

Liquidity Management Tools in Investment Funds

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Managing Risks from
Stressed Redemptions



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Research & Policy Center

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EXECUTIVE SUMMARY

This report examines how open-end investment funds (OEFs) can use liquidity management tools (LMTs) to manage the inherent tension between offering investors daily redemptions and holding underlying assets that may be difficult to sell quickly, especially during periods of market stress. We explore the use of LMTs and the trade-offs they create between investor protection, fiduciary duty, and financial stability objectives.

This report is primarily for two audiences: (1) policymakers and supervisors designing LMT frameworks for OEFs; and (2) fund managers, directors, and boards who must select, calibrate, and govern LMTs in practice.

We consider the use of LMTs by OEFs across two dimensions: how far they reduce fire-sale losses and systemic spillovers (a core policy concern), and how they affect the liquidity available to investors who redeem (a core fiduciary and investor-protection concern). The liquidity offered to redeeming investors can affect not only the value of the fund but also how much liquidity is available to remaining investors. Understanding how OEFs use LMTs and the balance of liquidity among different investors not only has important implications for the operation of the fund and the corresponding protection of investors, but it also has wider ramifications for how OEFs affect financial stability.

Our work is motivated by the role of non-bank financial institutions (NBFIs), which include OEFs, in market-wide stress, where redemption pressures can amplify system-wide vulnerabilities. Redemption pressures among NBFIs, particularly corporate bond funds, were evident during the onset of the COVID-19 pandemic, when there was a deterioration of market liquidity in financial markets and in the underlying financial instruments. These pressures stem from a structural feature of OEFs: Investors can typically redeem daily, while the underlying assets that need to be sold to meet those redemptions may be less liquid. If redemptions are large, this can trigger price dislocations as funds try to sell less liquid assets to meet redemptions, potentially amplifying losses through fire-sale dynamics and spillovers to other institutions. Hence, LMTs are designed to mitigate these spillover effects, either by reducing the redemption price through antidilution measures (by passing the costs associated with selling less liquid assets to redeeming investors) or by limiting redemption quantities through such tools as redemption gates.

LMTs lie at the intersection of three objectives that cannot be maximized simultaneously: financial stability, investor protection, and managers' fiduciary duties. They reduce fund losses for remaining investors and systemic spillovers, but they impose higher costs on redeeming investors through lower prices or quantities. Recognizing and analyzing this trade-off is the central motivation behind this report.

We examine how LMTs affect fund losses and investor liquidity by using a model of stressed redemptions that accounts for fire-sale effects (based on Capponi et al. 2024). The model assumes an initial market shock that reduces asset prices that affect the value of funds' asset holdings. This situation triggers investor outflows via a flow-to-performance relationship, and to meet such redemptions, funds are forced to sell assets. Asset sales to meet redemptions generate a price impact, decreasing the price of the assets sold and resulting in mark-to-market (MtM) losses for the fund. This creates spillover effects, where MtM losses impact funds that commonly hold the sold asset.

While similar stylized models have been proposed, the model of Capponi et al. (2024) allows the incorporation of LMTs and the evaluation of total fund losses under the initial shock and fire-sale impact of asset sales.

We present empirical findings using corporate bond fund data from LSEG Lipper. We use December 2024 holdings for 668 actively managed UCITS (undertakings for collective investment in transferable securities) corporate bond funds domiciled in Europe. In our analysis, we focus on two LMTs: an antidilution measure (a 2% redemption fee) and a quantity-based measure (a gate that caps redemptions at 5% of the fund's net asset value). Outcomes are assessed based on total fund losses, representing losses across all funds under both the initial market shock to asset prices and the subsequent market impact cost (MtM losses) from asset sales to meet redemption requests. We also consider investor liquidity, representing the total value of shares redeemed by investors across all funds in response to the initial market shock.

Our main findings are as follows:

- **Fire-sale effects are present in corporate bond funds, but they are not the main source of losses in our scenarios.** Across the scenarios we model, most losses arise from the initial market shock rather than from subsequent MtM losses caused by redemption-driven asset sales. This finding suggests that, under our data and modeling assumptions, contagion through overlapping corporate bond fund holdings is limited relative to the direct impact of a broad market shock.
- **Redemption fees change who bears liquidity costs, rather than materially reducing system-wide losses.**
 - A redemption fee lowers the amount investors receive when redeeming, while total fund losses fall only marginally under our modeling. This is consistent with the intended role of antidilution tools: protecting remaining investors by charging redeeming investors for the liquidity costs associated with meeting redemptions.
 - Antidilution tools used in isolation may be unable to prevent large-scale losses, as observed in a fire-sale scenario. This finding highlights the trilemma facing policymakers and fund managers: It is challenging to simultaneously maximize the objectives of investor protection, fiduciary duty, and financial stability when using LMTs.

