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Antoine Bouveret, Antoine Martin, and Patrick E. McCabe

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Money Market Fund Vulnerabilities: A Global Perspective

Antoine Bouveret (ESMA), Antoine Martin (FRBNY), and Patrick E. McCabe (FRB)¹

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Abstract: Money market funds (MMFs) are popular around the world, with over \$9 trillion in assets under management globally. From their origins in the 1970s, MMFs have operated in a niche between the capital markets and the banking system, as investment funds that offer private money-like assets with features similar to those of bank deposits. Hence, they are vulnerable to runs that arise from liquidity transformation and from sudden changes in investor perceptions of the funds' ability to serve as money-like assets. Since 2000, MMF runs have occurred in many countries and under many regulatory regimes. The global pattern of runs and crises shows that MMF vulnerabilities are not unique to a particular set of governing arrangements, and that mitigating these vulnerabilities requires fundamental reforms that either place MMFs more clearly within the investment-fund sector or establish protections for MMFs similar to those for deposits.

Keywords: Money market funds, liquidity transformation, runs, nonbank financial institutions, short-term funding markets, information-insensitive assets, financial stability.

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Money market funds (MMFs) are mutual funds – that is, open-end collective investment funds – that invest primarily in short-term instruments and aim to maintain stable, or near-stable, share prices. MMFs were first created in the United States and then in France to offer investors money market rates of interest when bank deposit rates were constrained by regulatory caps. From their origins, MMFs operated in the niche between the capital markets and the banking system, as investment funds that offered private money-like assets with features similar to those of bank deposits. Even the earliest funds in the United States were designed to blend investment and deposit features, such as share prices rounded to \$1.00 and check-writing privileges, and rounded share prices were adopted in some other countries. MMFs today are popular around the world, with over \$9 trillion in assets under management (AUM) as of mid-2021, about 13 percent of global mutual fund assets.²

However, MMFs are also vulnerable to disruptive waves of redemptions and runs. MMFs, like other investment funds, are not eligible for the protections provided to modern bank deposits, including public backstops such as deposit guarantee schemes and routine central bank liquidity support. Hence, the money-like features of MMFs have made them vulnerable – just as bank deposits historically were – to runs that arise from liquidity transformation and from sudden changes in investor perceptions of the

¹ This paper represents the views of the authors and does not necessarily reflect the views of the European Securities and Markets Authority (ESMA), the Federal Reserve Bank of New York (FRBNY), the Board of Governors of the Federal Reserve (FRB), or their staffs. The authors would like to thank Kenechukwu Anadu, Burcu Duygan-Bump, Refet Gürkaynak, Satoshi Izumihara, Marius de Jongh, Helen Keil-Losch, Martina Kelly, Steffen Kern, Akber Khan, Lei Li, Robert Plaze, Gary Richardson, Will Riordan, Andreas Schrimpf, and Jonathan Wright for assistance, helpful conversations, suggestions, and analysis.

² Sources: The International Investment Funds Association (IIFA) and SEC Form N-MFP filings (for U.S. MMFs). See FSB (2021) for a discussion of the roles of MMFs for investors and borrowers in the short-term funding markets around the world.

funds' moneyness. Rapid growth of the MMF industry, increasing use of MMFs by institutional investors for cash management, larger footprints in the short-term funding markets that contribute to contagion risk, and cross-border investing have heightened vulnerabilities.

Since 2000, MMF runs and other crises have occurred in many countries and under many regulatory regimes, with early strains mostly due to poor management of credit or interest-rate risks but more recent runs arising from liquidity transformation. For the most part, the crises have occurred among MMFs that invest in private-debt instruments, such as U.S. prime funds that hold commercial paper and bank obligations.³ After these crises, authorities have often modified MMF rules to prevent recurrence of the problems just observed and with the intention of mitigating broader vulnerabilities. The severe repercussions of runs on MMFs during the global financial crisis and at the onset of the COVID-19 pandemic, and the need for central bank interventions, as well as taxpayer support in some instances, have led to calls for significant additional reforms to limit the risk MMFs pose to financial stability. The global pattern of runs and crises shows that MMF vulnerabilities are not unique to a particular set of governing arrangements, and that mitigating these vulnerabilities requires structural reforms that either place MMFs more clearly within the investment-fund sector or establish protections for MMFs similar to those for deposits.

Although this paper focuses on MMFs, other nonbank financial institutions use liquidity transformation to offer money-like features to investors and hence may be vulnerable to runs. Examples include private liquidity funds and bank-sponsored short-term investment funds (STIFs) in the United States and the rapidly growing worldwide stablecoin sector.

1. MMF origins. MMFs were first introduced in the United States and then in France to offer investors money market rates of interest when bank deposit rates were capped by regulation. As such, from their origins, MMFs straddled the functions of bank deposits and investment funds.

United States, 1972. MMFs were invented in the United States and first approved by the U.S. Securities and Exchange Commission (SEC) in September 1972. The first MMFs were intended to give investors with modest wealth – including small businesses – access to money market yields, as bank interest rates were capped at the time by Federal Reserve Regulation Q, and Treasury bills (which were a popular means of earning market rates) were subject to \$10,000 minimum investments.⁴ From the beginning, U.S. MMFs were designed to mimic deposit features, with many funds maintaining stable share prices (that is, net asset values per share, or NAVs) fixed at \$1 or \$100. By 1974, Fidelity was offering check-writing privileges for its MMFs (Nocera, 1994).⁵

By straddling the functions of bank deposits and investment funds, MMFs gained popularity but also stirred controversy. Assets in MMFs grew from \$1.7 billion in 1974 to \$220 billion in 1982 – that is, from 5 percent to 74 percent of all U.S. mutual fund assets (Chart 1). The banking industry saw MMFs, which were already 10 percent of the size of bank deposits by 1982, as an end-run around bank regulations and a competitive threat. Banks mounted campaigns at the federal and state levels to reign in MMFs

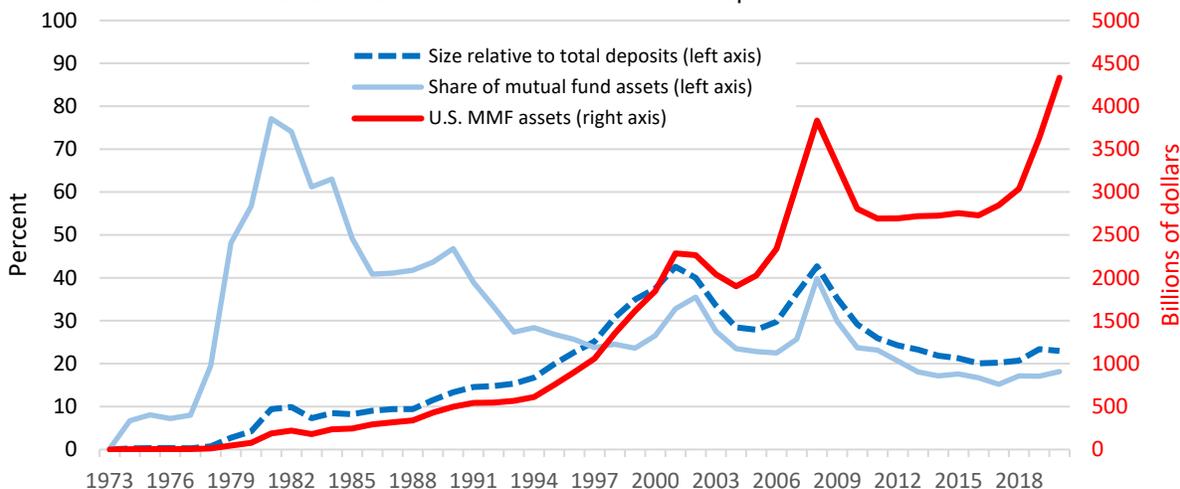
³ Such funds are “non-public-debt” funds in Europe. In contrast, “government” MMFs in the United States and “public-debt” funds in Europe primarily invest in sovereign debt securities and repo backed by them.

⁴ “Treasury Puts Minimum on Bills,” *New York Times*, 26 February 1970, p. 68.

⁵ See also: “Overnight Mutual Funds for Surplus Assets,” *New York Times*, 7 January 1973, p. 5.

and liberalize deposit-rate policy. Only the latter was successful: Bank deposit-rate ceilings were effectively eliminated in 1986.⁶ Thus, MMFs survived and had a key role in giving middle-class investors access to competitive short-term interest rates (Nocera, 1994; Gilbert, 1986).

