnerable to runs than banks, it is also the case that stable NAV funds are equally resistant to bank runs as variable NAV funds. A fund with a price that varies marginally day-by-day in a normal market environment, offers no better protection to investors in a period of market turmoil compared with a fund with a stable price. The variable price offers no protection to investors if the value of assets in the fund start to fall. In a MMF with a stable NAV all investors will be able to redeem equally at par until such time that the fund is unable to provide daily liquidity and/or maintain its price at 1.00. At this point the fund directors might suspend or limit redemptions from the fund, or might allow the fund to "break the buck" and move to variable pricing. From this point onwards all investors will be able to redeem at a lower price and/or under a specific constraint on the volume of daily redemptions. In a MMF with a variable NAV exactly the same process would be followed. Once the fund's natural liquidity had been exhausted the fund directors would either suspend or limit redemptions from the fund, or the fund would fall in value to reflect the falls in market prices of its assets. The fact that the fund's price changes marginally from day-to-day cannot prevent a loss of liquidity due to withdrawals or a loss of value due to falling secondary market prices. In both stable and variable NAV fund the first mover is slightly better off than later movers, who are slightly better off than last movers: but to the extent that any disadvantage is experienced, it is caused by a loss of liquidity and falling asset prices and not by the pricing structure of the fund.

From the investors' point of view, the factors that determine whether they are able to withdraw funds from a MMF by selling their share and what value they receive for this share are, first, the amount of natural liquidity in the fund and, second, the ability of the fund to create new liquidity by selling assets into the secondary market. Neither of these factors is influenced in any way by the price structure of the fund. A MMF with a variable NAV that is short of liquidity and finding it hard to sell assets at close to their face value has no advantage over a MMF with a stable NAV in a similar environment. Unless investors are systematically deceived as to nature of the equity share they own and its sources of value, they have no reason to prefer a variable to a stable NAV fund; likewise they would have no reason to exit a stable NAV fund sooner than a variable NAV fund.

[9] In Europe, under UCITS legislation, it is a requirement that the fund directors treat the interests of all shareholders equally.

One final observation about the recommendation that MMFs change from stable to variable NAV pricing. The claim - which we believe to be deeply flawed- is that variable pricing reduces the incentive for investors to redeem from MMFs, thereby lowering the level of systemic risk. In circumstances where, for whatever reason, a run on the MMF sector has already started, the use of variable pricing would provide no assistance in mitigating the risk. Trying to prevent a run is one task; dealing with a run is a completely different task. The price structure of MMF makes no difference once the run is underway: the fund will be forced to sell assets into falling markets, thereby contributing to the loss spiral and amplifying the level of risk across the financial markets as a whole. Variable NAV turns out to be neither a prevention nor a cure.

It is this thought that brings us back to the idea of suspension of convertibility. While Diamond and Dybvig showed that this policy was a second best for retail demand deposits, it appears to be the most promising policy for shares in MMFs. Suspension of convertibility means the temporary abandonment of the standard terms whereby contracts are terminated and cash is returned to investors. For banks this means that deposits are no longer able to be redeemed on demand. Investors must wait to gain access to their cash, which often turns out to be unpopular and might lead to a reduction in social welfare (Sprague, 1908; Friedman & Schwartz, 1963; and Ennis & Keister, 2009).

The theory behind the suspension of convertibility in banking is that the standard terms of the deposit contract, while appropriate for standard market conditions, become inappropriate when market conditions deteriorate. At this point some form of "escape clause" should be invoked. For banks, this might mean allowing reserves to decline below a statutory minimum; or it might mean using a "life-boat operation" to rescue a particular bank that was in difficulty. When there is a generalised run on the whole banking system, suspension of convertibility is the best form of escape clause because it prevents contagion spreading within the system (Eichengreen, 2008, p.36-37).

For MMFs the suspension of convertibility might mean that the fund limits (in whole or in part) the ability of shareholders to sell their shares for cash for a period of time (known as a "liquidity gate"); or it might mean that the fund imposes a charge on shareholders who sell shares, equivalent to the cost of restoring liquidity in the fund to its pre-redemption levels (known as a "liquidity fee"). In either of these cases the standard terms of the equity contract - between the MMF and the shareholders - would be suspended, pending the resumption of normal market conditions. Given the very short maturity profile of the assets held by MMFs, and the transparent nature of their asset holdings, the restoration of the natural liquidity of the fund would take place very quickly and publicly. By comparison with banks, suspension of convertibility for MMFs would be a shorter and less painful process.

There are three reasons why the ability to suspend or limit redemptions from a MMF looks to be the most promising regulatory policy tool to reduce the risk of runs of MMFs. First,

given the legal and economic structure of a mutual fund, suspension of convertibility makes sense because the equity contract is by nature conditional. While this might seem no more than serendipitous, in fact it makes regulatory policy changes in this area easy to introduce for MMF sponsors and easy to explain to MMF investors, which are both non-negligible gains when it comes to improving financial sector regulation. For a bank, the refusal to redeem a demand deposit is a breach of contract; for a MMF, the refusal to allow an investor to sell their shares on any particular day, if to do so would unfairly disadvantage other shareholders, is an implicit element of the equity contract.

Second, if all investors know and understand that the MMF sponsor would suspend convertibility if and when the fund can no longer provide liquidity to redeeming investors without disadvantaging non-redeeming investors - i.e. no investor is disadvantaged by the actions of other investors - then the first mover advantage is removed. There is no need to try to run to the front of the queue if those at the front of the queue cannot gain benefit from their position in the queue. There is no shame in being the last mover if the last mover ends up with the same value as every other mover. The equal treatment of all shareholders is, at the same time, both a fundamental principle of mutual fund management and the best protection of funds against runs.

Third, the suspension of convertibility provides the best mitigation against a loss spiral in the event of a widespread run on banks and MMFs. If, as in September 2008, MMFs experience unusually large redemption demands, which in turn would require significant sales of assets in falling markets, and there is a risk of a significant amplification of market distress, the best option for MMF sponsors, MMF investors and regulators is an orderly, industry-wide suspension of convertibility. Rational investors will understand that they have no need to run, but in the extreme case that some (or all) try to run because of widespread panic in the markets, the MMF industry needs to be able to impose conditions upon the equity contract with regard to convertibility and these conditions need to treat all shareholders equally. In short, if MMFs are able to suspend or limit fund redemptions - by the use of a liquidity gate or a liquidity fee - then investors cannot run because the door is shut, and it could only be opened for them upon the payment of an appropriate price.

Conclusions

Certain of the policy proposals in the recent IOSCO, FSOC and FSB reports are based on a faulty analysis of the academic literature on bank runs and the first mover advantage. While these regulatory reports list the many real and substantial risks that exist in short-term money markets, none of them is able to establish a credible causal connection between these risks and the pricing structure of MMFs. Tinkering with price structure of MMFs will not achieve the benefits that are claimed. A world in which all MMFs had converted to

variable NAV would not be a world with lower systemic risk: much effort would have been expended, but for no discernible benefit.

In the absence of a credible deposit insurance policy for the MMF industry, suspension of convertibility should be the preferred option: for regulators, for MMF sponsors and for investors. Liquidity gates and liquidity fees provide the clearest disincentive to institutional investors to seek to gain a first-mover advantage by running from their fund; they also provide the strongest policy tool to stop a run once it is underway, by breaking the downward value spiral.

Mark Hannam

Institutional Money Market Fund Association

v.2 January 2013

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March 31, 2014

Elizabeth M. Murphy, Secretary
Securities and Exchange Commission
100 F Street, NE
Washington, DC 20549-0609

RE: File Number S7-03-13, Money Market Fund Reform

Dear Secretary Murphy:

We submit as commentary on the proposed Reform the attached paper: "Proposed Money Market Fund Regulation: A Game Theory Assessment."

This paper presents a game theory analysis of the SEC's June 2013 proposals for reform of Money Market Funds (the "Release"). Game theory is relevant to this policy debate as regulators, particularly FSOC, have depicted investor behavior using terminology of shareholder runs and first mover advantage – a framework classically employed in game models of bank runs.

The paper is responsive to various questions raised in the Release. We demonstrate that when implemented properly, the Fee/Gate alternative would effectively halt and even prevent runs from taking place. However, the alternative of moving to a fluctuating net asset value would neither halt nor prevent runs. The alternative of combining Fees/Gates with a fluctuating net asset value is found to be inferior to Fees/Gates alone because it would create an economically inferior product that would inevitably promote regulatory arbitrage without materially reducing run risk beyond the features of the Fee/Gate alternative.

The paper describes these issues in detail, both with regard to framing the final rule and in stating the requisite powers and responsibilities of directors. We believe that the current policy debate inside the Commission needs to reflect this perspective on the ability of Fees/Gates to provide a robust policy solution and adequately protect investors from first mover risks.

We thank you for your consideration.

Sincerely,

Anthony J. Carfang, Partner

Cathryn R. Gregg, Partner

Enclosures

cc: The Honorable Mary Jo White, Chair
The Honorable Luis A. Aguilar
The Honorable Daniel M. Gallagher
The Honorable Kara A. Stein
The Honorable Michael S. Piwowar

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Proposed Money Market Mutual Fund Regulations: A Game Theory Assessment

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Abstract. This paper presents a game theory analysis of the SEC's June 2013 proposals for reform of Money Market Funds (MMFs). Game theory is relevant to this policy debate as regulators have depicted investor behavior using terminology of shareholder runs and first mover advantage – a framework classically employed in game models of bank runs. The paper demonstrates that when implemented properly, the Fee and/or Gate alternative would effectively halt and even prevent runs from taking place. However, the alternative of moving to a fluctuating net asset value would neither halt nor prevent a run.

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Introduction

The Securities and Exchange Commission (SEC) recently developed a set of proposed regulations for money market funds (MMFs).[1] Throughout the debate surrounding the need for additional reforms, regulators have referenced elements of game theory with their discussion of "first mover advantage." In particular, in its November 2012 Rule Proposal for MMFs, FSOC employed the first mover concept in justifying its proposed reforms, which differ from the SEC's June 2013 proposals.[2] The Federal Reserve has similarly employed first mover concepts in arguing against the SEC's Alternative 2 proposal (Fees and/or Gates) [3]. For these reasons, it is logical to employ game theory to evaluate the efficacy of the SEC's proposals (the "Release").

Game theory is a well-established body of thought that is used to model competitive economic behavior. It describes how economic agents make rational decisions under uncertainty when the actions of other agents can also affect the outcome. Because of its sound methodological underpinnings and widespread applicability, game theory has been employed in numerous theoretical, business and military contexts. In the present context, it is useful in exploring the issue of run risk in MMFs. The SEC must balance this risk against other public policy objectives that are not captured by game theory, such as the effectiveness of MMFs in the capital markets.