- Gated redemptions can significantly reduce total fund losses under larger shocks, but this corresponds to a large reduction in investor liquidity.**
 The effect is most pronounced in high-stress calibrations, where redemption gates severely restrict the liquidity of investors. Redemption gates can therefore be effective at limiting forced sales in extreme scenarios. However, they do so by limiting investor liquidity, particularly at the point at which investors most need it. If investors are unclear on how and when these tools are used, it can damage confidence in the ability of the fund to provide liquidity in future events. Hence, strong governance, activation criteria, and clear and timely disclosures are critical if gated redemptions are used.
- LMTs applied in tandem should be calibrated to ensure intended and balanced outcomes.** Because fire-sale dynamics are nonlinear, combining antidilution and quantity-based tools without careful calibration may only produce limited additional reductions in fund losses relative to using a single LMT. Although adding LMTs will not lead to an increase in fund losses, it can reduce investor liquidity, which may be unattractive for investors. While calibration is challenging because funds differ in risk limits, investor base, and exposure to stress scenarios, funds should apply approaches that consider how LMTs interact with each other across a range of scenarios. This ensures that outcomes when LMTs are used remain proportionate and aligned between the fund and redeeming investors.

Recommendations

For Policymakers

- Regulators should establish, via supervisory guidance, that the responsibility for liquidity risk management, including the selection, calibration, activation, and deactivation of LMTs, should rest with the asset manager. Policymakers should promote flexible, fund-specific LMT frameworks and avoid prescriptive one-size-fits-all rules.
- The appropriate use of LMTs depends on the liquidity of the underlying holdings, redemption terms, investor concentration, dealing frequency, and the fund's historical and stressed redemption profile. It also reflects a fundamental distinction from prudential regulation of deposit-taking institutions; OEFs are pass-through investment vehicles, not leveraged intermediaries, and their investors bear risk directly. This suggests that regulator-driven mandates that prescribe specific LMTs, fixed calibrations, or rigid tool combinations across the industry risk creating a false sense of harbor, unnecessarily displace managerial judgment, and may produce poor outcomes.
- Policymakers should reinforce manager accountability through governance, disclosures, stress testing, and supervisory dialogue. Where quantity-based tools, such as redemption gates, are permitted, their use should be supported by clear activation triggers, escalation procedures, governance approvals, review requirements, and investor communication expectations.

This is particularly important because the reduction in investor liquidity can be large relative to the reduction in total fund losses. Frameworks that allow LMTs to be calibrated to these characteristics are more likely to balance financial stability objectives with investor protection.

For Fund Managers, Fund Boards, and Directors

- Tool selection and calibration should reflect the fund's liquidity profile, investor base, redemption terms, stress-testing results, and offering documents. Periodic stress testing and precalibration support timely activation under stress and reduce reliance on discretionary judgment at the point of crisis.
- Using multiple LMTs without calibration can erode investor liquidity disproportionately or fail to reduce fund losses meaningfully. If quantity-based tools, such as redemption gates, are used in conjunction with antidilution tools, such as redemption fees, swing pricing, or antidilution levies, managers should assess their interaction across a range of scenarios to evaluate the trade-offs between protecting redeeming investors and those that remain invested in the fund.
- Embed LMT decisions within fund governance. Activation criteria, escalation procedures, review requirements, and investor communication expectations should be defined *ex ante* and integrated into the fund's broader risk management framework. This supports both supervisory dialogue and investor trust, particularly during periods of market stress.

INTRODUCTION

In recent years, the size of NBFIs has significantly increased, particularly in Europe. According to the European Systemic Risk Board (2025), in 2024, European investment funds and other financial institutions, such as security dealers and securitization vehicles, held EUR50.7 trillion in assets, which is 20% larger than the European banking sector. While there are different types of NBFIs, such as money market funds, hedge funds, and insurance firms, we focus on open-end funds because they are of particular interest to regulators for systemic risk and financial stability.

The International Organization of Securities Commissions (IOSCO) defines an OEF as a registered, authorized, public collective investment scheme (CIS) that “provides redemption rights to its investors from its assets, based on the net asset value of the CIS, on a regular periodic basis during its lifetime” (IOSCO 2013, p. 2). OEFs can hold different assets, which provides investors with exposure to various investment strategies. In addition, investors can access short-term liquidity by selling (redeeming) their shares/units to the fund at a price equal to the net asset value (NAV).

However, there can be an asset-liability mismatch in OEFs from funds offering daily redemptions while holding less liquid assets. Put simply, when investors redeem, a fund may not be able to raise cash quickly enough to meet those redemptions if some of its asset holdings are difficult to sell promptly without incurring costs or depressing prices. The liquidity mismatch highlights the fact that liquidity is not free: Its cost becomes most apparent under stress. Under such stress, the cost of liquidity for investors who redeem is passed on to the fund that leads to liquidating assets, often at depressed prices. As stated by Jon Cunliffe (2015, p. 5), former deputy governor of the Bank of England, “Liquidity comes at a price. And that price is not at all the same for all financial assets.” The focus of this study is the present liquidity risk associated with OEFs and how LMTs can be used by funds to address such costs.

Most importantly, during market stress, large redemption requests can trigger forced sales and may escalate into a run on the fund. The volume of redemption requests can force funds to sell holdings beyond those assets that are easiest to sell, decreasing prices and lowering fund NAV. This situation can prompt further redemptions because investors may seek to exit the fund to avoid additional losses. Because fund asset holdings will have a degree of commonality with the asset holdings of other funds, the MtM adjustment from sales in each asset affects all funds holding the asset. A decline in the price of assets held by funds can reduce fund net asset values, triggering further redemptions and asset sales in a procyclical manner. Forced sales, often called “fire sales,” can then amplify losses. Multiple rounds of asset sales and the interconnectedness of funds through their common asset holdings can exacerbate market volatility and create a cyclical spiral of decreasing asset prices.