Chart 1: U.S. MMF assets under management and size relative to all mutual funds and to deposits



Notes. Data are annual. Total deposits is checkable deposits (excluding those issued by the Federal Reserve) plus time and savings deposits. Sources: Investment Company Institute; SEC (1975); Federal Reserve Board, Financial Accounts of the United States.

Meanwhile, within three years of approving the first MMFs, the SEC was already expressing concerns about practices that foreshadowed the vulnerabilities of MMFs. The SEC in 1975 and 1977 noted “deficiencies” in MMFs’ use of amortized (historical) cost for valuing portfolio assets and stated that use of amortized cost – which to this day helps MMFs in many countries maintain stable NAVs – might advantage redeeming investors over others:⁷

The Commission is concerned that the use of the amortized cost method... may result in overvaluation or undervaluation of the portfolios of [MMFs]... [so that] investors purchasing or redeeming shares could pay or receive more or less than the actual value of their proportionate shares of the funds' current net assets. The effect of such sales or redemptions may therefore result in inappropriate dilution of the assets and returns of existing shareholders (SEC, 1977).

If market values for a fund’s portfolio assets drop, amortized cost overvalues them, and redeeming investors can receive more than the value of the assets backing their shares. Hence, within five years of

⁶ Until its repeal in 2011 under the Dodd-Frank Act, Regulation Q continued to require that no interest be paid on demand deposits, but other deposit-rate ceilings ended in 1986. See: <https://www.federalreserve.gov/newsevents/pressreleases/bcreg20110714a.htm>.

⁷ Amortized cost is a valuation method that is typically used for short-term discount instruments. It sets the value at the instrument’s initial (historical) cost plus any interest that has accrued since acquisition, where interest is assumed to accrue at a constant rate, rather than at current market rates. Because this method results in stable valuations for portfolio assets, it facilitates MMFs’ maintenance of stable share prices.

MMFs' creation, it was clear to regulators that MMF practices could create a first-mover advantage for redeeming investors.

In addition, the SEC recognized early that some MMF portfolio assets, such as commercial paper, do not have substantial secondary markets:

“Market quotations are not readily available for many money market instruments in these funds' portfolios because they are generally held to maturity, thereby eliminating a meaningful secondary market” (SEC, 1975).

More than four decades later, these instruments are still illiquid (FSB, 2021). As such, MMFs perform liquidity transformation: The shares they offer to investors, which by U.S. law must be redeemable daily, are more liquid than some of their underlying assets. As discussed below, this contributes to MMFs' vulnerability to runs.

Based on these considerations, the SEC in 1977 stated that amortized cost would be inappropriate “under all but very limited circumstances” (SEC, 1977). Nonetheless, after many MMFs sought to use amortized cost, the SEC changed direction. In 1983, it adopted Rule 2a-7, which allowed funds to use amortized cost and NAV rounding to maintain stable share prices if they adhered to certain restrictions, including holding only short-term assets that present “minimal credit risks” and limiting portfolio average maturity to no more than 120 days (SEC, 1983). Over the next decade, the U.S. MMF industry tripled in size to more than \$500 billion in assets under management. Today, the U.S. MMF sector is still the world's largest, with AUM of over \$5 trillion.⁸

France, 1981. The first European MMFs were created in France for regulatory arbitrage purposes similar to those that spurred development of the U.S. industry. In 1981, a large share of French term deposits became subject to an interest rate cap, as the government sought to reduce bank funding costs.⁹ To avoid losing clientele, banks bypassed the rate caps by setting up MMFs through their asset management affiliates to offer money market yields to investors. Initially, MMFs invested mostly in short-term government debt, but deregulation in the mid-1980s and the opening of French capital markets allowed MMFs to invest more in private short-term debt instruments, such as commercial paper (CP) and certificates of deposit (CDs). Demand for MMFs expanded due to favorable changes to the tax code in 1989 (Icard and Drumetz, 1994) and the introduction in the early 1990s of new types of “dynamic” MMFs with higher credit risk and longer portfolio maturities.¹⁰ By 1993, total assets of French MMFs had reached almost €240 billion (Chart 2) and accounted for more than 60 percent of the French open-end investment (mutual) fund industry (Leclair, 2009).

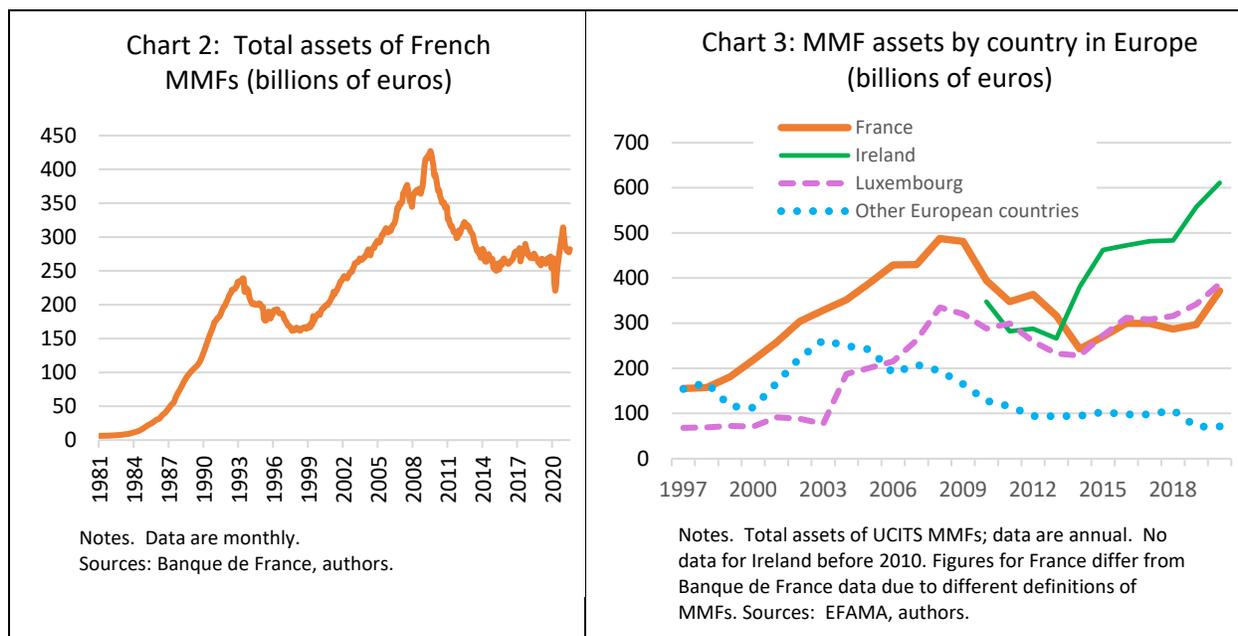
Unlike their U.S. counterparts, French MMFs all had variable net asset values (VNAVs, or “floating” NAVs), as so-called “constant” NAVs (CNAVs) – equivalent to the stable NAVs that prevailed in the United States – were prohibited. French MMFs were permitted to use amortized cost to value assets

⁸ As of September 30, 2021. Source: SEC Form N-MFP filings.

⁹ On 4 September 1981, rates on term deposits with maturities of less than 6 months and balances below 500,000 francs were capped at 6 percent (compared to money market rates of 15 percent).

¹⁰ MMFs were given the ability to accumulate coupons, rather than distribute them to MMF investors, so investors' earnings became subject to capital gains taxes, rather than (higher) income taxes.

with less than three months to maturity in part because of very limited secondary market activity for these assets and hence the lack of adequate market data to value them.¹¹



Luxembourg and Ireland, late 1980s-early 1990s. In addition to France, Ireland and Luxembourg have become major domiciles for European MMFs (Chart 3). MMFs have remained relatively small in most other European countries, where they are mainly targeted at retail investors.

Luxembourg has long been a hub for European mutual funds, and MMFs first appeared there in the late 1980s. Early MMFs in Luxembourg were VNAV funds patterned on French MMFs but with tax advantages that allowed them to invest economically in a broader range of (non-French) assets. Tax advantages also encouraged investment by residents of other European countries, such as Germany and Spain (Baklanova and Tanega, 2018). In addition, Luxembourg developed a U.S. dollar (USD) MMF sector with CNAV funds mainly targeted at non-resident institutional investors, who were mostly outside of Europe (Ansidei et al., 2012).