The debate concerning MMF reform has now developed an extensive literature that addresses the costs and benefits of the proposed alternatives in terms of the impact on fund shareholders and issuers, as well as the broader macro effects on capital formation, efficiency, competition and systemic risk. For several viewpoints on potential risk and reform see Fisch and Roiter (2011),[4] Bengtsson (2010),[5] HSBC (2011),[6] Jank and Wedow (2010),[7] Kacperczynk and Schnabl (2012)[8] and Investment Company Institute (2012).[9] This paper contributes to the debate by providing a microeconomic analysis of investor behavior under the proposed alternatives. This is necessary in order to rigorously evaluate likely investor behavior under each regulatory regime and free the analysis from mere conjecture regarding the outcomes. This is particularly relevant in evaluating the issue of investor protection and board responsibilities under the various alternatives.

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[1] http://www.sec.gov/rules/proposed/2013/33-9408.pdf

[2] U.S. Department of the Treasury Financial Stability Oversight Council. (2012). Proposed recommendations regarding money market mutual fund reform (Docket No. FSOC 2012-0003).

[3] http://www.sec.gov/comments/s7-03-13/s70313-111.pdf

[4] Fisch, J., & Roiter, E. (2011). A floating NAV for money market funds: fix or fantasy? University of Pennsylvania Law School Research Paper, 11(30).

[5] Bengtsson, E. (2011). Shadow banking and financial stability: European money market funds in the global financial crisis. Sveriges Riksbank working paper.

[6] HSBC (2011). Run risk in money market funds.

[7] Jank, S., & Wedow, M. (2010). Sturm und drang in money market funds: when money market funds cease to be narrow. CFR working paper, No. 10-16.

[8] Kacperczyk, M., & Schnabl, P. (2012). How safe are money market funds? AFA 2012 Chicago Meetings paper.

[9] Investment Company Institute (2012). A bad idea: forcing money market funds to float their NAVs.

We analyze four primary questions:

- Will requiring a variable net asset value (VNAV) prevent or stop a run on money fund assets?
- Will maintaining a constant net asset value (CNAV) and providing MMF board discretion to impose liquidity or redemption fees (Fees) prevent or stop a run on money fund assets?
- Will maintaining a constant net asset value (CNAV) and providing MMF board discretion to impose a temporary redemption gate (Gates) prevent or stop a run on money fund assets?
- Will combining VNAV with Fees and/or Gates prevent or stop a run on money fund assets?

Conclusions

Our analysis considers the distinction between stopping a run in progress ("stopping") versus preventing a run from starting ("preventing"). Public policy recognizes both objectives in order to avoid fire sales, prevent contagion and to protect investors from the "first mover" effects of other investors (which particularly relates to preventing runs). The rule-making challenge is to balance these goals in a way that preserves the integrity of MMFs as securities (and thus the allocational efficiency of markets, a primary SEC mandate) while minimizing risks to financial stability (a primary FSOC mandate). On the basis of our analysis, we reach several conclusions:

- A variable NAV structure is ineffective at either preventing or stopping a run. Compared with the SEC's other proposals, it removes the apparent motivation to run that results from a potential shadow price deviation from $1. However, the neglect of real-world switching costs that investors face in changing investment programs causes this effect to be overstated. In a significant stress event, the effect is a minor determinant of behavior.
- Both the Fee and Gate alternatives are effective in stopping a run in progress. Gates do so by definition. Fees stop a run provided that the Fee is of sufficient magnitude. In either case, it is essential that fund boards have the latitude to implement Fees or Gates when they deem necessary. In particular, a requirement that boards wait until the end of day would render these alternatives ineffective.
- Fees and Gates are also effective in preventing runs, provided that boards are sufficiently preemptive in their actions. Investors must believe that they will be unable to redeem in a way that disadvantages other shareholders. Game theory provides an analytic prescription for how boards must set Fee/Gate policy that is based on setting investor expectations.
- The SEC has provided an extensive discussion of the factors relevant to implementing Fees or Gates. In particular, Section III.B of the Release identifies the key principles that underlie an effective policy and tradeoffs among them. We find that effective run prevention is attainable within the

approaches contemplated by the Release, while requiring that fund boards be given discretion to take protective action.[10]

- Fees and Gates have been primarily analyzed in terms of their ability to stop or prevent runs – particularly those resulting from liquidity or credit stress events in which fund values are impaired, but markets remain continuous. However, recent developments make it apparent that markets may be discontinuous. Events such as cyber attacks, market shutdowns (or glitches) and extreme weather events, to list a few, disrupt market continuity with some frequency. This is especially important if the disruptive event does not impact all markets to the same extent or if some markets remain open. Regulators should therefore also consider allowing directors to impose very short-term Gates when there are business continuity events in which it may not be in the best interest of shareholders to make continuous redemptions. In these circumstances, fund directors and advisors may need a pause in order to make critical decisions on behalf of shareholders. Such power would complement the existing ability of funds to delay settlement for up to seven days.

- Fees and Gates fill what are currently gaps in Rule 2a-7. At present, a fund that breaks a dollar has no choice but to liquidate. Fees and Gates provide a framework for a fund to bridge such periods, and continue to operate afterwards. Fees enable investors to access their liquidity, but at a price. That price may (and probably will) exceed the discount of the shadow price to $1 during a crisis, but that is the cost of being able to assure that a stable NAV product will not cause contagion or fire sales during such periods. Gates do not impose an extra fee on shareholders but have the effect of restricting access to liquidity during critical periods. Together, Fees and Gates provide fund boards with powerful tools to prevent a run from materializing, to stop a run in progress, and to assure that a stress event does not cause contagion or fire sales.

- The proposal to combine VNAV with Fees/Gates would be effective at both stopping and preventing runs, due almost entirely to the effect of Fees/Gates. It would also eliminate any first mover effects of an initial shadow price beneath $1. However, it is likely that this proposal is completely ineffective as a practical matter due to the inevitable regulatory arbitrage. Revising Rule 2a-7 in this manner would largely eliminate the distinct meaning of a "Money Market Fund" as it is currently understood and would make these funds inferior to near substitutes that do not hold themselves out as 2a-7 funds.

- The combination of VNAV with Fees/Gates is an example of a policy prescription that weighs systemic risk concerns so heavily that investment utility

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[10] Note that rule 2a-7 already mandates board action in the relevant circumstances, a fact pointed out in the comment file. See comments of Federated Investors, Inc., Section 4.3, pp. 9 – 11, (Sep. 16, 2013), http://www.sec.gov/comments/s7-03-13/s70313-130.pdf. " Rule 2a 7(c)(8)(ii)(A) already requires a Board to meet whenever it ["believes the extent of any deviation from the money market fund's amortized cost price per share may result in material dilution or other unfair results to investors or existing shareholders, [and] cause the fund to take such action as it deems appropriate to eliminate or reduce to the extent reasonably practicable such dilution or unfair results."]"

of the resulting product is undermined. Other rules could have a similar effect. For instance, our analysis shows that extreme preemptive action by boards in imposing Fees could be so effective that, while eliminating run risk, the resulting penalty to access liquidity could become unduly burdensome. In balancing these competing objectives, it is possible that directors should be allowed to set Fees that are an adequate deterrent to runs, but still with reasonable proportionality to transaction costs (and any current discount of the shadow price to $1), so they do not improperly penalize redemptions.

I. Proposed Money Fund Regulations

On June 5, 2013, the Securities and Exchange Commission (SEC) proposed regulations that would include additional restrictions for institutional prime money market mutual funds and tax-exempt money market funds (MMFs). One proposed reform alternative would require MMFs to sell and redeem shares based on a variable net asset value (VNAV) rather than the constant $1.00 per share net asset value determined by amortized cost (CNAV). A second reform alternative of the SEC proposal allows CNAVs, but would grant fund boards the discretion to impose liquidity fees (Fees) if the level of weekly liquid assets falls below a specified threshold. This alternative also would grant fund boards the discretion to suspend redemptions or "gate" the fund (Gates) if the level of weekly liquid assets falls below the proposed threshold.

These proposals follow significant and important Rule 2a-7 reforms enacted in 2010 that did much to address MMF risk. They substantially reduced the likelihood of a fund experiencing a run and were executed in a way that did not impair the money fund business. They mandated:

- Shorter maturity limits
- Periodic stress testing of circumstances that might result in the fund breaking a dollar
- Increased transparency of portfolio holdings and valuations
- The requirement that MMFs seek to determine liquidity needs of shareholders and plan accordingly (Know Your Customer requirements), and maintain a buffer of highly liquid assets from which to pay redemptions

With the success of these 2010 changes, the current proposals may be viewed as attempts to address remaining concerns. Regardless of which, if any, proposals are implemented, the ultimate success or failure of these proposed regulations will depend on how MMF investors respond to the new rules.

During a period of economic stress (a stress event), each individual investor's behavior is influenced by his perception of whether a certain action will make that investor better or worse off, and by the anticipated actions of other investors. This is true regardless of the stress event’s cause, which may be precipitated by a lack of liquidity, a negative credit event, or misinformation. As a result, the likelihood of a run on MMFs and contagion to other financial sectors depends on the decisions investors make in the face of a stress event.

II. Regulatory Objectives and the Game Methodology

There appear to be two primary drivers behind the SEC's proposed regulations:

- Reduce what the SEC perceives to be money fund vulnerability to heavy redemptions in times of financial stress, sometimes referred to as a run. It believes these redemptions could trigger fear and contagion across other MMFs or asset classes, leading to widespread asset sales, volatility and losses – primarily on credit and credit-like instruments. As such, these proposed rules would apply to prime MMFs and municipal tax-exempt MMFs that carry explicit credit risk rather than federal agency or U.S. Treasury MMFs.
- Eliminate first mover advantage to prevent relatively unsophisticated investors from being exposed to losses or illiquidity that might be avoided by more proactive investors.

To assess the ability of the proposed reforms to meet these objectives, we adopt a game theory formulation similar to Diamond and Dybvig's (1983) classic analysis of bank runs. For simplicity, assume there are only two investors and one fund in the market; however, results can be generalized to multiple investors and funds. For this illustration, we assume there is a stress event impacting the market that creates a perception of risk in a prime fund. Before the risk is resolved, investors are faced with the choice of remaining in the MMF or redeeming. The figure below illustrates the choices that each investor can make, and the four possibilities: both Stay, both Redeem, Investor 1 Stays but Investor 2 Redeems, and Investor 1 Redeems but Investor 2 Stays.

		Investor 2	
		Stay	Redeem
Investor 1	Stay	Stay, Stay	First Mover Advantage
	Redeem	First Mover Advantage	Run

Desired Outcome

Figure 1. Regulatory objective

The Diamond Dybvig Model

Diamond and Dybvig (1983)[11] addressed the issues of financial contagion and first mover advantage in the context of bank runs. Many view their model as the classic model of run risk. In that paper, the authors present a two-period model of consumption which assumes two types of agents: some that only consume in period 1 and some that only consume in period 2. Each individual agent is given an initial endowment of money at time 0, but all are uncertain as to which period they will consume and will not learn so until period 1.