In severe market stress, central banks may provide liquidity backstops to OEFs by purchasing assets to increase market liquidity (acting as a buyer of last resort), preventing further asset fire sales.

However, investment funds cannot access central bank liquidity directly through credit lines or deposit insurance. The reason is that, compared with large retail banks, investment funds are not subject to the same prudential oversight, capital requirements, and liquidity requirements. This appropriately reflects the different nature of the respective businesses of banks (that lend on principal) and OEFs (that act as agents of investors), where the distinction between them is relevant to how liquidity risks in OEFs are most appropriately addressed.

Funds can also decrease liquidity risks if they increase their cash holdings or liquidity buffers (comprising highly liquid securities—e.g., short-term sovereign bills). Using cash holdings to meet redemptions reduces sales in less liquid assets. However, holding significant cash buffers to accommodate large outflows can conflict with the fund's investment objectives, acting as a cash drag that reduces the fund's performance, making these investment vehicles less attractive.

In response, investment funds can use LMTs to mitigate fire-sale losses through antidilution or quantity-based methods. Antidilution LMTs reduce redemptions by imposing the cost of liquidity on redeeming investors by decreasing the share price redeemed (i.e., applying a fee or levy such that the redemption price is at a discount to the NAV). The liquidity costs of antidilution LMTs reflect the previously stated sentiment of Jon Cunliffe (2015) on this issue. In contrast, quantity-based LMTs limit the quantity of shares investors can redeem from the fund, such as by imposing gates on redemption requests. In this regard, using LMTs is advantageous because they reduce the need for external market intervention and reduce the need for funds to hold excessive cash or liquidity buffers.

However, a potential trade-off in using LMTs is that the costs of liquidity are passed on to investors, who receive a lower value and/or quantity of shares. This can create conflicts between the financial stability objectives of prudential regulators (favoring LMTs), the investor-protection objectives of securities regulators, and the fiduciary duties of fund managers (favoring investor access to liquidity).

Because protection for each stakeholder is important, there can be serious challenges in designing policies that balance the distribution of liquidity costs between redeeming investors and the fund, while still aligning with prudential regulators. Hence, how funds use LMTs, particularly during periods of high market stress, has important financial stability implications.

A key example showing the need for LMTs as a policy tool is the liquidity stress experienced by OEFs during the onset of the COVID-19 pandemic in 2020.

During that time, there was a significant deterioration of liquidity in the global fixed-income markets. The liquidity mismatch in OEFs was exacerbated by the liquidity deterioration of the underlying assets and the increase in investor redemption requests, with fixed-income OEFs typically providing daily liquidity to investors. In the case of corporate bond markets, the behavior of investors was mixed and varied by jurisdiction due to the different investment strategies and the duration of the crisis. In March 2020, at least 215 investment funds (with net assets totaling EUR73.4 billion) in the eurozone suspended redemptions, representing a quantity LMT, with most funds suspending redemptions for a few days and others suspending for longer periods, or being liquidated altogether (Grill et al. 2021). In this period, the suspensions were mainly for real estate and bond funds. These redemption suspensions show how LMTs dampened liquidity risks, with the crisis eventually abating and market functions returning to normal in the subsequent weeks.

This report investigates the exposure of funds to fire-sale risk and how different LMTs can be used to reduce losses of funds. We focus on two types of LMTs: redemption fees (an antidilution LMT), which decrease the share price at which investors redeem; and gated redemptions (a quantity LMT), which reduce the quantity of shares that investors can redeem from the fund. Our study differs from previous research in that we investigate the sensitivity of losses to OEFs across a range of different scenarios and different combinations of LMTs. While we focus on redemption fees and gated redemptions, OEFs can use a range of other LMTs to mitigate losses, which we discuss later in the report.

We use Q4 2024 data on European corporate bond funds to conduct our analysis. We focus on corporate bond funds because the systemic risk vulnerabilities of these funds have been highlighted by such organizations as the International Monetary Fund (IMF 2022). Under different LMTs, we simulate losses using empirically motivated shocks, including historical volatility during periods of market stress. We then consider how combining antidilution and quantity LMTs can dampen or exacerbate fire-sale losses for funds and investors.

We acknowledge that the model used applies a level of simplicity to the complex and interconnected events discussed. Neither this model nor any other model can offer a fully comprehensive view of the risks faced by investment funds. Nevertheless, we consider this model a valuable tool for quantifying exposures, exploring the effects of various LMTs that funds can use, and examining various scenarios that might lead to a fire sale. The real benefit of a financial risk model lies not in representing the complete “truth” but in providing a systematic framework to test sensitivities and a systematic approach to evaluate LMTs and fire sales. Our results help clarify the trade-offs among relevant stakeholders, thus making risk assessments more transparent. As George Box and Norman Draper (1987) wrote, “Essentially, all models are wrong, but some are useful.”