Ireland’s first MMFs were a CNAV USD government fund and a USD prime fund opened in 1991 and 1993, respectively, by Federated, a U.S. asset management firm.¹² Moreover, many of the Irish-domiciled management companies that offered additional Irish MMFs belonged to U.S. asset management groups. Like most other European mutual funds, Irish MMFs complied with European UCITS rules.¹³ At the same time, they largely adhered to U.S. MMF rules and guidelines from credit

¹¹ CNAVs were prohibited in France before the entry into force in July 2018 of the European Money Market Fund Regulation (MMFR), which allows for CNAV funds. As of end-2020, no French MMFs offered stable NAVs.

¹² USD government funds primarily invest in U.S. government securities and repo backed by those securities. See Central Bank of Ireland UCITS Register.

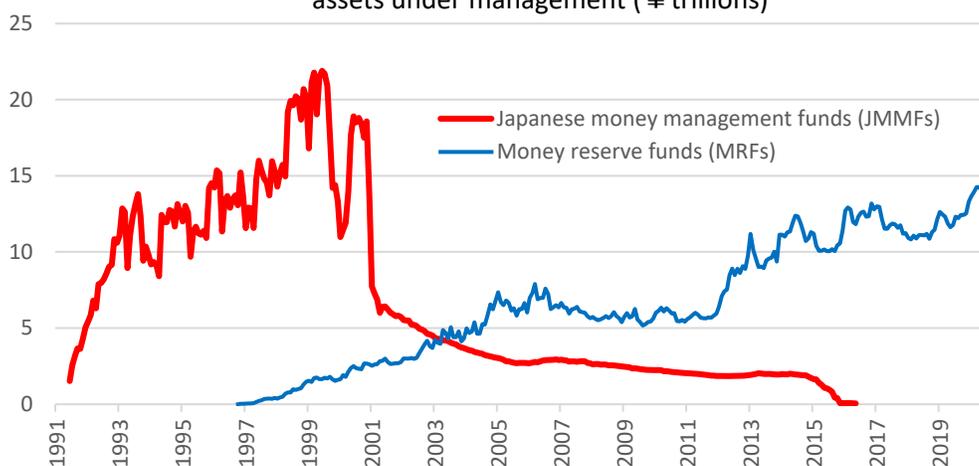
¹³ The Undertakings for the Collective Investment in Transferable Securities (UCITS) Directive provides the regulatory framework for mutual funds in the EU.

rating agencies (CRAs), as there was no European regulatory framework specifically for MMFs before 2018 and the funds were offered largely to non-resident institutional investors, who were familiar with U.S. rules and credit ratings. Hence, an AAA money market fund rating from a CRA was initially seen as a prerequisite for authorization of an Irish MMF. Up to this day, almost all Irish MMFs offer a stable NAV (ESRB, 2021).¹⁴

Most MMFs in Ireland have been issued in foreign currencies (mainly USD and sterling), reflecting their foreign investor bases. Luxembourg MMFs are denominated in a mix of USD, euros, and sterling (ESRB, 2021).

Japan, 1992. Money management funds (JMMFs) were introduced in Japan in 1992 and marketed as a safe but higher-yielding alternative to bank deposits. JMMFs maintained stable ¥10,000 NAVs, even though these funds had virtually no safeguards like those that limited risk in U.S. or European funds (IMF, 2002; Kunishima, Shino, and Imakubo, 2016). Within two years of their introduction, JMMFs had ¥12 trillion in AUM and accounted for more than a quarter of the Japanese mutual fund sector (Chart 4), but, as discussed below, a run on these funds beginning in late 2001 nearly wiped them out.¹⁵ A second, safer type of money fund, the money reserve fund (MRF), which first became available in 1997, did have credit quality restrictions. MRFs were used in customer securities trading accounts at broker-dealers for settlement purposes and as a place to temporarily invest cash (Fukumitsu, 2002; FSB, 2021).

Chart 4: Japanese money management and money reserve funds: assets under management (¥ trillions)



Notes: Data are monthly.

Source: Investment Trusts Association, Japan (JITA).

¹⁴ Blackrock (2012) states that investors gravitated towards CNAV funds because only those funds received top MMF ratings from CRAs and such ratings were required by investors in the absence of MMF regulation or guidelines. In 2010, The Committee of European Securities Regulators (the predecessor to ESMA) published Guidelines on MMFs (CESR, 2010).

¹⁵ The JMMF sector disappeared entirely in 2017, about a year after the Bank of Japan's introduction of a negative interest rate on reserves, which made the JMMF business model unviable. Japanese MRFs survived, in part because the Bank of Japan exempted MRF balances held by trust banks from negative rates (Bank of Japan, 2016; FSB, 2021).

South Africa, 1995. MMFs were introduced in South Africa in 1995 by insurance companies targeting retail customers. Later, MMFs were also offered by banks and asset management firms, and clientele expanded to institutional investors, who constituted 70 percent of MMF investors by 2015 (IOSCO, 2015; FSB, 2021). South African MMFs mostly maintain CNAVs.

China, 2003. MMFs were first introduced in China in 2003. As was the case in the United States and France, MMF growth in China was driven, particularly after 2010, by below-market caps on bank deposit rates and an easing of portfolio restrictions for MMFs in 2011 (McLoughlin and Meredith, 2017). The introduction of T+0 settlement in 2012 further enhanced the deposit-like features of Chinese MMFs (Barclays, 2014). Chinese MMFs also compete with Wealth Management Products (WMPs), which are riskier and less liquid but offer higher rates. Hence, new regulatory constraints on WMPs in 2013 and 2014 also contributed to the growth of MMFs (IOSCO, 2015), resulting in MMFs accounting for about half of the Chinese mutual fund industry. Growth in recent years has been propelled by linkages between MMFs and major e-commerce platforms, such as Alibaba, Baidu, and Tencent (IOSCO, 2015). The Chinese MMF sector is now the second largest in the world, with \$1.4 trillion in AUM as of mid-2021.¹⁶

Chinese MMFs mostly maintain stable NAVs, with sponsor support expected when the MMF portfolio experiences small losses (IMF, 2017), and are held by a mix of retail and institutional investors. Unlike their counterparts in the United States and Europe, MMFs in China regularly employ leverage, largely by using repo financing (FitchRatings, 2016; McLoughlin and Meredith, 2017).

2. MMF vulnerabilities and their significance. The vulnerabilities of MMFs have been extensively described and documented, both in academic research and in official publications. Academic research was largely silent on MMF risks until the Global Financial Crisis (McCabe, 2010), but the run on MMFs in 2008 prompted a wave of studies of factors that contributed to redemptions (see, for example, Baba, McCauley, and Ramaswamy, 2009; McCabe, 2010; Kacperczyk and Schnabl, 2013; Schmidt, Timmermann, and Wermers, 2016). Additional research has focused on the factors behind heavy redemptions from U.S. MMFs during the 2011 European debt crisis (Chernenko and Sunderam, 2014) and amidst the runs on MMFs at the outset of the COVID-19 pandemic (Li, Li, Macchiavelli, and Zhou, 2021; Cipriani and La Spada, 2020). Other papers focused more specifically on vulnerabilities and policy proposals to address them (for example, McCabe, Cipriani, Holscher, and Martin, 2013; Hanson, Scharfstein, and Sunderam, 2015).

Government authorities and international organizations have also weighed in with a focus primarily on developing and analyzing proposals for reforms that might mitigate MMF vulnerabilities. These include official publications in the wake of the 2008 crisis (PWG, 2010; FSOC, 2012; SEC, 2013; EC, 2012; IOSCO, 2012) as well as after the March 2020 money market stress (PWG, 2020; ESMA, 2021, 2022; FSB, 2021; ESRB, 2021, 2022; SEC, 2021). For example, the FSB's 2021 report on "Policy Proposals to Enhance Money Market Fund Resilience" lists two types of vulnerabilities for MMFs: They are susceptible to sudden and disruptive redemptions, and they can face challenges in selling assets to meet heavy redemptions. The report also notes that the susceptibility to redemptions arises because the funds perform liquidity transformation, they are used for cash management, and they are exposed to credit risk.

¹⁶ Source: IIFA.