There also effectively exists at time 0 an option to purchase an interest-bearing asset (a bond with rate of return) with a maturity of two periods. If purchased, the initial endowment is unavailable until period 2, thus the asset is completely illiquid until maturity. If an agent purchases the asset and discovers he must consume in period 2, then his utility is increased by the amount of return generated. However, if the asset is purchased and he subsequently discovers he must consume in period 1, then his utility is reduced as he lacks the liquidity to consume. Conversely, if the asset is not purchased, then liquidity to consume exists at any time, but no return is earned and utility is not increased.

Diamond and Dybvig show that due to the differences in consumption preferences, agents actively seek to share risks. This risk sharing is facilitated through the creation of banks that provide liquidity and, thus, guarantee a reasonable return when the investor must withdraw before maturity (i.e., consume in period 1). The authors conclude that banks issuing demand deposits can provide better risk sharing among people who need to consume at different times.

However, Diamond and Dybvig also show that the demand deposit contract providing this improvement has an undesirable equilibrium during a stress event (i.e., bank run) in which all depositors panic and withdraw immediately, including those who would prefer to leave their deposits in if they were not concerned about the bank failing. These depositors are motivated by the desire to be first in line to withdraw so as to avoid absorbing losses associated with distressed asset sales. In short, the illiquidity of bond assets provides the rationale for both the existence of banks and for their vulnerability to runs.

One of the issues in bank runs is a two-way lack of transparency problem – depositors do not know what risks are in the bank's portfolio and the bank does not know when depositors need to withdraw their deposits for liquidity needs. The 2010 SEC reforms for money market funds help mitigate the problems that make a bank's portfolio vulnerable to runs: lack of transparency, illiquidity and credit risk.

Diamond and Dybvig see suspension of convertibility (halting withdrawals from bank accounts) as a reasonable solution when deposit insurance is not available. This is analogous to the idea of redemption Gates for MMFs during similar stress events.

[11] Diamond, D.W., & Dybvig, P.H. (1983). Bank runs, deposit insurance, and liquidity. Journal of Political Economy 91 (3): 401–419.

Finally, Diamond and Dybvig cite Bernanke (1983),[12] asserting that bank runs are significant and harmful because banks intermediate between savers and small business borrowers who otherwise have no alternative way to reach credit markets. The cost of bank runs has also been analyzed by Friedman and Schwartz (1963),[13] Fischer (1911)[14] and Bryant (1980).[15] Money market funds, in contrast, invest in notes of large, rated and often public issuers who have alternative access to capital markets.

In the game shown in Figure 1, it is clear that the (Stay, Stay) strategy in the top left quadrant, where both investors choose Stay, achieves the most stable outcome. Both investors remain in the fund and a run is averted.[16]

Consider (Redeem, Redeem) in the bottom right quadrant. Here, each investor chooses Redeem, probably as quickly as possible, so as not to incur future losses in case the stress event does cause a loss. As a result, the fund may need to liquidate portfolio securities at fire-sale prices, creating losses. This is the outcome regulators are trying to prevent or limit.

In the bottom left quadrant, Investor 1, seeking first mover advantage, chooses Redeem and Investor 2 chooses Stay (Redeem, Stay). To meet Investor 1's redemption, the fund may have to liquidate some holdings, perhaps at a loss, even if the stress event results in no other losses. Investor 1 incurs no loss due to having redeemed first, at the $1 constant net asset value. However, Investor 2 may incur loss, if the actual fund value has dipped below $1. Vice versa for the top right quadrant (Stay, Redeem).

These two quadrants illustrate versions of the first mover advantage that regulators wish to avoid – where early redeemers leave remaining shareholders with a portfolio that may be impaired by losses or illiquidity. First mover is a concept of game theory that can define relative advantage in competitive games like the ones addressed in this paper.

Game theory analysis concerns how investors make their decisions to Redeem or Stay, and how the presence of other investors influences the outcome. One investor, in isolation, might choose Stay and ride out the storm. However, in the presence of another investor who chooses Redeem, the first investor may actually be better off by choosing Redeem. The run scenario is the plausible equilibrium outcome of the game, even though the loss associated with the stress event may not occur. This will be the case as long as the investor perceives the expected outcome of redeeming is better than that of any other choice.[17]

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[12] Bernanke, B.S. (1983). Non-monetary effects of the financial crisis in the propagation of the Great Depression. The American Economic Review, 73 (3).

[13] Friedman, M., & and Schwartz, A.J. (1963). A monetary history of the United States, 1867-1960. Princeton, NJ: Princeton University Press (for National Bureau of Economic Research).

[14] Fischer, I. (1911). The purchasing power of money: Its determination and relation to credit, interest and crises. New York, NY: Macmillan.

[15] Bryant, J. (1980). A model of reserves, bank runs, and deposit insurance. Journal of Banking and Finance, 4, 335-44.

[16] This may also be the "best" outcome if the concern of a stress event turns out to be unfounded.

[17] Note that in selecting a strategy, the investor does not know the exact behavior of other investors, but can assess the circumstances faced by all investors and deduce what might be optimal for other

One of the SEC's regulatory objectives is to enact policies that incent investor choices that will prevent a run and possible follow-on contagion. In terms of the game above, that objective requires policies that would move the equilibrium to the top left quadrant (Stay, Stay). If this objective can be met, runs can be prevented, first mover advantage can be eliminated and overall utility can be maximized. In this paper, we will analyze whether any of the SEC's proposed rules can actually achieve this objective. In Appendix A, we outline another classic model of game theory, the Prisoner's Dilemma, that bears some formal similarities to the choices investors make in deciding to redeem or retain MMF holdings.

III. Expected Utility Theory

To model the games and test the effects of the proposed regulations, we must first understand how investors value the potential outcome of those games and make investment choices (Redeem or Stay) under uncertainty regarding future market events. Expected Utility Theory is a cornerstone of modern financial economics that was developed along with game theory as a framework for modeling behavior under uncertainty. As in most game theory applications, we employ that framework here.

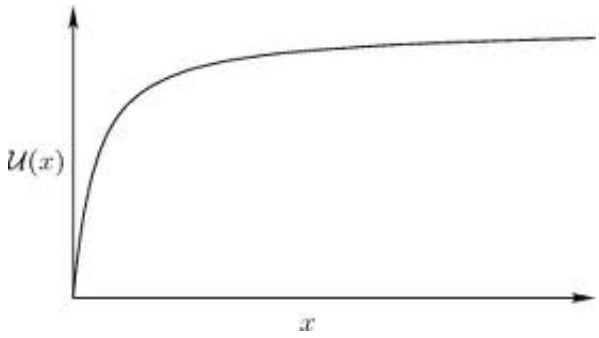

Figure 2. Illustrative Utility of Wealth Function

We assume each investor possesses a utility function based on wealth that reflects the preference over return (wealth) outcomes. The wealth utility function measures how much better off an investor is, as his wealth rises. Utility rises with wealth. However, it rises at a diminishing rate as shown in Figure 2, a property called concavity. As a consequence, a loss of a given magnitude reduces utility by more than the same gain increases utility. For this reason, investors would not make an investment that gives them an equal chance at the same dollar gain or loss. A positive expected return is required in order to induce the investor to take a risk. This is how risk aversion is reflected in financial decisions and asset prices.

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investors to do. In the Redeem, Redeem scenario, each investor may try to be the "first mover," even though each may anticipate that others are doing the same.

Most financial models of investor behavior begin by specifying how different investment choices lead to different return outcomes or *distributions*. In concept, the investor: (i) identifies the differing wealth outcomes associated with each possible investment decision; (ii) assigns a probability to each outcome; and (iii) calculates the utility of each outcome. The investor selects the investment that maximizes the *expected*, or probability-weighted utility. We employ this framework here.

Our game analysis begins with an unspecified stress event. That is, something in the marketplace happens that may possibly impact an MMF's value. In the analysis, each investor has two choices: to keep his investment in the fund or to redeem his investment. The outcome of either choice is uncertain, because the investor cannot be 100% sure of the value of the fund due to the stress event. However, the investor estimates possible outcomes, the associated probabilities, and the expected utility of each choice. He then selects the action he believes will maximize expected utility. Additional characteristics and implications of the investor utility function are discussed in Appendix B.

IV. The Decision Framework

In this section, we discuss the situation faced by MMF investors and the decisions they could make in the context of a game theory model. We then summarize the outcome of that game, in the context of a stress event within a single fund.

The illustration, shown in Figure 3 below, develops our game methodology using a highly simplified exposition. We first model the current MMF CNAV structure – that is, without new regulations – and illustrate the issue regulators believe they are addressing with these proposals. We then introduce a more detailed framework that captures the complexity of the current debate.

We assume a market stress event that creates the risk of loss. Investors must decide whether to stay invested in the MMF or redeem, and they select the course of action that maximizes expected utility. Faced with a stress event, each investor can either redeem now at $1 per share, or stay invested in the fund but face a possible decline in value below the $1 constant NAV (i.e., the stress event may turn out to be real and negatively impact the fund's portfolio value). If both investors stay in the fund, they each face a possible outcome of their investment value dropping below the $1 NAV. They would share any loss equally. If one investor stays in the fund and the other redeems, the one that stays faces the possible outcome of less than $1 NAV, while the other redeems at $1 NAV and has no loss. If there were a loss, the investor that stays would bear the entire loss himself. If both investors redeem, they would both exit at $1 NAV, because the redemption occurs before the loss, if any, is realized.[18]

Each investor assesses probabilities for each return outcome. In the scenario we have depicted, the outcome that maximizes utility for each is (Redeem, Redeem). The reason is simple: by redeeming, neither investor can be made worse off and might be better off. This is labeled in the figure as a Nash Equilibrium, an important concept in game theory studied by the noted mathematician John Nash. When each investor knows the choices available to

[18] This illustration assumes a simplistic framework by shareholders and ignores the potential that if both investors redeem, a fire sale of assets could cause losses. This possibility is discussed in later sections as we introduce complexity into the model.

the others, and has made a decision (Stay or Redeem), and neither investor can be made better off by a unilateral change, then the current choices and the resulting outcomes are a Nash Equilibrium. Economists view such outcomes as strongly predictive because the theoretically optimal behavior is so unambiguous.

		Investor 2	
		Stay	Redeem
Investor 1	Stay	Possibly <$1, Possibly < $1	Possibly < $1, $1
	Redeem	$1, Possibly < $1	$1, $1

Nash Equilibrium

Figure 3. Investor payoff matrix

Regulators have argued that, as a practical matter, first movers create a contagion effect that draws others into the run, and can even spread across funds. In the case discussed here, the Nash Equilibrium is for both investors to Redeem. If regulations can be designed that eliminate the optimality of running, then regulatory objectives are met, even if some residual (or idiosyncratic) first movers still remain. Clearly, the SEC's intent with the proposals is to achieve this. The question is whether any of alternatives will be effective.