Background

This analysis explores how institutional common asset holdings can be exposed to losses that could eventually lead to a fire sale. Shleifer and Vishny (2011, p. 30) describe a fire sale as “a forced sale of an asset at a dislocated price,” which often occurs because institutions face constraints or are obliged to make such sales. In the case of OEFs, fire sales typically only occur when the fund needs to liquidate assets to meet a high volume of investor redemption requests in a stressed market environment. In other cases, aside from OEFs, financial institutions may sell assets to meet regulatory requirements on leverage and liquidity, to manage counterparty risks, or to meet margin or collateral requirements. Furthermore, the scale of fire-sale losses can be large because it is not just one type of financial institution acting alone that causes these price dislocations. Rather, it is the collective behavior of various institutions with their own objectives engaging in fire sales that can significantly distort prices and result in additional rounds of selling.

Fire-sale risk is also concerning due to the nonlinear nature of losses. The initial decline in prices can prompt asset sales by financial institutions. These sales can then create a feedback loop of declining prices and asset sales, where after multiple rounds, total losses far exceed the initial losses. Brunnermeier and Pedersen (2009) emphasize the nonlinearity of fire sales, introducing the concept of a liquidity spiral—where downturns reinforce reductions in both market liquidity (the ability to transact an asset without significant price impact) and funding liquidity (the capacity to obtain financing). Their analysis was important in explaining the scale of losses observed during the 2008 financial crisis, in which fire sales contributed significantly to the financial system’s dysfunction.

Some argue that fire-sale risk may be less severe because of capital arbitrage. This refers to certain institutions acting as arbitrageurs, purchasing undervalued assets during fire sales and thereby establishing a price floor. As discussed by Shleifer and Vishny (1992) and Allen and Gale (1994), such arbitrageurs would reduce fire-sale risk and would benefit as prices of these assets recover following the crisis. However, this viewpoint assumes there will be a group of financial institutions that can withstand fire-sale losses and would act as bidders for these discounted assets. The 2008 financial crisis showed that even well-capitalized institutions—for example, banks, money market funds, and hedge funds—were either directly exposed to or affected by liability demands, leading to asset sales and fire-sale losses. The potential for widespread exposure to fire sales in future scenarios may leave few institutions positioned to provide liquidity support, posing significant financial risks.

Literature Review

We consider a systems-based methodology to model fire-sale dynamics where we account for the spillover effect of institutions' asset sales. Related studies include Greenwood et al. (2015) and Duarte and Eisenbach (2021), who introduced a multiasset fire-sale mechanism focusing on banks, where asset sales are triggered through banks maintaining an assumed target leverage. While this work captures fire-sale effects, it focuses on banks and therefore does not account for the liquidity mismatch where asset sales are driven through investor redemptions. In our case, because leverage is limited for UCITS funds, it is not a major driver for fire-sale losses originating from OEFs (further detail on leverage and UCITS is provided in the Discussion section).

Addressing such limitations, Fricke and Fricke (2021) provide extensions to the model introduced by Greenwood et al. (2015). Fricke and Fricke (2021) account for the flow-to-performance relationship between a market shock and investor redemptions that can result in funding shocks for an investment fund. Additionally, the work by Sydow et al. (2024) develops a stress-testing model that accounts for the spillover in fire-sale losses between banks and investment funds. The channels of transmission between banks and investment funds can lead to higher losses compared with modeling each group in isolation. In this regard, the fire-sale models of Fricke and Fricke (2021) and Sydow et al. (2024) are more suitable for assessing the risk of investment funds relative to the bank-focused models of Greenwood et al. (2015) and Duarte and Eisenbach (2021).

Our work mainly builds on the Capponi et al. (2024) model, which is a system-based model that accounts for the structure of OEFs. The model uses a multiasset fire-sale mechanism, specific for investment funds, that is an extension of the work by Capponi et al. (2020). Capponi et al. (2024) used historical data on US mutual funds, including a broad range of equity, bond, and other assets between 2010 and 2022, and found sizable spillover effects across investment funds. Further, the dynamics from the Capponi et al. (2024) model capture the nonlinear nature of fire sales, where losses can be sizable, as highlighted by Brunnermeier and Pedersen (2009).

We use the Capponi et al. (2024) model as the baseline but extend their analysis in two ways. First, we examine losses for both funds and investors, which allows us to assess how reducing fund losses via LMTs can increase the liquidity costs borne by redeeming investors. This portrays the impact of LMTs that are not captured by Capponi et al. (2024). Second, we evaluate outcomes when multiple LMTs are used at the same time. We consider funds that can use multiple LMTs because this reflects how funds are likely to operate in stressed conditions. This analysis also helps show whether combining LMTs materially reduces fund losses or mainly increases the liquidity costs imposed on redeeming investors.

Other work on liquidity stress testing for investment funds includes a report by the European Securities and Markets Authority (ESMA) that provides an

overview of ESMA's stress simulation (STRESI) framework (ESMA 2019).¹ The report includes a case study with 6,000 UCITS bond funds covering a range of EU countries. This report found that most funds were resilient to the redemption shock, having enough liquid assets to meet redemptions. However, funds with less liquid assets, including emerging market-focused funds and high-yield bond funds, were more vulnerable. Our work also focuses on bond OEFs but differs from ESMA (2019) in that we account for LMTs. We believe the inclusion of LMTs is important as part of a stress-testing analysis because LMTs represent one of the main ways in which funds can reduce fire-sale losses.