Here, we argue that MMF vulnerabilities have two fundamental sources: They perform liquidity transformation, and they serve as private money-like assets that can – like other such assets – suddenly lose their “moneyness.” Both can contribute to sudden redemptions, and together they make MMFs vulnerable to runs.

2.1. Liquidity transformation. Diamond and Dybvig (1983) provides a theoretical basis for understanding how runs can arise from liquidity transformation – that is, the transformation of illiquid assets into liquid liabilities. The role of liquidity transformation in contributing to redemption risks for investment funds has been analyzed both theoretically and empirically for non-MMF mutual funds (for example, Chen, Goldstein, and Jiang, 2010; Feroli, Kashyap, Schoenholtz, and Shin, 2014; Goldstein, Jiang, and Ng, 2017; Zeng, 2017).

For MMFs, liquidity transformation may be particularly stark. As the SEC observed in 1975 and the FSB reiterated in 2021, many money market instruments, particularly private short-term debt securities like CP and negotiable CDs, have little or no secondary markets (SEC, 1975, 1977; Bouveret and Danieli, 2021; FSB, 2021). Investors in these instruments typically hold them to maturity, so potential intermediaries have little incentive to make markets. As such, liquidity rules for MMFs are based on the maturities of these instruments, not on the funds’ ability to sell them in secondary markets. That is, MMFs in many jurisdictions around the world are required to hold buffers of liquid assets; to qualify, private debt securities typically must *mature* within five business days.

Hence, liquidity transformation can motivate investors to redeem MMF shares faster amid market stress than they would sell money market assets if they held them directly, for two reasons. First, when market liquidity costs rise, liquidity in MMF shares is underpriced, as MMFs typically offer investors unrestricted redemptions without any explicit cost for liquidity. Second, if an MMF’s portfolio contains only a limited share of liquid assets (as is the case for prime funds in the United States and non-public-debt funds elsewhere), investors who redeem early in stress can enjoy a first-mover advantage. Indeed, U.S. prime MMFs that suffered heavy redemptions in 2008 sold their safest and most liquid holdings first, leaving the investors who did not redeem with riskier, less-liquid assets (Strahan and Başak, 2015).

Because MMF investors have incentives to redeem shares when liquidity is scarce, MMFs are likely to be forced to dispose of assets faster than other investors amid crises. Below, we show that, during the COVID-19 crisis, MMFs in the United States and Europe disposed of greater proportions of CP and CDs than other investors.

2.2. Private money-like assets. From their beginnings in the United States, MMFs have sought to replicate features of bank deposits, such as maintaining a stable share price and offering check-writing services. The success of this model has established MMF shares as private money-like assets (see, for example, Gorton, Lewellen, and Metrick, 2012; Gorton, 2017). Like other private money-like assets, MMF shares normally benefit from a no-questions-asked (NQA) property that facilitates their use for cash management by investors who needn’t question their value (Holmstrom, 2015).

However, many MMFs hold assets with credit and other risks, and the importance of moneyness for the MMF business model is seen in the actions of MMF sponsors in some jurisdictions when those risks threaten the moneyness of MMF shares. For example, in the United States, MMF sponsors have stepped in to absorb MMF losses *over 200 times* since the 1980s (Moody’s, 2010; Brady, Anadu, and Cooper, 2012; McCabe, 2015). In contrast, U.S. MMF shareholders (who nominally and legally bear the

market risks of MMF shares) have only suffered losses *twice* – once each in 1994 and 2008. Evidently, sponsors, who rarely support other types of investment funds, understand the importance of preserving the NQA nature of MMF shares.

Moneyness is fragile. On the rare occasion when questions *are* asked about MMFs – for example, when portfolio credit risks become salient – investors rush to redeem (Gorton, 2017). Liquidity transformation and the resulting first-mover advantage for redeeming investors may increase incentives to redeem when MMFs lose their moneyness, but they are not essential: Investors who use MMFs as money will redeem when the shares no longer serve that function. And in jurisdictions where sponsor support is important in preserving moneyness for MMF shares, concerns about sponsors’ ability to provide support may hasten the loss of moneyness and worsen a run (McCabe, 2010).

2.3. Other factors that contribute to vulnerabilities. The combination of liquidity transformation and MMFs’ role as private money-like assets makes them vulnerable to redemptions and runs. Other characteristics can exacerbate this vulnerability, including MMFs’ use by institutional investors for cash management, similarities in their regulation and portfolio holdings that give rise to contagion risks, and threshold effects that may motivate investors to engage in preemptive runs.

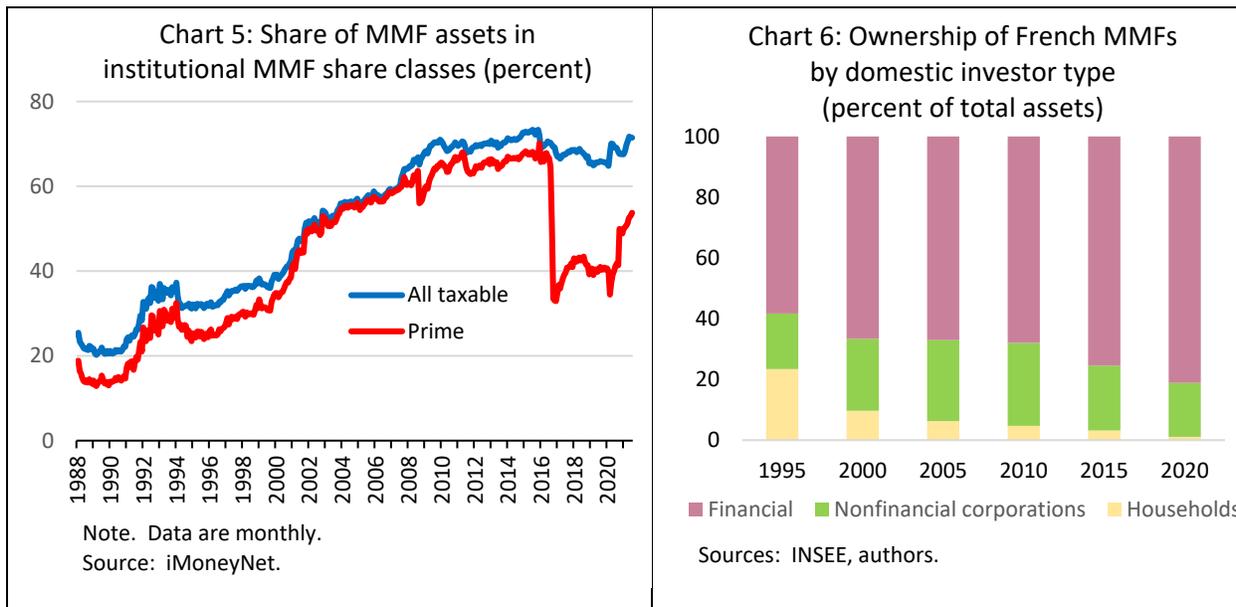
2.3.1. Institutional investors. Institutional investors use MMFs more than other investment funds. For example, in the United States, nonfinancial businesses owned 18 percent of MMF shares at the end of 2020 but only 1.9 percent of mutual fund shares.¹⁷ For institutional investors, the diversified exposure to money market instruments represented by MMF shares may be *safer* than bank deposits, which – because of limits on deposit insurance coverage – represent unsecured exposure to a single institution. Hence, the removal of deposit-rate caps in some countries (such as in the United States in 1986 and in France in 1987) eroded the advantages of MMFs over deposits for retail investors, but for institutional investors, MMFs continued to offer safety advantages. As such, the share of institutional investors grew substantially in the 1990s and 2000s in the United States and France (see Charts 5 and 6). In other jurisdictions, such as Ireland and Luxembourg, MMF investors have always been predominantly institutional. As of year-end 2020, institutional investors owned around 90 percent of the aggregate net asset value of EU MMFs.¹⁸ Services such as intraday redemptions and T+0 settlement contribute to the appeal of MMF shares for cash management for institutional investors (FSB, 2021; Casavecchia, Ge, Li, and Tiwari, 2020).

The treatment of MMF shares as cash equivalents for accounting purposes has also contributed to their use by institutional investors. Authorities in some jurisdictions have encouraged cash-equivalent treatment. For example, in 2000, the SEC clarified that MMF shares could be considered cash equivalents (SEC, 2000), and the Commission reaffirmed this position for floating NAV funds when it adopted its 2014 MMF reforms (SEC, 2014). In 2011, the French AMF argued that some types of MMFs

¹⁷ Source: Financial Accounts of the United States.