The introduction of a variable NAV or Fees and Gates can alter the investor's expectation of return outcomes and shift optimal behavior. For instance, in a Fee scenario, the probable return associated with a decision to Redeem must be adjusted by the Fee to be paid. In a Gate scenario, the probable return of a decision to Stay or Redeem must be adjusted by the consequence of temporarily not having access to one's liquidity. In the subsequent sections, we further develop our game framework and then summarize each of the SEC's rule proposals to determine their effect on run risk and investor behavior.

V. The CNAV Model with Shadow Price and Market/Credit Risk

The model shown in Figure 3 makes highly simplified assumptions regarding the choices investors face. We now introduce additional features that provide a more realistic depiction of the current CNAV model. In this section, we consider the shadow NAV and interest rate/credit risk.[19]

In exchange for accepting a small (but non-zero) risk, MMFs provide investors with liquidity and a competitive rate of return that approximates the average yield on very short-term securities. Treasury funds are thought to contain interest rate risk only, while prime funds contain both interest rate and credit risk. MMFs now generally report the shadow

[19] Shadow NAV is the good faith estimate of the fair value of the fund share price. It is generally computed as the unrounded mark-to-market or mark-to-model net asset value fund share.

NAV (that we denote "S"). S is the good faith estimate of the fair value of the fund share price, but is subject to inaccuracies due to the data limitations in the models employed.[20]

Shadow NAVs continuously fluctuate, even if infinitesimally. This is because of ongoing market-wide fluctuations in interest rates or general spreads (up or down). We will express this risk by writing the shadow price as S = \$1 + ε, where ε (called "epsilon") represents a price deviation that can be positive or negative. In rare events, such as during September 2008, credit events can be an additional source of risk in shadow NAVs. Here, any unforeseen credit losses that are concentrated in a particular sector or security can cause further losses in a prime MMF. We express this price component as η (called "eta"). The overall prime fund shadow price is therefore expressed as S = \$1 + ε + η, where ε and η represent price deviations due to changes in the overall level of rates (or spreads) and specific credit events, respectively.

		Investor 2	
		Stay	Redeem
Investor 1	Stay	S, S	S, \$1
	Redeem	\$1, S	\$1, \$1

Figure 4.

The model including these extensions is expressed in Figure 4. When faced with a possible stress event (market-wide shock to rates/spreads or a specific credit event), investors must decide to Redeem at \$1 or stay in the fund and realize S (if the event occurs). In either case, the optimal decision is for both investors to Redeem. Shareholders are not worse off, but might be better off by choosing to Redeem.

VI. A Two-Period CNAV Model with Shadow Price, Market/Credit Risk and Switching Costs

In applying the model depicted in Figure 4, regulators also consider the distinction between: (i) the current or starting value of the shadow price, versus (ii) the value that investors might expect it to be at the end of the next investing period. This is because it is common for investors to remain in a fund after there has *already been* a deviation of the shadow price (from \$1) caused by prior period market or credit events. Regulators have pointed out that, if the starting value of the shadow price is below \$1, and further losses are feared, this gives investors an even stronger reason to redeem, thus serving as an accelerant to a run. In fact, regulators sometimes suggest that this is the origin of "first mover advantage". We will use

[20] In all but the most extreme circumstances, deviations of the shadow price from \$1 are de minimis. This is why cost/benefit analysis favors the use of amortized cost (or \$1) for shareholder transactions, rather than the shadow price.

S^o to represent the current (starting) value of the shadow price and S^1 to denote the value at the end of the next investment period.[21]

From the foregoing sections, one may think it is optimal for the investor to Redeem whenever the current shadow price is less than \$1. Using our definitions, this is expressed as S^o < \$1. In fact, the broad historical record demonstrates that shadow prices have fallen below \$1 due to increases in the general level of interest rates or credit spreads (i.e., ε , η < 0), but with little or no correlation to redemption activity. Moreover, because changes in prices reflect changes in yields, one cannot claim that any small correlation is driven by a desire to avoid loss rather than a desire to obtain higher yield. There appears to be a materiality threshold that must be crossed before investors redeem, provided there are no immediately expected events that would drive S still lower (when investors have remained in the fund with the shadow price at S^o).

The explanation for this effect is that shareholders experience costs in switching investment programs. When shareholders redeem for an unplanned reason, there is time and expense incurred in finding an acceptable alternative. Furthermore, large institutional investors have client relationships with the MMF advisor that could be jeopardized by frequent trading in the affected MMF. This is because advisors are under no obligation to take any given investor's future subscriptions, and they have a fiduciary obligation to refuse future investments from investors who are deemed disruptive to the fund.

We express the switching costs that investors incur from unplanned redemptions as a reduction in the proceeds received from redemption. Only this net amount is available for reinvestment into an acceptable alternative. Using π (called "pi") as the expression of switching costs, the net proceeds from unplanned redemption are \$1 – π. Using this definition, investors would remain in the fund after a prior period market event as long as S^o > \$1 – π.

As an illustration, say a shareholder invests at the CNAV of \$1 and overall market rates then rise by 25 basis points. Assuming the maximum permitted 60-day average maturity for the fund, the shadow NAV would be expected to decline to approximately \$0.9996. Would it make sense for the shareholder to redeem at \$1 and reinvest the proceeds at a 25 bp higher rate? If π = 10 bp, the shadow NAV would have to fall to below \$.9990, or market rates would have to rise by more than 60 basis points, before it is worthwhile for the investor to redeem and invest in an alternative asset. So in the case of a 25 bp rate increase, the investor would not redeem.

These relationships may now be expressed in Figure 5 below. When S^o > \$1 – π, investors who stay in the fund until the end of the second period realize the value $S^1 = (S^o + \varepsilon^1 + \eta^1)$. Those who redeem receive \$1 – π. Under normal circumstances, investors anticipate that η = 0 and $|\varepsilon| < \pi$ so that S^1 > \$1 – π and it is not optimal for an investor to redeem. However, when there has been an adverse outcome (or the risk of a sufficiently adverse future outcome) for ε or η, then switching costs do not dissuade an investor from redeeming

[21] Using our definitions, S^o is equal to $\$1 + \varepsilon^O + \eta^O$ where ε^O and η^O are the market-wide or specific credit events that may have caused the current shadow price to deviate from \$1. We can write $S^1 = S^o + \varepsilon^1 + \eta^1$, where ε^1 and η^1 are the market-wide or specific credit events that occur during the next investment period that may cause the shadow price to further deviate from its starting value of S^o.

because of the risk that $S^1 < \$1 - \pi$ in the future. It would then be optimal for one or both investors to redeem, depending upon their risk assessments for future outcomes.[22]

		Investor 2	
		Stay	Redeem
Investor 1	Stay	S^1, S^1	S^1, \$1-π
	Redeem	\$1-π, S^1	\$1-π, \$1-π

Figure 5.

In Figure 5, we have adopted a simplified depiction of the game that reflects investor perception of the payoffs. A more complex alternative payoff matrix that could be more economically exact is shown in Figure 5a. In this matrix, when one investor redeems and the other stays, the remaining investor receives S^1 - (\$1-S^o) because he is adversely impacted by the dilutive effect of the exiting shareholder redeeming at \$1 rather than S^o. (Here we assume also that the redemption is not met in a manner that adversely concentrates risk for the remaining shareholder, e.g. by funding the redemption from liquidity while leaving the remaining shareholder with a more concentrated portfolio that may be impaired.) In addition, when both investors redeem, they receive S^o rather than \$1 (less switching costs, if applicable).

		Investor 2	
		Stay	Redeem
Investor 1	Stay	S^1, S^1	S^1-(\$1 - S^o), \$1-π
	Redeem	\$1-π, S^1-(\$1 - S^o)	S^o-π, S^o-π

Figure 5a.

While this matrix is more mathematically accurate, it is notationally more complex and does not necessarily better reflect investor beliefs, particularly when we consider this game as an approximation to a more realistic N-person format. For instance, the effect on remaining investors of a first mover redemption in an N-person format (with equal investments) becomes S^1 - (\$1-S^o)/(N-1), which is negligible for large N and small initial departures of S^o from \$1. More importantly, Figure 5a does not lead to conclusions that are different from the depiction of the game in Figure 5. In particular, in subsequent sections, our conclusion that it is optimal for investors to be first movers (under particular circumstances) is only increased in Figure 5a due to the fact that redeeming shareholders

[22] For example, in the face of a material event such as experienced in September 2008, an existing small deviation of the shadow price from \$1 is a minor portion of the loss that investors are hoping to avoid by redeeming.

further dilute remaining shareholders. The equilibrium outcome does not change. For these reasons, we will continue to employ the simpler payoff assumptions as expressed in Figure 5.[23]

VII. The Two-Period CNAV Model with Switching Costs and Fire Sale Risk

The model shown in Figure 5 incorporates the relevant features for analyzing the SEC's rule proposals – in particular, will the Commission's rule proposals eliminate the risk of runs? However, the model can also be used to depict FSOC's systemic risk concerns. First, FSOC's arguments imply that switching costs play little or no role in investor decisions (i.e., π is zero or at most a few basis points). As a result, if the initial shadow price is less than \$1 (i.e., S^o < \$1), investors will be quick to redeem at an assumed \$1 if there is ***any*** investment concern for the period ahead. Second, there is the risk of fire sales when both investors redeem.[24] We express this cost as "ω" (called "omega"), which appears as a reduction in redemption proceeds when both shareholders redeem.[25] These relationships are captured in Figure 6, where we have assumed that $\pi = 0$.

		Investor 2	
		Stay	Redeem
Investor 1	Stay	S^1, S^1	S^1, \$1
	Redeem	\$1, S^1	\$1-ω, \$1-ω

Figure 6.

The analogy between the game depicted in Figure 6 and the Prisoner's Dilemma described in Appendix A is clear. Even when faced with a possible loss, it is possible that investors would be better off by cooperating (i.e., remaining in the fund) and receiving S^1 rather than both realizing \$1 - ω.

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[23] Note also that (in Figure 5a) depicting the payoff in the (redeem/redeem) cell as (S^o, S^o) suggests that investors may be less likely to redeem (when they believe the other shareholder is also redeeming) because of the fact that they have both already incurred a loss of \$1- S^o. We do not believe this characterizes investor expectations or behavior.

[24] In an N-person game, this would occur when larger numbers of shareholders redeem.

[25] Furthermore, fire sales can create a social cost or externality not anticipated or borne solely by these investors. It is imposed on the rest of the economy through contagion that adversely impacts other markets or investors.

VIII. The Regulatory Proposals and Game Outcome Summaries

In this section, we developed a series of three game sets to understand better the effectiveness of the three main SEC proposals, which we summarize as:

- VNAV
- Fees
- Gates

In each game set, we discuss the situation faced by investors and the decisions they could make, and then summarize the outcome of that game, based on a stress event within a single fund.

Game 1: Will VNAVs Prevent A Run On Money Fund Assets?