Coudert and Salakhova (2020) studied the effect of investor withdrawals from mutual funds on the French corporate bond market. They found that between 2011 and 2017, net fund flows asymmetrically affected bond yields to maturity, and with large bond holdings, the price effect of asset liquidation from funds could be large. Following Coudert and Salakhova (2020), we account for price impact effects in the fire-sale model. The sensitivity of asset prices to selling pressure can generate fund losses that can exceed those caused by the initial market shock, underscoring the importance of LMTs.

Our study focuses on European corporate bond funds as a potential source of systemic risk because of the relative illiquidity of assets held by these funds that offer daily redemptions for investors. The risk of corporate bond funds has been investigated in other stress-testing research, such as that of Baranova et al. (2017), who showed that fixed-income instruments can be a source of liquidity risk because of the need for market dealers to facilitate buyers and sellers. Such market intermediation can be challenging in periods of market stress, where dysfunction can occur and liquidity can dry up.

Liquidity risks were observed during the COVID-19 pandemic. Lewrick and Claessens (2022) studied corporate bond funds in Luxembourg during this period and found that market relief by central banks mitigated the buildup of risks for investment funds. However, interventions can be unsustainable if funds assume that such support is always available, which can present a moral hazard. With LMTs, large-scale policy interventions can be avoided because the liquidity risks are fully passed on to the fund and redeeming investors. Hence, our study explores the extent of losses incurred by corporate bond funds and whether LMTs are sufficient to mitigate such losses.

Overview of International Regulation Pertaining to LMTs

We highlight the key recent developments in and debates surrounding LMTs for investment funds in Europe, the United States, and the United Kingdom, as well as for such international organizations as the Financial Stability Board

¹ The STRESI framework is a simulation-based approach that combines micro and macro prudential objectives. It provides two outputs: an assessment of the resilience of the investment fund sector, and the impact of an adverse scenario on the fund sector and potential spillovers to the financial system (ESMA 2019).

and IOSCO. While the discussion for each jurisdiction is nuanced, there is an emphasis on adopting a range of LMTs, improving data transparency, and standardizing regulation in using LMTs to strengthen market resilience.

Europe

The European Commission enforced the Alternative Investment Fund Manager Directive II (AIFMD II) on 15 April 2024 with significant amendments to the original AIFMD (Directive 2011/61/EU) framework (European Union 2024). Under the revised liquidity management provisions, fund managers must select two liquidity management tools based on the investment strategy, liquidity profile, and redemption policy of the alternative investment fund. Managers can choose from the nine available tools presented in Annex V of the directive; however, that selection cannot include only swing and dual pricing.

On 8 July 2024, ESMA released consultation papers on the proposed draft guidelines on liquidity management tools² and draft regulatory technical standards on LMTs.³ First, the guidelines emphasized that the primary responsibility for liquidity risk management, including the selection, calibration, activation, and deactivation of LMTs, lies with the fund manager. Second, alternative investment fund managers should select a minimum mandatory number of LMTs from Annex V and consider the merit of selecting at least one quantitative-based LMT and one antidilution tool. They should also consider key factors including but not limited to the fund's legal structure, its investment strategy and policy, fund terms, the liquidity profile of the fund and its underlying assets, and results of liquidity stress testing. Overall, these standards aim to harmonize the use of LMTs across the European Union while ensuring that fund managers are equipped to manage liquidity risks, contributing to financial stability and investor protection.

A dichotomy exists in how managers are expected to interpret guidelines inherently aiming at balancing investor protection (a market conduct consideration) and the financial stability of markets at large (a prudential risk consideration). Assigning primary responsibility to managers for liquidity risk management is an attempt to resolve this difficulty, including a requirement for an analysis of the merits of LMTs to be conducted by the manager.

United States

In 2016, the Securities and Exchange Commission (SEC) adopted new rules and forms under the Investment Company Act of 1940 to reduce the risk of funds being unable to meet redemption obligations and mitigate antidilution of the interests of shareholders. These included the requirement for open-end

²www.esma.europa.eu/document/consultation-paper-guidelines-liquidity-management-tools-ucits-and-open-ended-aifs.

³www.esma.europa.eu/document/consultation-paper-draft-regulatory-technical-standards-liquidity-management-tools-under.

management investment companies, including open-end exchange-traded funds (ETFs), to establish a liquidity risk management program and enhance disclosure requirements around fund liquidity and redemption practices (SEC 2016). In 2022, the SEC proposed further amendments regarding liquidity risk management programs and swing pricing to improve liquidity risk management, prepare funds for stressed conditions, and ensure transparency in liquidity classifications.

In 2024, the SEC released guidance on open-end liquidity risk management programs, which led to amendments and changes to filing frequency and increased information on liquidity service providers, including their identifying information and any affiliations with the fund or investment adviser (SEC 2024). The change in regulation on managing liquidity risk for investment funds shows the active conversation in the United States regarding the increased use of LMTs and data collection to improve risk management and supervision.