¹⁸ EU MMFs are mainly held by financial institutions, which own 60 percent of the funds’ aggregate net asset value. Within the financial sector, “other financial institutions,” which include investment funds, hold 40 percent of the aggregate, followed by insurance and pension funds (10 percent), and banks (9 percent). Nonfinancial firms hold 19 percent and government and households together only about 5 percent. See ESMA (2022) for details.

were presumed to be cash-equivalent (AMF, 2011), and it restated this position in 2018 in light of the new European MMF Regulation (MMFR) (AMF, 2018).¹⁹



Large and institutional depositors put greater strain on MMFs' liquidity transformation, as their cash needs are greater and they appear to be quicker than retail investors to reassess moneyness and redeem when MMF risks become salient. Historically, such investors, as depositors, also created greater run risk for banks: Amid the Depression in the United States, interbank and large depositors withdrew far greater proportions of their accounts than other types of depositors, especially those with small accounts (Krost, 1938; Breithut and Krost 1939). In the 1980s, institutional investors in MMFs – not retail investors – exploited discrepancies between the funds' stable MMF share prices and their market value (Lyon, 1984).

In the crises we discuss below, institutional investors consistently redeemed faster from MMFs than retail investors. Indeed, the greater riskiness of institutional investors led the SEC in 2014 to introduce more stringent reform measures for institutional funds than for retail funds.²⁰ In addition, the composition of institutional investors in MMFs is likely important, as the more sophisticated and larger

¹⁹ According to the AMF, shares in VNAVs are presumed to be cash equivalents as long as the MMF shares are used as a short-term cash management vehicle rather than as an investment. However, the presumption of negligible risk of change in the value of these shares – the basis for considering them to be cash equivalents – can be refuted based on market conditions, notably in periods of stress (AMF, 2018).

²⁰ In its 2014 MMF reform package, the SEC required that non-government funds offered to institutional investors have floating NAVs, while retail-only funds could continue to offer stable, rounded \$1 share prices.

institutional investors appear to have been the quickest to redeem in the crises of 2008 and 2020 (McCabe, 2010; Avalos and Xia, 2021).²¹

2.3.2. Contagion risks. Vulnerabilities in MMFs are exacerbated by contagion risks that stem from the similarities of their portfolios. MMF regulations (and CRA guidelines) constrain the funds to invest only in the obligations of governments and firms in the highest tiers of investment-grade credit quality. Since there are relatively few firms with such ratings that also issue short-term instruments, MMFs tend to hold obligations of the same issuers, and the funds' portfolios have a high degree of similarity. Georg et al. (2020) and Bouveret and Danieli (2021) show that U.S. prime and European private-debt MMFs, respectively, have very similar exposures. In addition, the footprint of MMFs in the markets for the debt instruments they hold (mainly financial CP and negotiable CDs) tend to be substantial. U.S. and European USD MMFs hold between 30 and 40 percent of U.S. financial CP and negotiable CDs, and European MMFs hold between 50 and 70 percent of euro-denominated financial CP and negotiable CDs (FSB, 2021). High portfolio overlap and large market footprints – combined with the very limited capacity of short-term funding markets to absorb secondary-market sales – imply that when MMFs are subject to a common liquidity shock they are likely to face acute challenges in disposing of their assets to meet redemptions (Baes, Bouveret, and Schaanning, 2021).

2.3.3. Threshold effects. Some MMF rules can cause abrupt (discontinuous) changes in the expected payoffs for redeeming investors when certain thresholds are reached. As such, thresholds may motivate investors to redeem preemptively, before a threshold is crossed (Cipriani, Martin, McCabe, and Parigi, 2014). Three important examples of threshold effects are the link between weekly liquid asset (WLA) thresholds and potential imposition of redemption fees and gates, NAV rounding, and the closure and liquidation of distressed MMFs.

Link between WLA thresholds and redemptions fees and gates

MMF rules in the United States and Europe set minimum WLA requirements for certain MMFs. For example, U.S. MMFs and CNAV and low-volatility NAV (LVNAV) European MMFs must hold at least 30 percent of their assets in WLA. If WLA falls below 30 percent, these funds may impose redemption fees or gates on investors.²² In March 2020, many MMFs facing heavy outflows raised cash by depleting their liquid assets, and as WLA buffers approached the regulatory threshold, investors accelerated redemptions (Li, Li, Macchiavelli, and Zhou, 2021; Cipriani and La Spada, 2020; Dunne and Giuliana, 2021).

NAV rounding

NAV rounding and NAV “collars” also create thresholds that can motivate pre-emptive runs. U.S. MMFs that maintain stable NAVs typically round their share prices to the nearest cent. This creates a discontinuity when the market value of the shares drops more than 50 basis points; if the value dips below \$0.995, the NAV can no longer be rounded up to \$1.00 and drops suddenly. Hence, investors

²¹ Information about the composition of institutional investors is generally not publicly available, so researchers have used fund-level proxies, such as low MMF fees (for sophistication) and high minimum investment requirements (for investor size).

²² For European MMFs, an additional requirement for imposing fees or gates is that the fund has experienced outflows of 10 percent of AUM on a single working day.

have a strong incentive to redeem if the market value per share of the fund is approaching the threshold. Moreover, in such a scenario, redemptions at the \$1.00 NAV reduce the value of remaining shares and create a first-mover advantage for those who redeem quickly.

NAV collars used by European LVNAV MMFs create similar threshold effects, although rounding for these funds is limited to 20 basis points. For example, for a LVNAV fund that usually maintains a €1.00 NAV, if the market value per share of the fund's portfolio drops below €0.998, the fund must transact using a floating NAV.

MMF liquidation

Even without WLA thresholds and NAV rounding, MMFs – like other mutual funds – have an inherent threshold associated with the possibility that a fund may suspend redemptions or enter liquidation.²³ For example, as discussed below, investors who requested redemptions in September 2008 from one fund that closed and liquidated had to wait *several years* to receive their full claims on the fund.

2.4. MMFs vulnerabilities threaten financial stability. MMFs are key intermediaries in the systemically important short-term funding markets, where stress can have an immediate disruptive effect on financial stability. In part, this reflects the moneyness of many of the private instruments that trade in these markets, which – like MMFs – can be vulnerable to sudden changes in investor perceptions of safety. In addition, money markets are characterized by greater “urgency” than other markets (Holmstrom, 2015). For example, 17 percent of the private securities and 88 percent of the repo held by U.S. prime MMFs mature *overnight*, and the failure to roll over overnight debt can quickly lead to crises.²⁴ Their role in the short-term funding markets distinguishes MMFs from other investment funds that operate in the less fragile bond and equity markets.

MMFs are also pivotal in the financial system because MMFs globally (including prime funds in the United States) mostly invest in the obligations of financial institutions, notably banks. In the United States, 80 percent of the private financing provided by prime funds is debt and repo financing for banks; in the EU, banks account for close to 70 percent of all MMF exposures; and in Japan, South Africa, and China, MMFs also primarily hold claims on banks (ESRB, 2021; FSB, 2021; IOSCO, 2014).²⁵

In addition, much of MMFs' financing for banks is done across borders, which creates cross-border vulnerabilities. Globally, non-U.S. banks, which generally do not have access to insured U.S. deposits, must rely on wholesale funding markets for USD short-term funding, and MMFs are an important source of that funding. As such, of the financing extended by U.S. prime MMFs to banks, 84 percent went to non-U.S. banks. In addition, about 60 percent of the aggregate assets of MMFs in Ireland and Luxembourg are various forms of financing for banks from other countries (FSB, 2021).

Hence, MMFs can be a channel for rapid transmission of stress across borders – in both directions. For example, runs on MMFs in the United States have caused rapid losses of funding for banks in Europe, and problems in the European banking sector have caused investors in the United States to question the

²³ It is also worth noting that investment funds without either WLA thresholds or NAV rounding, such as ultrashort bond funds in the U.S and some European VNAV MMFs, also experienced sharp outflows in March 2020.

²⁴ Data as of 30 September 2021. Source: SEC Form N-MFP filings.

²⁵ Data as of 31 December 2020 for U.S. prime funds. Source: SEC Form N-MFP filings.

moneyness of prime MMFs. Indeed, MMF crises transmitted stress across borders in 2008, 2011, and 2020, as we note in section 3.