This game considers a regulatory environment where VNAVs are required and MMFs have changed their valuation method from amortized cost to "mark to market." When there is a stress event, each investor must make the decision to either stay in the fund or redeem, possibly sparking a run. As before, we assume there are just two investors in the fund. This assumption can easily be generalized to more than two players so it is not restrictive. The table below illustrates the choices and payoffs associated with this game.

		Investor 2	
		Stay	Redeem
Investor 1	Stay	$VNAV^1$, $VNAV^1$	$VNAV^1$, $VNAV^0$-π
	Redeem	$VNAV^0$-π, $VNAV^1$	$VNAV^0$-π, $VNAV^0$-π

Figure 7.

Notice that this game is similar to the depiction of the CNAV game in Figure 5. The return relationships, and the associated probabilities, are largely unchanged simply by changing the pricing convention. Therefore, the Nash Equilibrium is for investors to run when faced with similar risks as were discussed under the CNAV game scenario.

This result may be counterintuitive, so we will use a numerical example. We start by re-examining the CNAV game in Figure 5. Assume that market events have already caused the shadow price to decline by 5 bp, so that S^o = $.9995. We now assume that investors fear a potential loss of 50 – 100 bp that could result from impairment in a large MMF holding. Based on these assumptions, one or both investors may redeem the fund depending on the probability assigned to the loss.

Now consider the same scenario, but under a variable NAV as in Figure 7. The only difference is that investors have already realized a 5 bp loss due to market events (i.e.,

$VNAV^0$ = \$.9995), but still have not redeemed.[26] This realized loss eliminates any motivation to redeem in order to avoid the 5 bp loss, as might be the case under CNAV (holding aside the materiality threshold created by switching costs). However, the potential future loss due to a possible credit event remains at 50 to 100 bp. If investors are assumed to have a similar loss aversion as under the CNAV case, the likely outcome will be similar – one or both investors will redeem.

The only reason to expect that the outcome of the two games would be different would be if investor aversion to losses were different. However, while a differing regulatory regime and pricing convention may change risk awareness, there is no reason to expect a change in risk tolerance among investors that pursue the safety and liquidity of MMFs.

We can conclude that in the face of a stress event, VNAV would not prevent a run on MMFs . In particular:

- The rationale behind the proposal incorrectly presumes that the conversion of CNAV to VNAV would cause investors become more risk tolerant.
- The proposal incorrectly presumes that it is primarily the ability to redeem a CNAV fund at \$1 (when the shadow NAV may be less) that creates the motivation to run, rather than the risk of subsequent greater loss.

Game 2: Will CNAV with Board Discretion to Impose Redemption Fees Stop or Prevent a Run?

This game considers a regulatory environment where the MMF board has the right to impose a redemption Fee. Although the decision on Fee imposition rests with fund boards, the ultimate impact of a decision will depend on how investors react**.** If Fees are imposed, they accrue to the benefit of investors who stay in the fund until the redemption Fee is lifted. We denote the redemption Fee by "δ" (called "delta"). The redemption Fee need not be a fixed number that the shareholder knows in advance, if it is imposed.

There are two methods for imposing a redemption Fee. In the first method, when a fund board decides to impose the Fee, it becomes effective after that day's close of business. We call this the **end-of-day method**. In the second method, when a board decides to impose the Fee, it is effective at the next intraday order settlement. Thus, it impacts all outstanding redemption orders that were not yet settled at the time of the Fee decision. We call this the **intraday method**.

In either of these methods, we must distinguish between: (i) the ability of the Fee to stop a run in progress, versus (ii) the ability of the Fee to prevent a run from occurring.

Game 2a: Stopping a Run in Progress

If the Fee has already been imposed, the analysis is simple: a run will be stopped if the Fee exceeds the potential loss the investor is seeking to avoid. In this case, the Nash Equilibrium will be Stay/Stay (provided that both investors hold a similar view of the potential loss in relation to the Fee). If it is less, the investor will have a motivation to run. The

[26] They have not yet redeemed due to the materiality threshold discussed in Section VI (i.e., switching costs) or because they may be content to own the fund at this yield.

corresponding investor payoff matrix is shown in Figure 8, where for simplicity we initially assume that switching costs are zero (i.e. $\pi = 0$). If both investors stay they receive S^1. If one stays and one redeems, the redeeming investor receives $\$1 - \delta$, and the remaining investor receives $S^1 + \delta$. If both redeem, they receive $\$1 - \delta$. Investors will stay if $S^1 > \$1 - \delta$ (or $\delta > \$1\text{-}S^1$). If switching costs are positive, then the condition becomes $S^1 > \$1 - \delta - \pi$ (or $\delta + \pi > \$1 - S^1$). The suggested Fee in the SEC's proposal is 2%, which seems designed to exceed losses that might be realistically expected, so that Stay/Stay is a Nash Equilibrium.[27]

		Investor 2	
		Stay	Redeem
Investor 1	Stay	S^1, S^1	$S^1+\delta$, $\$1-\delta$
	Redeem	$\$1-\delta$, $S^1+\delta$	$\$1-\delta$, $\$1-\delta$

Figure 8.

In the foregoing discussion, the end-of-period value S^1, and hence the potential loss that investors face ($\$1 - S^1$), is of course uncertain. Therefore, the condition $\delta > \$1 - S^1$ is probabilistic in the investor's mind. That is, it is true, or not, with a certain probability. Game theory (and its expected utility underpinnings) provides guidance on setting the Fee under these conditions. Specifically the Fee need not exceed the worst-case loss that investors fear. Indeed, it is doubtful that setting the Fee in this way would be in the best interest of investors, or public policy, since it could be unduly burdensome for those who are not running to avoid loss, but simply need access to liquidity. Instead, the *expected utility of wealth* after imposition of the Fee must less than the expected utility from remaining in the fund. Using this reasoning, risk aversion implies that the Fee must exceed the mathematical expectation of the loss (that is, the probability weighted loss), but may be less than the worst-case fund loss itself, since it is not certain. [28]

As a practical matter, boards may take several approaches in determining the Fee. One approach would simply be to pick a fixed number (such as 2%) that will be seen as large in relation to any expected loss. A more general method would be to base the Fee either on a Value-at-Risk calculation (e.g. a 99% confidence level); or on stress tests using market-implied default probabilities reflected in the yield spreads of the securities in the fund portfolio. A very direct method (that would be closer to a worst-case loss) would be to assume a default of one or more securities (with reasonable recovery rates) and to calculate

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[27] Note that if the Fee imposed is too small in relation to the feared loss, Redeem/Redeem *may* be a Nash Equilibrium. However, whether or not it is will be influenced by the fact that one investor may be inclined to stay if he knew the other was redeeming (due to Fees accruing to the remaining shareholder.)

[28] Using conceptual notation, we can express this as $U(\$1 - \delta) < E[U(S^1)]$, where $U(\bullet)$ denotes the investor's utility function and $E[\bullet]$ denotes expectation. We would then require $\delta > \$1 - U^{-1}(E[U(S^1)])$ for every investor, where $U^{-1}(\bullet)$ denotes the inverse of the utility function. This expression states that the Fee must be set such that the utility of the assured wealth upon redeeming (and after the Fee) must be less than the expected utility of remaining in the fund.

the portfolio loss that would result. In calibrating Fees to severe adverse outcomes, boards would need to be cognizant of the tradeoff between eliminating run risk and unduly penalizing investors for accessing liquidity. The current or proposed stress tests required under Rule 2a-7 could easily be adapted to compose an acceptable Fee estimate that is effective but economically fair. We will denote the Fee that satisfies the requirements for Stay/Stay to be a Nash Equilibrium as δ^N.

Game 2b: Preventing a Run from Occurring

The analysis is more complex when the Fee has not yet been imposed and the investor must decide a course of action, knowing that a Fee may be imposed in the near future. This is the question we now examine. We first address the issue of whether the Fee can be effective if it is imposed either at the end-of-day or intraday.

End-of-day Method – As before, we assume there are two investors in the fund. There is a stress event with possible implications for the MMF. Regulations permit the fund's Board to impose a redemption Fee, which goes into effect **after** all today's trades are settled.

In the face of that stress event, an investor has some expectation of how big a loss the fund may incur and whether other investors are seeking to redeem. He may also possibly benefit from Fees paid by other investors who redeem after the Fee is imposed, if he stays. He knows his own liquidity needs; if he redeems today, he knows that he will pay no Fee, but after today, and until the Fee is lifted, he will incur it if he decides to redeem and if the fund directors have imposed the Fee.

He must balance all these factors together to determine his maximum utility. Figure 9 illustrates the payoffs that each investor faces based on the choice Stay or Redeem during the **current** decision period (i.e., during the day before a Fee is potentially imposed at end-of-day).

		Investor 2	
		Stay	Redeem
Investor 1	Stay	S^1, S^1	S^1, \$1-π
	Redeem	\$1-π, S^1	\$1-π, \$1-π

Figure 9.

Notice that this payoff matrix is identical to that shown in Figure 5, that is, the game without a redemption Fee. In this scenario, and under the assumption that a stress event is at hand, the Nash Equilibrium is (Redeem, Redeem) *before* the end of the day, whenever the expected loss exceeds the switching costs. It is clearly therefore suboptimal for boards to be required to wait until the end-of-day to impose a Fee. The Fee would then have no ability to prevent a run, although it may be able to stop a run in progress from continuing on the second day, depending on the magnitude of the Fee.

Intraday Method – Again, there are two fund investors, and a stress event with possible implications for the MMF. Assume under this method that regulations permit the

fund's Board to impose a redemption Fee, which takes effect during the day and accrues to the benefit of investors who remain in the fund.

In considering a possible redemption, an investor does not know whether he will incur a Fee or not. The Fee itself is therefore uncertain. This makes it similar to S^1 in that it is an unknown prior to imposition by the board. When subject to this uncertainty, we will denote the Fee by δ^*. Faced with this uncertainty, the investor must consider the full range of outcomes in deciding whether or not to redeem. He will also weigh the possibility of having to redeeming after today, but before the Fee is lifted. Finally, he will consider the possibility of benefiting from Fees paid by the other redeeming investor.

Figure 10 shows the payoffs to each investor. The game is similar to that shown in Figure 8 except that the uncertain Fee (δ^*) now replaces the certain Fee (δ). (And we have also explicitly shown switching costs, π.) As before, this game has two possible equilibria. The relative size of the anticipated Fee versus the potential loss determines whether either is a Nash Equilibrium.

- If one investor redeems but the other stays, the one who redeems *may* have to pay a Fee. The one that stays will experience any potential future loss, but will benefit from Fees paid by the first mover, if any. The probability of the Fee will be important in the investor's decision process.
- If both investors stay, then each will suffer the potential future investment loss, and each may benefit (or lose) from the effect of any future Fees that are assessed on either or both investors, should one or both redeem in the future.
- If both investors redeem, both face a possible Fee. Here, investors may anticipate the Fee would have a greater likelihood of being imposed than if just one investor redeems.
- As in our prior analysis, investors will select the strategy that maximizes expected utility.