United Kingdom

The Bank of England's Financial Policy Committee (FPC), in its December 2019 Financial Stability Report, recognized "first-mover advantage" due to the mismatch between redemption terms and the liquidity of fund assets, giving investors an incentive to redeem ahead of others, particularly in periods of stress (Bank of England 2019). It assessed that the first-mover advantage could become a systemic risk issue through forced asset sales that could cause stress to other parts of the system. The FPC established that there should be greater consistency between the liquidity of a fund's assets and redemption terms, based on the time needed to liquidate a given volume of assets, thereby mitigating the incentive to redeem from a fund ahead of other investors.

In August 2020, the Bank of England and the Financial Conduct Authority (FCA) launched a survey to review the vulnerabilities associated with the liquidity mismatch of open-end funds with a reporting period from Q4 2019 to Q2 2020 (Bank of England 2021). The survey received responses from 272 authorized funds holding less liquid assets, including corporate bond funds, mixed bond funds, and several small- and mid-cap equity funds. The survey shows that funds predominantly used swing pricing as an LMT and intensified the use of swing pricing during the onset of the COVID-19 market shock, with large variations in how swing pricing was applied. The same survey found that funds also managed their liquidity by holding liquidity buffers in cash and noncash liquid assets.

International

In 2017, the Financial Stability Board (FSB) published policy recommendations to address four structural vulnerabilities arising from asset management that could present financial stability risks: liquidity mismatch of fund investments and redemptions, leverage within investment funds, operational risk under stressed conditions, and securities lending activities of asset managers and

funds (FSB 2017). This report highlighted nine policy recommendations to address the liquidity mismatch and asked IOSCO to review its current guidance. Subsequently, IOSCO reviewed its 2013 liquidity risk management standards and suggested further recommendations, including more detailed guidance on greater and consistent use of antidilution liquidity management tools in normal and stressed conditions.

In 2023, the FSB revised its 2017 recommendations to address vulnerabilities observed during the COVID-19 pandemic and set out its policy recommendations (FSB 2023). A key recommendation was the increased use of liquidity management tools—specifically, antidilution tools—to mitigate potential first-mover advantage. In 2025, IOSCO, following the FSB in its work program, finalized its revised recommendations (IOSCO 2024b) and implementation guidance (IOSCO 2024a) to enhance the resilience of collective investment schemes.

Summary

The policy debate on liquidity risk is not settled but has moved from the formal availability of LMTs to their effective use, calibration, and supervision in practice. Regulators remain concerned that liquidity mismatch in open-end funds can still generate first-mover advantage, investor dilution, and procyclical selling. In the EU, the LMT regime is now being operationalized through binding delegated regulations that applied beginning in April 2026. In the United Kingdom, the FCA is still consulting on stronger antidilution and liquidity risk management requirements,⁴ and the Bank of England's FPC has recently reiterated that liquidity mismatch in open-end funds remains a key market-based finance vulnerability (Bank of England 2026). Recent stress in less liquid asset classes also continues to test the framework, with the FSB noting that open-end property funds have faced significant redemption requests in recent years, leading to gates or suspensions (FSB 2025), and warning that private credit raises concerns around liquidity mismatch, leverage, data gaps, and retail access (FSB 2026).

⁴The FCA (2026) has published Policy Statement 26/17, which finalized the proposals in Consultation Paper 25/38. The final framework requires UK UCITS and non-UCITS retail scheme managers to have appropriate antidilution mechanisms available, while preserving managerial discretion over their activation and calibration.

METHODOLOGY

We evaluate fund losses under stressed redemptions using the model of Capponi et al. (2024). A fire sale can occur if a large quantity of assets is sold by funds to meet the redemption requests of investors demanding liquidity. Such forced selling can spill over to other funds because of the pricing dislocations that mark down the value of common assets. Further liquidity demands can trigger further rounds of asset sales that can cause stress to the financial system.⁵ The stressed redemption mechanism is shown in **Exhibit 1**.

We outline the model as follows:

- An initial shock to asset prices leads to initial losses for funds. The market dislocation of asset prices increases market volatility and decreases market liquidity. Decreasing asset prices decrease the fund's share price (NAV per share, which is defined as total assets minus total liabilities, divided by the fund's outstanding shares). Investors observe the fall in the fund's share price from the initial shock and respond by redeeming shares. The size of redemptions is determined by the fund's total net assets and a flow-to-performance parameter, which assumes a larger shock leads to a larger quantity of redemptions.