3. MMF crises. Crises have arisen in MMFs around the world, particularly since 2000. Although each crisis event has reflected the particular characteristics of a jurisdiction's MMFs and how they were regulated at the time, some common themes emerge. Investors and even regulators in many cases appear to have been surprised that MMFs were not as safe and money-like as they had been perceived. Investors often respond by running from MMFs even though losses – if any – are typically small relative to losses that can occur in other types of investment funds. Institutional investors are especially fast to run, and investors who redeem early are typically at an advantage relative to others. The range of events also shows that MMF crises are not unique to a particular jurisdiction or regulatory regime, and that runs still occur even after authorities have introduced new restrictions to respond to past crises.

Early examples of strains in MMFs often involved exposures to assets with credit and interest rate risks, including some that are no longer considered appropriate for MMFs to hold. Some of these episodes nonetheless highlight that even small losses – or the threat of losses – can cause sudden loss of moneyness in MMFs and disproportionate reactions by investors.

United States, 1980s-2003. Between 1989 and 2003, sponsors stepped in voluntarily more than 140 times to support MMFs that held defaulted debt or other assets that had lost value. For example, in 1989 and 1990, several MMF sponsors purchased defaulted CP from their funds at par (SEC, 1990; Moody's, 2006; ICI, 2009). Meanwhile, shareholders over these years suffered losses only in *one* instance, in 1994, when the Community Bankers' U.S. Government Money Market Fund, a MMF sold primarily to small community banks seeking to earn a spread over the federal funds rate, "broke the buck" – that is, its share price fell below \$1.00 (two other funds using similar strategies received sponsor support and avoided losses).²⁶

During this period, the SEC responded to each wave of distress and sponsor support with new rules or other actions designed to limit risks that had just become apparent. For example, amendments to rule 2a-7 were adopted in 1991 in the wake of the 1989-1990 CP defaults to tighten diversification requirements and again in 1996 after losses stemming from the Orange County bankruptcy led to sponsor support for several dozen MMFs (ICI, 2009).

Japan, 2001. As Enron collapsed in late 2001, five JMMFs that held Enron's Euroyen bonds suffered losses that caused them to "break the buck" – that is, their share prices dropped below their normal ¥10,000 NAVs. One fund fell to ¥9,319 (Fukumitsu, 2002). Investors responded by redeeming shares en masse, and JMMF assets shrunk by 58 percent from October to December and continued falling thereafter (Chart 4).

While the JMMF holdings of Enron reflected the particularly lax rules for these money funds, this episode illustrates broader vulnerabilities and patterns. The crisis demonstrated a first-mover advantage for those who redeemed quickly, and institutional investors were among those who got out fastest. Enron obligations in the Sumisei MMF climbed from 2.2 percent of the assets at the end of October to 5.3 percent near the end of November, as the fund met heavy redemptions by selling other assets. The *Economist* observed in January 2002, "Slow to sniff trouble at Enron, retail investors

²⁶ See Leslie Eaton, "New Caution about Money Market Funds," *New York Times*, 29 September 1994, D-1.

suffered when fund managers sold liquid assets to finance withdrawals from better-informed institutional investors, leaving individuals stuck with mostly illiquid paper.”²⁷

Second, this MMF crisis resulted in central bank intervention. The Bank of Japan expanded its liquidity provision, in part to mitigate broader effects of the JMMF redemptions on financial markets (IMF, 2002; Chorafas, 2004).

Third, as has often been the case after MMF crises, new rules were introduced to address the risks that had become apparent. The Investment Trusts Association of Japan put in place a variety of new rules in January 2002, including credit-quality requirements and a 180-day limit on portfolio weighted average maturity.

European Union, 2007-2008. In the summer of 2007, “enhanced” and “dynamic” MMFs in France, Luxembourg, and Germany suffered mark-to-market losses and difficulty valuing certain portfolio assets, including asset-backed subprime mortgage securities.²⁸ Some asset managers intervened to support their funds, while others suspended redemptions and imposed losses on investors. For example, following significant losses on subprime mortgages, Luxembourg-based AXA Investment Management offered to purchase all shares in two of its enhanced MMFs at the prevailing NAV (Bengtsson, 2013), and French asset manager ODDO suspended redemptions in its enhanced MMFs, liquidated the funds, and protected retail investors from losses. BNP suspended redemptions in three MMFs and eventually reopened them with haircuts of between 1 and 2 percent of NAV. Some German asset managers suspended redemptions for their enhanced MMFs, as well.

In the second half of 2007 and early 2008, some MMF sponsors provided support to their MMFs either by purchasing assets directly from the fund’s portfolios or by guaranteeing the value of the MMF shares to investors. At the crisis intensified, sponsor support increased. At least 26 MMFs received support between August 2007 and the end of 2009 (Moody’s, 2010). Support actions resulted in large losses for asset managers and their parent banking groups, leading to contagion from MMFs to the banking system (Bengtsson, 2013; McCabe, 2010).

United States, 2007-2008. In the aftermath of the 2007 crisis in the market for asset-backed CP (ABCP), SEC records indicate that 44 MMFs received support due to holdings of distressed ABCP. Despite news of substantial MMF exposure to these securities, MMF investors did not run from the funds during the ABCP crisis, as sponsor support – even though it was discretionary – evidently convinced investors that MMFs were safe (McCabe, 2010).

U.S. prime MMFs attracted large inflows in the year after the 2007 ABCP crisis, even as the broader financial crisis expanded, likely because sponsor support for MMFs had preserved their moneyness while other assets and cash-like vehicles were losing value (Baba, McCauley, and Ramaswamy, 2009; McCabe, 2010; Kacperczyk and Schnabl, 2013). However, when Lehman Brothers failed on September 15, 2008, some prime MMFs were holding its debt, and investors redeemed more than \$300 billion (15 percent of assets) from prime funds in the next five days. Outflows only abated when the U.S. Treasury

²⁷ “Japanese Bond Funds: Stuffed,” *Economist*, 26 January 2002.

²⁸ These funds had taken on greater risk than other MMFs by investing in collateralized debt obligations and asset-backed securities.

guaranteed virtually the entire MMF industry and the Federal Reserve provided liquidity using its emergency powers (PWG, 2010; FSOC, 2012; Duygan-Bump et al., 2013).²⁹

The 2008 run in the United States underscored the vulnerabilities of MMFs, such as the fragility of their NQA moneyness and their susceptibility to contagion. SEC data show that 29 MMFs had losses large enough to break the buck in 2008, but sponsors bailed them out (McCabe, Cipriani, Holscher, and Martin, 2013; see also Brady, Anadu, and Cooper, 2012). However, the failure of just *one* MMF sponsor to support its fund immediately accelerated the run on the *entire* MMF sector. Daily prime MMF outflows on the two days after Lehman's bankruptcy (September 15 and 16) averaged \$40 billion, but news late on September 16 that the Reserve Primary Fund would not be supported by its sponsor and had broken the buck prompted \$102 billion in redemptions from *other* MMFs the next day.³⁰

Amidst the run, the importance of liquidity transformation, the first-mover advantage for redeeming investors, and threshold effects were also clear. Investors who redeemed from the Reserve Primary Fund early on September 15 received \$1 per share. But redemptions depleted the fund's liquidity, including its capacity for overdrafts from its custodian bank, and the fund halted redemptions (permanently) later that day. Investors who waited to redeem not only received less than \$1 for their shares, but also had to wait several *years* to receive all of their money (SEC, 2009; Shapiro, 2012).

Institutional investors worsened stress for MMFs in 2008. Institutional MMFs, which held 64 percent of the assets in prime funds on the eve of Lehman's failure, accounted for 95 percent of the redemptions in the first five days of the run.

The run on prime MMFs quickly exacerbated strains in short-term funding markets, in part because MMFs had to liquidate holdings to meet redemptions. The repercussions were not limited to the United States. U.S. prime MMFs had become very large suppliers of short-term dollar funding for global banks particularly those in Europe. The run quickly put funding pressure on those banks that was only relieved by emergency increases in currency swap lines by Federal Reserve and other central banks (Baba, McCauley, and Ramaswamy, 2009).