		Investor 2	
		Stay	Redeem
Investor 1	Stay	S^1, S^1	$S^1+\delta^*$, $1-\pi-\delta^*$
	Redeem	$1-\pi-\delta^*$, $S^1+\delta^*$	$1-\pi-\delta^*$, $1-\pi-\delta^*$

Figure 10.

To summarize the outcome using utility concepts, if for every investor the expected utility of the payoff $\$1 - \pi - \delta^*$ is less than the expected utility of the payoff of S^1, then staying is a Nash Equilibrium.[29] If the opposite is true, redeeming will be the Nash Equilibrium. To illustrate these conclusions, consider a situation in which investors believe that, $\delta^* > \$1 - S^1$. For simplicity we assume that $\pi = 0$ (and $S^1 < \$1$).

[29] That is, if $E[U(\$1 - \pi - \delta^*)] < E[U(S^1)]$.

Investor 1's optimal strategy would be:

- If Investor 2 stays, then $S^1 > \$1 - \delta^*$, so Investor 1's optimal strategy is to stay.
- If Investor 2 redeems, then $S^1 + \delta^* > \$1 - \delta^*$, so Investor 1's optimal strategy is to stay.

Similarly, Investor 2's optimal strategy would be:

- If Investor 1 stays, then $S^1 > \$1 - \delta^*$, so Investor 2's optimal strategy is to stay.
- If Investor 1 redeems, then $S^1 + \delta^* > \$1 - \delta^*$, so Investor 2's optimal strategy is to stay.

Since either investor will choose to stay regardless of the actions of the other investor, (Stay, Stay) is a Nash Equilibrium.

Now consider a situation where investors believe that the potential loss exceeds the potential Fee such that $\delta^* < \$1 - S^1$ and for simplicity $\pi = 0$ (and $S^1 < \$1$). .

Investor 1's optimal strategy would be:

- If Investor 2 stays, then $S^1 < \$1 - \delta^*$, so Investor 1's optimal strategy is to redeem.
- If Investor 2 redeems, then $S^1 + \delta^* < \$1 - \delta^*$, so Investor 1's optimal strategy is to redeem.

Similarly, Investor 2's optimal strategy would be:

- If Investor 1 stays, then $S^1 < \$1 - \delta^*$, so Investor 2's optimal strategy is to redeem.
- If Investor 1 redeems, then $S^1 + \delta^* < \$1 - \delta^*$, so Investor 2's optimal strategy is to redeem.

Under these circumstances, either investor will choose to redeem, again regardless of the action of the other. Hence, this scenario (Redeem, Redeem) is a Nash Equilibrium.

Game 2c: Setting Fee Policy Using the Intraday Method

The success of Fees has been shown to critically depend on the magnitude of the Fee in relation to the potential loss. When a Fee has *already* been imposed, the stated Fee must exceed a probability (and utility) weighted measure of the anticipated loss. (In Section VIII.2.a we provided practical guidance on how this could be done.) When the Fee has *not yet* been imposed, we have shown that the corresponding probability (and utility) weighted *anticipated* Fee (or the Fee that the investor anticipates will be realized on a future redemption) must exceed the probability (and utility) weighted measure of anticipated loss. We now discuss how to frame Fee determination in this case. Specifically, utility theory provides practical guidance regarding how fund boards must set Fees in this scenario.

Recall that the Fee (δ^*) is not necessarily predetermined in timing or magnitude and that the board can implement the Fee as and when it deems necessary. In Section VIII.2.a we defined δ^N as the Fee that, when already imposed, is sufficient to imply that Stay/Stay is a Nash Equilibrium.[30] Game theory (and its utility underpinnings) demonstrate that a Fee (δ^*) will be effective at preventing a run if shareholders believe that:[31]

$$E(\delta^*) \geq \delta^N$$

This formula states that the *expected* Fee must equal or exceed the fixed Fee (δ^N) that is necessary (when imposed) to deter redemptions. The board has some latitude in determining its Fee policy provided that the above expression is satisfied.[32]

In practice, directors would not state a probability of redemption Fee to shareholders. They disclose their policy (as appropriate) and operate in a manner that (along with disclosures from the advisor) enables investors to estimate what Fees will be and when they will be imposed. If the directors wished to reduce some uncertainty and adopted a particular redemption Fee, such as 2% (and disclosed this), then the directors must adopt other policies or practices that cause the probability of implementation to satisfy the above formulas.

The question of how to set Fee policy to stop or prevent runs is a key issue in evaluating the efficacy of the SEC's proposals. Thus far, there appears to be an understanding that, once imposed, Fees can stop runs. However, the ability of Fees to **prevent** runs may not be fully appreciated in the policy debate. This is highly relevant for determining that Fees or Gates can provide adequate protection for investors while eliminating contagion and fire sales.

As a practical matter, boards can meet the requirements for Fees to be effective if they are adequately preemptive in reacting to market developments. For this to be true, the investor must believe that the probability of Fee imposition is not determined by the directors simply as a function of how many investors have already redeemed. This could encourage some investors to be first. Investors must believe that even a first redeemer is subject to the Fee risk. The probability of imposition must be primarily determined by characteristics of the portfolio in a way that cannot be gamed by first movers. Directors should have a reasonable conception of the materiality threshold that their customer base employs and be able to exercise fiduciary duty in determining whether allowing redemptions is in the best interest of shareholders. In particular, forms of activity that are harmful should be prohibited by policy or rule and disclosed to shareholders, as are many other requirements of Rule 2a-7.

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[30] That is, δ^N is larger than the mathematical expectation of the loss but not necessarily as large as the worst case outcome. It is sufficient to meet the utility conditions described in footnote 28.

[31] This is a result of the concavity of utility functions and Jensen's inequality.

[32] A particular application of this formula illustrates the Fee necessary to deter redemptions simply on account of the current shadow price being below \$1, (i.e., if $\pi = 0$). In this case the redemption Fee and associated probability of imposition must satisfy $E(\delta^*) \geq \$1 - S^o$. If the Fee were imposed under any circumstance, the probability of imposition is 1, and the requirement becomes $\delta^* \geq \$1 - S^o$. This amounts to implementing a VNAV structure, since the Fee must always be at least the current shadow price discount to \$1.

As an example of how the SEC could proceed within the parameters of the Release, funds adopting a Fee could evaluate two Fee measures: (i) a fixed default fee, such as 2%; and (ii) an alternate fee (usually smaller) that is based on market-determined measures reflecting liquidity, transaction costs, default risk, etc. This alternate measure could be developed and maintained using the stress test methodology that is required under any new rule. Trigger events would require that boards consider the implementation of either of the above fees, or a different fee (including zero) at the discretion of the board. Mandatory trigger events could include a liquidity threshold test, as in the Release. However, the SEC could also provide guidance with respect to additional policies and procedures that boards should adopt to protect investors. The policies would provide specific actions that a board must take if it determined that making redemptions at $1 could be harmful to remaining shareholders. Note that rule 2a-7 already mandates board action in the relevant circumstances, a fact pointed out in the comment file. " Rule 2a 7(c)(8)(ii)(A) already requires a Board to meet whenever it ["believes the extent of any deviation from the money market fund's amortized cost price per share may result in material dilution or other unfair results to investors or existing shareholders, [and] cause the fund to take such action as it deems appropriate to eliminate or reduce to the extent reasonably practicable such dilution or unfair results."]" [33]

Under such a regime, investors would know that redemptions are not on autopilot and that any potentially harmful redemption is under scrutiny. These measures would give the board specific requirements, but also rely on policy guidance with respect to fulfilling the board's fiduciary responsibility. (Over time, and as necessary, additional specific rules could be adopted based on the experience gained through the process.) The effect of these changes would be to ensure that investors, even first movers, do not believe they will be able to force losses onto other shareholders. The effect of such board polices could be to place new safeguards on fund liquidity, portfolio management or other administrative procedures. However, this is the means by which the cost of investor protection and financial stability is internalized by the funds, while still retaining stable NAV.

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[33] See comments of Federated Investors, Inc., Section 4.3, pp. 9 – 11, (Sep. 16, 2013), http://www.sec.gov/comments/s7-03-13/s70313-130.pdf. An example: a board could adopt an "anti-fire sale" policy, in which a Fee is implemented preemptively in lieu of the advisor selling securities at a loss to fund redemptions. Specific procedures could be designed to implement the policy while not unduly hampering investment management. Similarly, policies could also require that any redemption (even funded from daily liquidity) that has the effect of reducing the shadow NAV must be determined (by the board) to be in the best interest of shareholders. Other procedures could require that, in the event of a trigger, the board would have information that is necessary to determine whether to apply the fixed Fee or the alternate Fee (where the alternative Fee may better correspond to current market events and represent a more economically fair price of liquidity).

Game 3: Will CNAV With Board Discretion To Impose A Redemption Gate Stop or Prevent A Run?

This game considers a regulatory environment where the MMF board has the right to impose a redemption Gate. No redemptions are permitted until the Gate is lifted.[34] There are two methods for imposing the Gate. In the first method, the board decides to impose the Gate, and it becomes effective after today's close of business. Thus, the Gate impacts all redemptions beginning tomorrow and thereafter, until lifted. We call this the end-of-day method. In the second method, when the board decides to impose the Gate, it is effective at the next intraday order settlement. It impacts any outstanding redemptions that were not yet settled at the time of the Gate decision and thereafter, until lifted. We call this the intraday method. In either of these methods, if the Gate has already been imposed, the run has clearly been stopped. The question is how investors react before a Gate has been imposed.

End-of-day Method – As in our earlier formulations, there are two investors in the fund and a stress event. Regulations permit the fund's Board to impose a redemption Gate, which becomes effective after all today's trades are settled.

In the face of that stress event, an investor has some expectation of how big a loss the fund may incur. He can exit the fund today. But if he waits until tomorrow, he cannot exit until the Gate is lifted. He loses access to his liquidity in the fund, and suffers a proportional share of the potential losses. In this scenario, the Nash Equilibrium is (Redeem, Redeem) for similar reasons that the end-of-day method fails under Fees:

- If one investor redeems but the other stays, the one that redeems pays nothing. The one that stays will suffer the entire loss if there is one, and loses access to his liquidity until the Gate is lifted.
- If both investors stay, then each will suffer part of the potential loss and lose access to their liquidity temporarily.
- If both investors redeem, neither suffers any impairment.

Thus the end-of-day Gate does not prevent a run from taking place. Both investors would choose to redeem.

Intraday Method – Again, there are two fund investors, and a stress event with possible fund losses. Regulations permit the fund's Board to impose a redemption Gate, which becomes effective during the day (today) at a time unknown to the investors. Gates impose a cost on investors similar to a Fee, but it is not explicit. Gates impair investor liquidity for an unknown period of time. This could prevent them from meeting other obligations and certainly prevent them from avoiding future losses. We will denote the investor's perceived cost of a Gate as θ^* (called "theta"). As with the redemption Fee (δ^*), the probability is uncertain and may vary depending upon various factors.