The *flow-to-performance* parameter represents the proportion of the fund's net asset value that investors redeem for a given market shock. For example, assume the fund has a price of USD100 NAV per share and 1 million outstanding shares, for a market capitalization of USD100 million. If we assume that the initial shock equals a 5% reduction in the value of the fund's total net assets and that the flow-to-performance parameter is 0.5, then investors will redeem USD2.5 million in total net assets from the fund ($\text{USD100 million} \times 5\% \times 0.5$). Values less than 1 imply that the percentage of NAV redeemed is less than the size of the initial shock, while values greater than 1 imply that investor redemptions are highly elastic to the initial shock. We assume investors will redeem due to the initial shock as a response to the continuing risks of leaving their capital in the fund, which could deteriorate.⁶

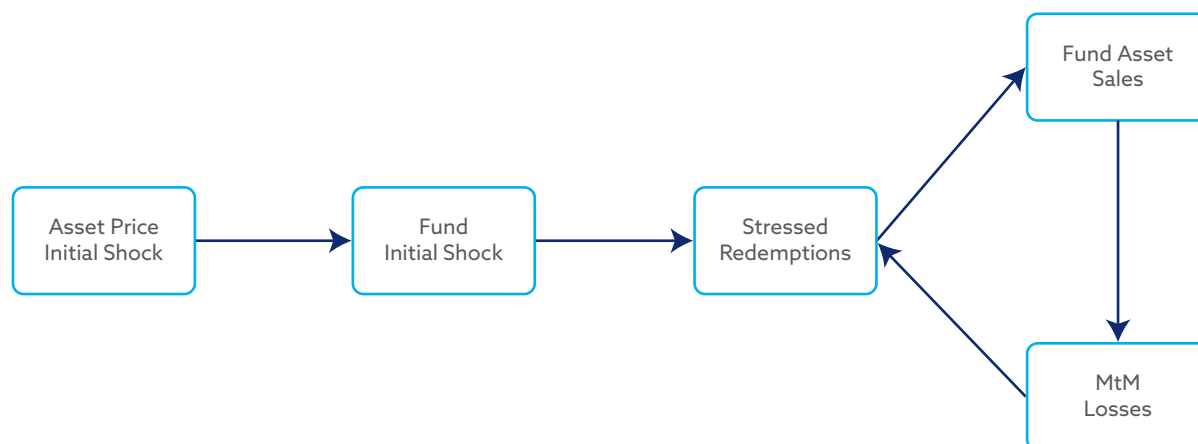
- Funds meet investors' redemptions through the proportional sale of their asset holdings, such that they strive to maintain their liquidity ratio and portfolio weights.⁷ Funds sell assets based on valuations that account

⁵For further detail on the model and the calculation methodology of fund losses, please use the following email: raymond.pang@cfa institute.org.

⁶From the fire-sale model, each fund has one associated flow-to-performance parameter across all shocks. However, we recognize that flow-to-performance parameters are nonlinear and can vary depending on the size of the shock—that is, investors in a fund may be more elastic to high-magnitude shocks than small-magnitude shocks. Future work can extend the model to account for nonlinear flow-to-performance changes based on the initial market shock.

⁷While we have chosen a proportional selling approach, other strategies could also be considered—for example, using cash holdings first or a waterfall approach selling the most liquid assets to meet investor redemptions. The proportional approach seeks to avoid deviating materially from target portfolio weights and uphold investment concentration rules.

Exhibit 1. Stylized Diagram of the Stressed Redemption Mechanism That Incorporates Fire Sales



for the initial shock. The collective assets sold across all funds trigger a price impact, which represents the change in the price of a given asset based on the quantity sold. The price impact results in mark-to-market losses for all funds that commonly hold this asset.⁸

Under this model, there can be multiple rounds of investor redemptions, resulting in asset sales and MtM losses in a procyclical manner. In our study, we consider only one round of sales, which reflects a large proportion of losses funds are exposed to. This is based on the magnitude of shocks considered and empirical estimates of the price impact. Additional rounds of sales could be simulated depending on the data and parameters used in the analysis. Based on the mechanism in Exhibit 1, we introduce one antidilution LMT and one quantity LMT that funds can use to reduce the liquidity stress that funds are exposed to. Antidilution LMTs decrease the share price at which investors redeem, and quantity LMTs decrease the quantity of investor redemptions. Funds may choose to apply different LMTs, in isolation or in combination, depending on their expected impact under stressed redemptions.

Specifically, we include the following LMTs:

- *Redemption fees* represent an antidilution LMT, where a fixed cost is applied to the share price of investor redemptions. Specifically, we use a 2% fee on the share price. Such fees are used to account for the liquidity and transaction costs incurred by the fund to meet investor redemption requests. In addition, redemption fees can serve as a deterrent to investors choosing to redeem a large quantity of shares in periods of stress.

⁸We do not account for short-selling or external buys of discounted asset prices. Note that such extensions could be considered in the model.

- *Gated redemptions* reduce the proportion of shares investors can redeem, at most 5% of fund NAV in any given redemption window. By imposing such restrictions, gated redemptions help mitigate fund losses by limiting the total value of shares that can be withdrawn from a fund. This limit on redemptions correspondingly lowers the volume of assets a fund must liquidate, thereby diminishing the impact of fire-sale dynamics.

Note that there are additional LMTs available to funds that are not included in the scope of this analysis, such as swing pricing, redemption in-kind, dual pricing, and cash buffers. For further details, the appendix includes a table that outlines a range of LMTs used by funds. Later, we will discuss the implications of using other LMTs and how it can affect funds and investors in a market stress scenario.

DATA

We take the universe of actively managed UCITS corporate bond funds domiciled in Europe from the LSEG Lipper database during December 2024. Because we use empirical price impact values for assets measured in US dollars, for consistency with the data, we also denote fund asset holdings and subsequent losses in US dollars. We exclude funds with less than USD5 million in total net assets and funds with missing or unclassified holdings data. This results in a sample of 668 corporate bond funds, with total net assets of USD316 billion and an average fund net asset value of USD473 million.