The SEC responded to the 2008 run by adopting two sets of reforms. In 2010, it introduced daily liquid asset and WLA requirements. In 2014, the SEC mandated that all non-government funds (that is, prime and tax-exempt funds) have the ability to impose gates and fees on redemptions if their WLAs fall below the regulatory minimum of 30 percent of total assets. In addition, institutional prime and institutional tax-exempt funds were required to have floating (variable) NAVs. One consequence of the 2014 reforms was significant shrinkage of both the prime and tax-exempt MMF sectors in the year leading up to October 2016, when the reforms went fully into effect. Prime and tax-exempt MMF assets under management fell 68 percent and 47 percent, respectively, in that year.³¹ The assets of publicly-sold

²⁹ Despite the large drop in prime funds' AUM amidst the run, the U.S. MMF sector *grew* during that time, as inflows to government MMFs more than offset the outflow from prime funds.

³⁰ Based on data from iMoneyNet, adjusted for misreporting (see McCabe, 2010). Both the creation and the demise of the Reserve Primary Fund were milestones in MMF history. Notably, this fund was the world's first MMF, as it was the first one approved by the SEC in September 1972.

³¹ Source: SEC Form N-MFP filings.

institutional prime funds fell especially sharply – 88 percent that year – so the fraction of prime funds held by institutional investors plummeted (Chart 5).³²

United States, 2011. Less than three years after the 2008 run, the direction of stress transmission across the Atlantic reversed: Through U.S. MMFs, European financial strains put pressure on U.S. financial markets. In June 2011, when the European debt crisis led to credit-ratings reviews for large French banks, U.S. prime MMFs that were exposed to European banks started experiencing heavy outflows. Over the next eight weeks, investors redeemed about \$180 billion (16 percent of assets) from institutional prime funds (FSOC, 2012). Again, the outflows were concentrated in institutional MMFs; retail funds saw *inflows* during this episode.

In the United States, the crisis led to reduced availability of short-term funding for firms that borrowed from the most Europe-exposed MMFs, as those MMFs cut back on lending even to non-European firms (Chernenko and Sunderam, 2014). Meanwhile, as U.S. prime funds slashed exposures to European banks, those banks faced USD funding shortfalls that led the Federal Reserve and other central banks to broaden USD swap arrangements in November 2011 (van Rixtel and Gasperini, 2013).

China, 2013. In June 2013, amid rising interest rates and strains in the Chinese interbank credit market, where MMFs have significant exposure, heavy redemptions caused several funds to “break the buck” (IOSCO, 2015).³³ MMFs had outflows of nearly 40 percent of AUM in the second quarter of 2013, and institutional fund outflows were close to 50 percent.³⁴ The Chinese Securities Regulatory Commission (CSRC) tightened rules for MMFs in 2016 by imposing new requirements for minimum holdings of liquid assets and reducing allowable leverage (FitchRatings, 2016). In addition, in 2017, the CSRC introduced investor concentration limits and a cap of CNY10,000 on T+0 settling redemptions from a single account (Shevlin, 2018; FitchRatings 2018).

South Africa, 2014. When African Bank Investments collapsed in August 2014, the South African Reserve Bank forced a 10 percent writedown of senior unsecured creditors’ claims. MMFs exposures to African Bank amounted to 1.3 percent of the funds’ aggregate assets, and ten of the country’s 43 MMFs broke the buck. Some of these funds experienced large outflows, but flows stabilized when MMFs introduced side pockets for their distressed investments (IMF, 2014; IOSCO, 2015).³⁵

United States, 2020. As concerns mounted in March about the economic and financial consequences of the COVID-19 pandemic, a “dash for cash” caused stress in a range of markets, including those for U.S. Treasury securities, corporate and municipal bonds, and money-market instruments. Redemptions from prime MMFs grew quickly into a run in mid-March (Chart 7): Publicly-offered institutional prime MMFs had outflows of 30 percent of assets over the two-week period from March 10 to 24, and retail prime funds had outflows of 9 percent over a two-week interval beginning a day later (PWG, 2020). By these

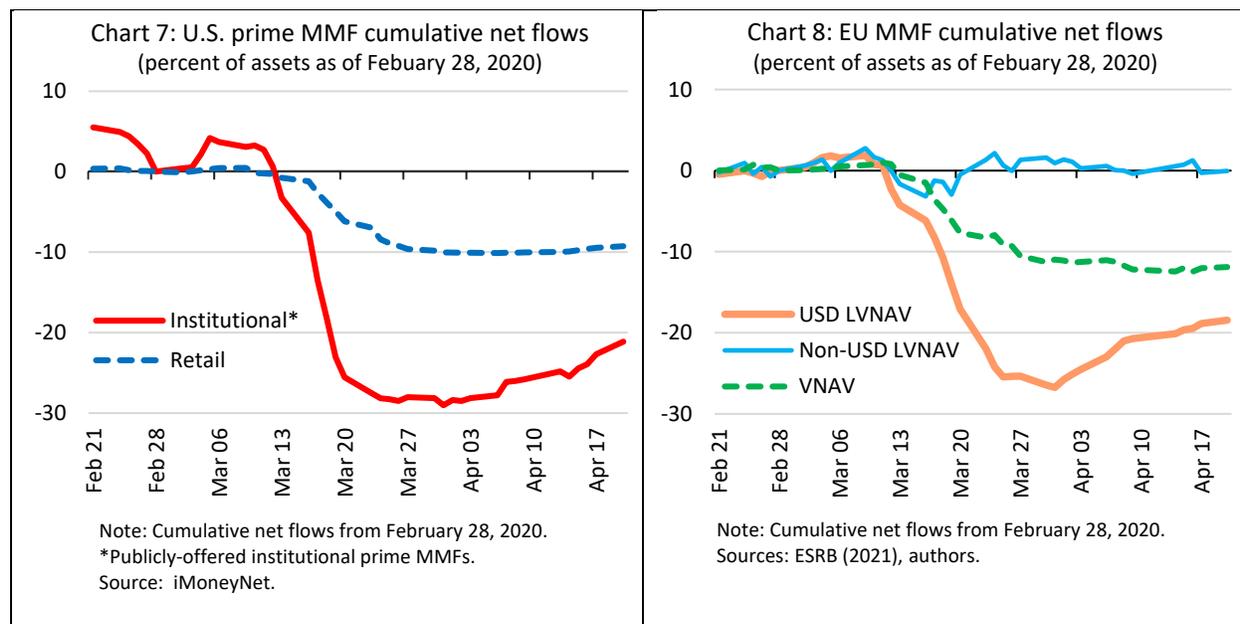
³² Source: iMoneyNet.

³³ See also Chris Flood, “China tightens money market regulation,” *Financial Times*, January 31 2016, <https://www.ft.com/content/66f85d72-b949-11e5-bf7e-8a339b6f2164>.

³⁴ Fitchwire, “Chinese MMF Assets See Major Outflows,” 26 July 2013.

³⁵ A “side pocket” is a separate fund into which distressed assets are transferred. The original fund’s investors’ shares are split, with a portion becoming claims on the side pocket. See also Steve Johnson, “South African money funds ‘break the buck,’” *Financial Times*, 24 August 2014.

measures, prime MMF outflows exceeded those in September 2008 (however, in dollar terms, institutional prime fund outflows were larger in 2008).³⁶



MMF vulnerabilities were evident again in this crisis. The funds were susceptible to the surge in liquidity demand because of their liquidity transformation: They offered shareholders liquidity on demand at no charge even as liquidity in the markets for the instruments the funds held was becoming scarce and costly. This contributed to a first-mover advantage for redeeming investors, which was exacerbated by threshold effects, as investors redeemed on concern that funds could impose fees or gates if their WLAs fell below the 30 percent minimum requirement (Li, Li, Macchiavelli, and Zhou, 2021; Cipriani and La Spada, 2020). The first-mover advantage was clear: Funds’ declining WLA levels were publicly available on a daily basis, so investors could see the detrimental effects of others’ earlier redemptions on their own prospects. The fragility of moneyness was also a contributing factor, as the dash for cash was not indiscriminate: Investors, apparently questioning the safety of prime MMFs, redeemed from prime funds and shifted money into government funds. Institutional investors were again faster to redeem than retail investors, and funds that appear to have been held by *large* institutional investors experienced disproportionately larger outflows (Avalos and Xia, 2021).