We consider two formulations of gating rules in order to illustrate the importance of investor expectations regarding the trigger event. In the first formulation, the Gate is

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[34] The specificity of the weekly liquidity threshold in the proposal is not a necessary precondition for its success. As in the case of Fees, it could become a counterproductive accelerant for a run if it motivates first movers to redeem as weekly liquidity declines, even if the decline is unrelated to stress in the fund.

imposed based on the volume of redemptions that are experienced. This will be shown to have an unstable outcome. In the second formulation, the Gate is triggered based on economic criteria that are unrelated to the volume of redemptions. This will be shown to have a favorable outcome if the economic criteria are appropriately determined.

Game 3a: Gate Imposed Based On Volume Of Redemptions

Figure 11 shows the payoff matrix associated with the first formulation. We consider the case that there is a potential loss greater than π. If investors stay, they both avoid the Gate and realize S^1. We assume that if they both try to redeem, the Gate will be imposed and both realize $S^1 - \theta^*$. But if one stays and the other tries to redeem, we assume that the Gate is not imposed and the redeeming shareholder loses only the switching cost. Under these assumptions, while both have an incentive to cooperate, Stay/Stay is not a Nash Equilibrium because either has an incentive to redeem if the other stays.

		Investor 2	
		Stay	Redeem
Investor 1	Stay	S^1, S^1	S^1, \$1-π
	Redeem	\$1-π, S^1	$S^1-\theta^*$, $S^1-\theta^*$

Figure 11. First Formulation of Gates

It is clear from Figure 11 that this game is qualitatively different from the games with Fees. In the case of Fees (shown in Figure 10), the Fee is assumed to be set on a criteria of potential loss in the portfolio and the Fee applies only to redeemers. There is no motivation for investors to cooperate. By contrast, in Figure 11, the Gate is imposed based on a criteria of the volume of redemptions and applies to all investors. Here, there is a motivation to cooperate. Clearly, the investors are better off if both stay rather than if they both redeem.[35]

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[35] In assessing the likelihood of the different outcomes in Figure 11, an investor does not know if he will encounter the Gate or not. If investors believe they can escape the Gate, the outcome is the same as in the end-of-day method, and the equilibrium is (Redeem, Redeem). The possibility of gating may induce investors to remain in the fund, just as the imposition of a redemption Fee may lead investors to stay. This will be the case if both investors realize (and understand through fund disclosures) that if both redeem then a Gate is very likely. If investors stay, the event risk may quickly dissipate and the potential for being rendered illiquid is eliminated. Therefore, there are benefits to cooperating.

However, it is difficult to prove that the gating rule in Figure 11 will as effectively dissuade investors from running as a high Fee will, since θ^* is potentially less costly to investors (although there can be significant cost to illiquidity, particularly during a stress event). For example, suppose a fund were gated for 30 days. The investor would lose liquidity and risk further loss. Now compare this to a 2% redemption Fee imposed with the same probability. For these two outcomes to be equal in the investor's eyes implies a very high convenience cost for liquidity: 2% which is an annualized rate of 24% for those thirty days.

In the case of Fees, a redeeming investor would still be able to avoid further losses, which would not be possible under gating. This could have a material effect. As with redemption Fees, Gates

However, it may be more difficult for directors to impose gating under this type of rule in a manner that causes (Stay, Stay) to be a Nash Equilibrium (i.e., to prevent a run). Although it may be in the best interest of investors to cooperate and remain in the fund, there is an incentive for one investor to redeem if he believes that he might be first to redeem or the other investor might stay. This is illustrated in the off-diagonal cells in the matrix. Clearly, however, once the Gate is imposed, the only possible outcome is (Stay, Stay).

Game 3b: Gate Imposed Based On Alternate Criteria

Figure 11 illustrates the difficulty in achieving a stable outcome when the probability of a Gate is based on the number of investors redeeming. Therefore, boards are likely to employ alternative criteria that are based, not on the numbers redeeming, but on portfolio characteristics. An alternative rule would be to impose a Gate, in lieu of a Fee, whenever a Fee *would have been* imposed in Figure 10. Figure 12 illustrates the payoffs in this game scenario.

		Investor 2	
		Stay	Redeem
Investor 1	Stay	$[S^1, S^1]$ or $[S^1 - \theta^*, S^1 - \theta^*]$	$[S^1, \$1 - \pi]$ or $[S^1 - \theta, S^1 - \theta^*]$
	Redeem	$[\$1 - \pi, S^1]$ or $[S^1 - \theta^*, S^1 - \theta^*]$	$[\$1 - \pi, \$1 - \pi]$ or $[S^1 - \theta^*, S^1 - \theta^*]$

Figure 12. Second Formulation of Gates

In this second formulation, the payoff matrix is more complex. The outcome will depend on whether a Gate is imposed (with the entry on the left representing the payoff when a Gate is not imposed, and on the right the payoff when it is imposed). In this formulation of gating, when the Gate is imposed, θ^* takes on a value and the entries on the right sides of each cell become applicable.

Several observations are in order. First, if investors believe that the Gate is triggered based on similar criteria as a Fee policy (i.e., one that assures Stay/Stay is a Nash Equilibrium), then shareholders will believe that they will not be able to redeem in a way that disadvantages other shareholders. As soon as they have a return motivation to run, they will be unable to.[36] Here, there is also no incentive to cooperate. In particular, the Gate can

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will be more effective if investors do not believe the imposition of a Gate is partly determined by whether some investors have already redeemed. If this is the case, an investor will be incented to run before the Gate is lowered. To avoid this, every redeemer (including a potential first mover) must face the same risk.

[36] Using our utility methodology, a gate would certainly be imposed when $U(\$1-\pi) \geq E[U(S^1)]$, or when the utility of redeeming exceeds the expected utility of staying. This implies that a gate would already have been imposed if $\$1-\pi \geq S^O$. A more exacting criteria must reflect the fact that investors will anticipate that a gate may be imposed. In this case the criteria becomes $U(\$1-\pi) \geq E[U(S^1 - \theta^*)]$. That is, the ability of gates to prevent runs must reflect investor aversion to the gate itself. In this case, investors that perceive a gate as very costly (i.e. θ^* is large even if the probability of imposition is

be applied even when both investors stay. As with Fees, Gates are effective at preventing a run when boards are sufficiently preemptive and the trigger is designed so that it cannot be gamed by investors. However, our analysis (see footnote 36) also demonstrates that investors will include the possibility of a Gate being imposed, along with possible future losses in the fund, as part of a decision to stay or redeem. Some investors may prefer a gated fund (i.e., with an ex ante de minimis risk of a Gate being imposed, but no Fees) to a fund without Gates (but with a possible Fee). These investors would perceive θ^* as small (so θ^* would not materially affect the gating analysis). But others may be intolerant of any risk of illiquidity (seeing θ^* as larger). For this reason, regulators may wish to permit both options, or allow funds to designate a primary method, so that investors may self-select into their preferred form of fund.[37]

IX. Combining VNAV with Fees/Gates

One of the SEC's proposals calls for combining VNAV with Fees/Gates. A VNAV has the ability to protect investors from the risks of first movers who are motivated by an initial departure of the shadow NAV from $1. However, it would not be effective at preventing a larger run. Conversely, Fees/Gates can stop a run in progress. However, if Fees/Gates were improperly implemented, they may not adequately prevent harm from first movers. The apparent logic in combining these features would be to marry the strengths of each. While intuitive, this is simplistic reasoning since the combination alternative will be challenged by the more fundamental economic force of arbitrage.

Investors will see the transition from CNAV to VNAV as a loss of utility that already fully reflects the market price of liquidity. Additional restrictions, like Fees or Gates in combination with VNAV, would be viewed as a noneconomic punitive feature similar to capital controls. While there may be a purported public policy reason for wanting to restrict MMF asset sales in a crisis, no other investment products, and certainly no mutual funds are encumbered in this way.[38] The combination would create an inferior economic product with many near substitutes that would draw investor assets. In particular, if VNAV is combined with Fees/Gates, then the current meaning of a 2a-7 fund would be lost and there would be no advantage for a fund to qualify as a "Money Market Fund". Thus, it is possible to make the rules so onerous that no rational investor would ever invest in MMFs. Other substitute vehicles would quickly absorb the assets that would otherwise have remained in MMFs.

These conclusions are most obviously arrived at by concepts of economic or regulatory arbitrage. However, the utility theory framework employed in our game theory models implies the same outcomes when the analysis is expanded to include alternative products. In particular, our methodology is predicated on the theory of expected utility in which investors array the investment choices and select the investment with the highest probability weighted utility of

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small), may redeem very early. This methodology demonstrates the more general observation that investors may self-select out of funds that have gates in preference of alternative vehicles. In this case, investors preemptively redeem by not investing in the fund to begin with.

[37] In particular, investors that perceive θ^* to be large in relation to π will be expected to select a Fee fund for investment, or redeem very quickly from a gated fund.

[38] Some mutual funds, such as certain high yield funds, have redemption Fees. However, these are implemented to restrict frequent trading in assets that have high transaction costs.

wealth. When we configure the choices to be not "Stay" vs. "Redeem", but instead "MMF with VNAV and Fees/Gates" vs. "Near MMF with VNAV and no Fees/Gates", investors will unambiguously choose the latter. (Similarly, investors' revealed preference of current 2a-7 MMFs over alternative VNAV products, along with their public commentary supporting the Fee/Gate alternative over the VNAV alternative, suggest that CNAV with Fees/Gates would be preferred over VNAV alternatives by utility optimizing investors.)[39]

X. Concluding Remarks

Our analysis has employed utility and game theory to derive important conclusions regarding the efficacy of the SEC's proposals for the reform of money market funds. We specifically addressed the ability of the proposals to stop or prevent runs, as well as the strength of these conclusions. We found that VNAV could not stop a run, although it could mitigate first mover advantage associated with the motivation to run that results from small shadow price departures from $1. We found that Fees and Gates can stop and prevent runs, provided that they are implemented effectively through policy and preemptive action by fund boards. In particular, Fess and Gates can be implemented so that remaining in the fund is a Nash Equilibrium, a strongly predictive economic result. We believe that the SEC has provided an extensive discussion of the factors relevant to implementing Fees or Gates. In particular, Section III.B of the Release identifies the key principles that underlie an effective policy and tradeoffs among them. We find that highly effective run prevention is attainable within the approaches contemplated by the Release, while requiring that fund boards be given discretion to take protective action. This is the mechanism by which Fees/Gates cause MMFs to internalize the cost of investor protection, while preserving the utility of current CNAV vehicles. We found that combining VNAV with Fees and Gates would ultimately be ineffective because arbitrage and investor preference would drive investors to other products. Cumulatively, these findings lend support to Fees and Gates as the preferred means of protecting investors and eliminating the related systemic risks of contagion and fire sales.