Facing heavy redemption pressures, MMFs in the United States and Europe (see below) together reduced their holdings of USD CP and negotiable CDs disproportionately relative to other investors. For example, while U.S. and so-called “offshore” USD MMFs held 55 percent of USD negotiable CDs at the end of February, their \$112 billion combined reduction in holdings represented 102 percent of the

³⁶ Some U.S. institutional prime MMFs are not offered to the public – for example, a number of asset management firms operate internal, non-public MMFs to provide cash management for other funds that the firms operate. The U.S. institutional prime MMF sector was more than four times larger on the eve of the 2008 run than the publicly-offered institutional prime fund sector was in February 2020.

aggregate drop in the amount of these CDs outstanding in March.³⁷ Similarly, MMFs in the United States and in the EU disposed of greater proportions of CP than other investors.

Because the run on MMFs was quickly contributing to severe stress in U.S. short-term funding markets, the Federal Reserve, with approval and credit protection from the U.S. Treasury, again used its emergency powers to provide liquidity to MMFs and to the broader funding markets (PWG, 2020). Moreover, the Congress, which after the 2008 crisis had restricted the Treasury's ability to establish future guarantee programs for MMFs, temporarily lifted that restriction in March 2020, although the Treasury did not use this authority.³⁸ Finally, as the strains on prime funds caused them to curtail funding for non-U.S. banks, USD funding shortages abroad led the Federal Reserve to expand its foreign currency swap lines with other central banks (Eren, Schrimpf, and Sushko, 2020a and 2020b; Aldasoro et al, 2021).

European Union, 2020. As the COVID-19 pandemic led to lockdowns across Europe, MMFs experienced massive outflows (exceeding 20 percent of NAV over one week for some European USD MMFs) as investors redeemed to raise cash and to avoid being subject to fees and gates (Bouveret and Danieli, 2021; Dunne and Giuliana, 2021). The challenges arising from liquidity transformation were evident, as MMFs had difficulty liquidating assets to meet redemptions because of the poor liquidity in markets for CP and CDs and the fact that dealers bought back limited amounts of their own paper.³⁹ In March 2020, the European Central Bank intervened to support euro money markets by extending its existing corporate sector purchase program to include euro-denominated nonfinancial CP with remaining maturities of as few as 28 days (reduced from an earlier 6 month minimum).

The stress was particularly acute for LVNAV European private-debt MMFs offered in foreign currencies, notably USD and, to a lesser extent, sterling MMFs (Chart 8) (FSB, 2021).

French MMFs, which are all VNAV funds that are not subject to fees and gates, also had very large outflows (Darpeix and Mosson, 2021). Redemptions were most likely driven by investors' increased need for cash (the "dash for cash") rather than concerns about threshold effects, as funds' liquidity levels did not significantly affect the pace of outflows (Darpeix, 2021). Nonetheless, the underpricing of liquidity in these funds likely contributed to redemptions.

³⁷ USD negotiable CDs outstanding fell \$110 billion (16 percent) in March 2020 – this represented a 4-standard-deviation monthly reduction in data going back to 2011 (source: DTCC Solutions LLC, an affiliate of The Depository Trust & Clearing Corporation). Meanwhile U.S. and offshore MMF holdings of CDs fell \$112 billion (29 percent). For U.S. MMFs, \$17 billion of the net reductions in CD holdings in March were due to sales into the Federal Reserve's Money Market Mutual Fund Liquidity Facility (MMLF), but this facility was not available to offshore MMFs (source: Federal Reserve Bank of Boston). Net of these sales, U.S. and offshore MMFs' \$95 billion in net reductions represented 86 percent of the aggregate reduction in negotiable CDs outstanding. Neither DTCC Solutions LLC nor any of its affiliates shall be responsible for any errors or omissions in any DTCC data included in this publication, regardless of the cause and, in no event, shall DTCC or any of its affiliates be liable for any direct, indirect, special or consequential damages, costs, expenses, legal fees, or losses (including lost income or lost profit, trading losses and opportunity costs) in connection with this publication.

³⁸ See Section 4015 of the Coronavirus Aid, Relief, and Economic Security Act (the "CARES Act"), H.R.748, 116th Congress, 2020, <https://www.congress.gov/bill/116th-congress/house-bill/748/text>.

³⁹ ICMA (2021) notes that the events of March 2020 have shown the "inherent precariousness of secondary market liquidity in short-term credit markets [including those for CP and CDs], particularly in times of market stress."

Like other crises, the 2020 MMF runs and strains in the United States and Europe have led to calls for further reforms and restrictions on MMF operations (see, for example, PWG, 2020; ESMA, 2021, 2022; FSB, 2021; SEC, 2021).

4. Policy implications and conclusions. Operating in the niche between banking and investment funds, MMFs appear to offer the best of both worlds, with money-like shares that pay market rates of interest. However, when crises have occurred, MMFs repeatedly have proven vulnerable and have failed to measure up to either the banking or the mutual fund models. Without the protections provided to bank deposits, the moneyness of MMFs is fragile. And, unlike the mutual fund model that disperses risks across a wide range of investors in proportion to their ownership of shares, MMF risks are disproportionately borne by non-redeeming shareholders, and – in some jurisdictions – by sponsors and taxpayers.

The hybrid bank-fund nature of MMFs suggests two approaches for addressing their vulnerabilities. One is the banking package: Insurance, access to lender-of-last resort liquidity, and supervision to mitigate moral hazard and protect taxpayers. A drawback of this approach is that the financial system already has banks.

The mutual fund model, in which risks are borne by shareholders, offers a second approach (McCabe, 2015). Mitigating vulnerabilities within the mutual fund model would require more novel policies to address liquidity transformation and the fragility of moneyness.

The fundamental challenge of liquidity transformation is how to allocate a scarce, underpriced resource – liquidity in a MMF – efficiently. Currently, liquidity is provided at no charge to the first investors to redeem. Three approaches might be possible to address this problem: *Increase* liquidity enough so that it isn't scarce, by requiring that MMFs hold only WLA or government securities; *ration* liquidity among investors by delaying redemptions or imposing partial gates (where investors can only redeem a fraction of their shares) to reduce the convertibility of shares to cash when liquidity is scarce; or *price* liquidity by introducing swing pricing or economically equivalent measures. Official publications by national and jurisdictional authorities and international bodies have assessed some of these options in detail (PWG, 2020; ESMA, 2021, 2022; FSB, 2021; SEC, 2021).

Making moneyness less fragile within the context of the mutual fund model – which is designed to impose risks transparently, rather than create information-insensitive, NQA assets – is more challenging. One possible approach would be to outsource risks to third parties who are compensated accordingly. For example, investors outside the MMF could provide a capital buffer (Hanson, Scharfstein, and Sunderam, 2015).

While some of these reform options for MMFs have been discussed for a decade or more, adopting robust structural reforms for MMFs has proven difficult. For example, the SEC's 2014 reforms came only after the Commission had failed to act in 2012 and the Secretary of the Treasury initiated a Financial Stability Oversight Council proposed recommendation for further reforms (Geithner, 2012; FSOC, 2012). Moreover, reforms put in place in the prior decade in the United States and Europe proved insufficient to contain the runs in March 2020. The difficulty of implementing effective reforms reflects, at least in part, the benefits of MMFs as they are currently structured for broad constituencies of investors, issuers, and asset managers and the implicit subsidies they receive from central bank support when MMF runs occur. Indeed, recent comment letters from the MMF industry express near-universal

opposition to all structural reform options, including swing pricing and capital buffers.⁴⁰ So, meaningful mitigation of MMF vulnerabilities is likely to continue to be a challenge for policymakers.

Finally, MMFs are not the only institutions with these vulnerabilities. Any vehicle that engages in liquidity transformation to provide money-like services presents similar challenges. In the United States, for example, private liquidity funds and bank-sponsored short-term investment funds (STIFs) have similar features. Worldwide, the explosive growth of stablecoins, which aim to offer not only stable value and liquidity but also access to the payments system, all backed by assets that are likely to become illiquid in crises, suggests that policymakers may have a new challenge on their hands.

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⁴⁰ See, for example, public comment letters on the PWG’s 2020 “Overview of Recent Events and Potential Reform Options for Money Market Funds” (comments available at: <https://www.sec.gov/comments/s7-01-21/s70121.htm>) and those on the FSB’s 2021 “Policy proposals to enhance money market fund resilience: Consultation Report” (comments available at: <https://www.fsb.org/2021/08/public-responses-to-consultation-on-policy-proposals-to-enhance-money-market-fund-resilience/>).

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