Fees and Gates have been primarily analyzed in terms of their ability to stop or prevent runs – particularly those resulting from liquidity or credit stress events in which fund values are impaired, but markets remain continuous. Recent developments, including cyber attacks, market shutdowns and extreme weather events, make it apparent that markets may be discontinuous. Regulators should therefore also consider allowing directors to impose very short-term Gates when there are business continuity events in which it may not be in the best interest of shareholders to make continuous redemptions. In these circumstances, fund directors and advisors may need a pause in order to make critical decisions on behalf of shareholders. Such power would complement the existing ability of funds to delay settlement for up to seven days.

Fees and Gates fill what are currently gaps in Rule 2a-7. At present, a fund that breaks a dollar has no choice but to liquidate. Fees and Gates provide a framework for a fund

[39] While this paper does not take up economic cost/benefit analysis of the alternatives, our conclusions with respect to combining VNAV with Fees/Gates supports the *marginal cost/benefit* argument that adding VNAV to a regime of Fees/Gates provides a net negative economic result.

to bridge such periods, and continue to operate afterwards.[40] Fees enable investors to access their liquidity, but at a price. That price may (and probably will) exceed the discount of the shadow price to $1 during a crisis, but that is the cost of being able to assure that a stable NAV product will not cause contagion or fire sales during such periods. Gates do not impose an extra Fee on shareholders, which is appealing to many shareholders, but have the undesirable effect of restricting access to liquidity during critical periods. Together, Fees and Gates provide fund boards with powerful tools to prevent a run from materializing, to stop a run in progress, and to assure that a stress event does not cause contagion or fire sales.

The combination of VNAV with Fees/Gates is an example of a policy prescription that weighs systemic risk concerns so heavily that investment utility of the resulting product is undermined. Other rules could have a similar effect. For instance, our analysis shows that extreme preemptive action by boards in imposing Fees could be so effective that, while eliminating run risk, the resulting penalty to access liquidity could become unduly burdensome. Policy makers must consider how best to balance these competing objectives. It is possible that directors should be allowed to set Fees that are an adequate deterrent to runs, but still with reasonable proportionality to transaction costs (and any current discount of the shadow price to $1), so they do not improperly penalize redemptions.

[40] In particular, boards may be more likely to take preemptive action when the corrective action (after Fee/Gate imposition) is a loss recognition that does not necessarily entail liquidation or abrupt change in operation. For instance, a fund that experienced a 25 basis point credit loss (but did not "break the buck") and had instituted a fee or gate, could be allowed to reverse split back to a $1 NAV and continue operation.

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Appendix A
Prisoner's Dilemma

A simple two-player game is typically described in tabular form as a set of outcomes for strategies for the Row player r and the Column player c.

In the classic Prisoner's Dilemma, two suspects Row and Column have been captured by police and accused of jointly participating in a crime. The suspects must decide if they will confess to the crime or accuse the other player of the wrongdoing.

If both Row and Column confess, i.e., (confess, confess) then they will each receive just one year in prison. However, if one player confesses and the other player accuses, i.e., (confess, accuse) or (accuse, confess), the accuser will go free while the confessor will receive four years in prison. On the other hand, if both accuse, (accuse, accuse) each other then they each receive three-year prison sentences.

Their strategies are, therefore, either confess or accuse. The payoffs to these actions are detailed in Table A1:

Prisoner's Dilemma			
	Column		
Row		Confess	Accuse
	Confess	1,1	4,0
	Accuse	0,4	3,3

Table A1. Prisoner's Dilemma

How do we solve the Prisoner's Dilemma? As stated previously, this involves finding the Nash Equilibrium to the game. A formal definition follows:

Nash Equilibrium. A Nash Equilibrium consists of probability beliefs (π_r, π_c) over strategies, and probability of choosing strategies (p_r, p_c), such that:

1. the beliefs are correct: $p_r = \pi_r$ and $p_c = \pi_c$ for all r and c; and,
2. each player is choosing (p_r) and (p_c) so as to maximize his expected utility given his beliefs.

Where expected utility is given as:

$$E(u_r) = \sum_r \sum_c p_r \pi_c u_r(r,c)$$

$$E(u_c) = \sum_c \sum_r p_c \pi_r u_c(r,c)$$

As such, it is apparent in this definition that a Nash Equilibrium is equilibrium in both actions and beliefs. In equilibrium each player correctly foresees how likely the other player is to make various choices, and the beliefs of the two players are mutually consistent.

Using this definition it is clear that there is only one Nash Equilibrium to the Prisoner's Dilemma. This outcome corresponds to the strategy (accuse, accuse) and is determined as follows:

- If Column confesses, it is in Row's best interest to accuse since Row will go free.
- If Column accuses, it is in Row's best interest to accuse since doing so will lead to just three years in prison instead of four if Row confesses.
- If Row confesses, it is in Column's best interest to accuse since Column will go free.
- If Row accuses, it is in Column's best interest to accuse since doing so will lead to just three years in prison instead of four if Column confesses.

The only strategy that is common to both players is (accuse, accuse), thus it is a Nash Equilibrium of the game. While this particular game had just one Nash Equilibrium, it is certainly possible to have more than one. A widely held "folk theorem" (i.e., unproven conjecture) of game theory is that all games have an odd number (e.g., 1, 3, 5, etc.) of Nash Equilibria as demonstrated by Lemke and Howson (1964)[41] and Wilson (1971)[42] with sufficient conditions provided by Li and Wang (2004)[43]. For simplicity we will concern ourselves only with "Pure Strategy" Nash Equilibria and avoid the more cumbersome and, in this case, unimportant "Mixed Strategies."

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[41] Lemke, C.E. & Howson, J.T. (1964). Equilibrium points of bimatrix games. SIAM Journal on Applied Mathematics, 12 (2), 413–423.
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Pure Strategy Nash Equilibrium: A Nash Equilibrium in pure strategies is a pair (r^*, c^*) such that:

$u_r(r^*, c^*) > u_r(r, c^*)$ for all Row strategies r, and

$u_c(r^*, c^*) > u_r(r^*, c)$ for all Column strategies c.

The existence of multiple Nash equilibria creates something of a problem. If there is more than one outcome to the game, which one is the "best"? To answer this question economists have developed the concept of Pareto optimality:

- A feasible outcome (r, c) is **weakly Pareto Optimal** if there is no other feasible outcome (r^*, c^*) such that all players strictly prefer (r^*, c^*) to (r, c)
- A feasible outcome **is strongly Pareto Optimal** if there is no feasible allocation (r^*, c^*) such that all players strictly prefer (r^*, c^*) to (r, c), and some player strictly prefers (r^*, c^*) to (r, c)

Note that in the Prisoner's Dilemma while (accuse, accuse) is the Nash Equilibrium and, hence, logical outcome of the game, it is *neither* strongly *nor* weakly Pareto Optimal. Both players could be made strictly better off by switching to (confess, confess), because their jail time would each be reduced by two years. However, (confess, confess) is not a Nash Equilibrium and, as a result, is not a viable outcome.

Economists have long held that government regulation is only justified if it moves games of strategic interaction away from Nash Equilibria that are not Pareto optimal to those that have either strong or weak optimality. In this sense the market couldn't gravitate naturally to an optimal outcome, so regulation is required to nudge it in that direction. Regulation that produces outcomes that are not Pareto Optimal are not justifiable in an economic sense.

Finally, it is worth noting that the classic lawyer's solution to the prisoner's dilemma is to have the two prisoners use the same lawyer. This would force cooperative behavior and a more positive outcome. MMF Board authority to impose Gates on behalf of the interests of all shareholders, without a specific numerical trigger, does the same thing.

Appendix B
Utility Functions

Investment utility functions are quantitative expressions of the preferences of investors. As such, we implicitly require that preferences be:

- *Complete.* If a decision maker has two choices, he or she has the knowledge to compare these choices and choose between the choices. The decision maker is never clueless.
- *Transitive.* Preferences are transitive when a decision maker is internally consistent (e.g., decision maker prefers a faster car. Given three cars, x, y and z, if x is faster than y, and y is faster than z, then x is faster than z.
- *Reflexive.* Preferences are reflexive when a particular good/option is at least as well liked as any other same good/option.
- *Continuous.* Preferences are continuous when not only a utility representation exists, but also a continuous representation exists. Preferences are continuous when they have no "jumps" or "reversals" when the options/goods being compared change slightly.
- *Strongly Monotonic.* More of a good thing is good.

If these requirements are met, then there must exist a continuous utility function $u : R_+^k \rightarrow R$ which represents those preferences. For a formal proof see Varian (1989)[44].

The money fund investor's utility function is characterized as: $u_i(w_i)$. Where w_i is the total wealth of investor i. We would expect that the derivative of the utility function is positive such that: $\frac{du_i}{dw_i} > 0$ The greater the wealth, the greater the overall utility.

We would also expect that the second derivative of the utility function is negative such that as wealth increases, utility increases at a diminishing rate.

Note that this utility function is not defined specifically for money funds; it can be generalized for *all* types of cash and short-term investments.

[44] Varian, H.R. (1992). Microeconomic analysis.

Utility Function Implications

Careful analysis of this utility function shows it has far-reaching implications. In fact, it brings into question the viability of the objectives motivating the SEC's proposals.

The expressed goal is to prevent runs on MMFs and potential contagion. Yet this utility function suggests that tighter regulation of MMFs begs the larger issue. These regulations will not control large sums of sophisticated, extremely liquid and extremely interest rate-sensitive assets from moving within the financial system during periods of credit market stress. Assets would just move to other instruments that meet similar utility functions (i.e., bank deposits, T-bills, direct commercial paper, etc.), especially if regulations are changed and the equilibrium shifts.

Second, it highlights that none of the proposed regulations operate directly on the investor utility function. Instead, they simply limit the viability of *one* particular investment vehicle (MMFs). All investors are utility maximizers. VNAVs, liquidity Fees and exit Gates reduce the utility of money funds since they represent a reduction in liquidity, safety of principal and perhaps even rate. Therefore, we would realistically expect large outflows from MMFs into other vehicles.

This exodus could be extremely problematic to the financial system as a whole. MMFs are, in general, designed to be very liquid and, as such, take very little interest rate risk. The typical duration of a money fund is usually less than 60 days such that redemptions would rarely, if ever, force the fund to realize losses due to rate movements. In this way they are perhaps the ideal vehicles for short-term liquidity.

Banks, on the other hand, are structured such that they take considerably more rate risk with deposits. If deposit proceeds are invested for a significantly longer duration (years) than the deposit itself, the bank's balance sheet could be at risk and the bank could be forced to realize significant losses to support deposit withdrawals. Bank products are less well-suited than MMFs for highly liquid deposits.

In a recent Treasury Strategies study (2012), we demonstrated that MMFs were more stable than other short-term investment vehicles during the financial collapse of 2007-2008. MMFs were the last domino standing among many in the financial collapse. From a game theoretic perspective, they optimized investor utility functions better than any other non-government insured short-term instrument[45].

[45] Treasury Strategies. (2012). Dissecting the financial collapse.