We include corporate bond funds domiciled in the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Liechtenstein, Luxembourg, Netherlands, Norway, Spain, and Sweden. The countries with the largest concentration of corporate bond funds are Luxembourg (51.2%), Ireland (10.18%), and France (8.53%), which are the largest European fund domiciles. We focus on corporate bond funds because these funds allow daily redemptions while holding less liquid assets that trade infrequently (often less than weekly or monthly after issuance). In addition, our focus on corporate bond funds is aligned with the discussion regarding financial stability and systemic risk by regulators, such as ESMA (2024b) and the Bank of England (2021).

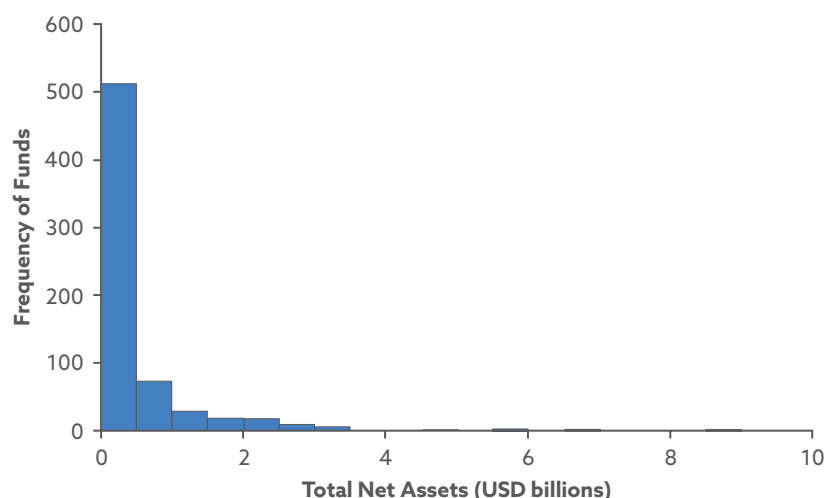
Exhibit 2 is a histogram plot of corporate bond funds' total net assets. The distribution of total net assets shows that 513 funds have total net assets between USD0 and USD500 million, representing 77% of total funds in the data. Most of the remaining funds have total net assets between USD500 million and USD4 billion, and only a few have total net assets above USD6 billion. Overall, the histogram shows a relatively high level of homogeneity in fund size, reflecting the extent of fund market fragmentation in Europe.

Exhibit 3 shows the breakdown of the asset holdings of funds in ten aggregate asset classes: asset-backed securities (ABS), cash and cash equivalents (including commercial deposits, money market funds, and commercial paper), common stocks, government bonds, high-yield corporate bonds, investment-grade corporate bonds, mortgage-backed securities (MBS), municipal bonds, other securities, and preferred stocks.⁹ Other securities include futures, ETFs, commodities, other equities, and other fixed income not classified under the main categories. We chose to aggregate assets into these categories to account for the commonality in assets between funds.¹⁰ The largest asset holding is corporate bonds, as expected. Across both high-yield and investment-grade securities, funds hold on average 87% of total net assets in corporate bonds. Other prevalent asset holdings include government bonds and other securities,

⁹ We classify high-yield and investment-grade corporate bonds under the Moody's classification ratings, assuming ratings higher than Baa3 are investment grade, with anything below being high yield.

¹⁰ Other levels of aggregation for assets could also be considered—for example, at a country, credit-rating, or sector level.

Exhibit 2. Histogram of Corporate Bond Funds' Total Net Assets



Source: Data for Exhibits 2–9 from LSEG Lipper.

Exhibit 3. Data on the Asset Holdings of Corporate Bond Funds

Asset Class	Fund Total Net Assets (USD mn)	Number of Funds	Average Fund Holding (%)	Price Impact (USD1 bn)
Asset-Backed Securities	9.8	8	0.00	0.5 bps
Cash and Cash Equivalents	7,783.7	551	2.48	0.0 bps
Common Stocks	329.5	56	0.27	2.8 bps
Government Bonds	12,789.0	376	3.42	0.3 bps
High-Yield Corporate Bonds	66,475.2	654	26.59	22.3 bps
Investment-Grade Corporate Bonds	207,411.2	655	60.25	7.7 bps
Mortgage-Backed Securities	4.7	9	0.00	0.5 bps
Municipal Bonds	319.1	39	0.07	14.5 bps
Other Securities	20,475.2	667	6.71	0.0 bps
Preferred Stocks	655.6	124	0.20	2.8 bps

which represent on average 10% of funds' total net assets, with holdings in cash and cash equivalents equaling 2.48%.

Asset classes could be made more granular by accounting for bond duration to derive shocks based on interest rate sensitivity. In the stress testing conducted by Karimalis et al. (2017), they consider European sovereign bonds using the Nelson–Siegel factor-based model. This model decomposes the yield into several factors, each describing a different aspect of the yield curve. However, the empirical price

impact associated with bonds based on maturity has not been covered in the fire-sale modeling literature and could be explored in future research.

We display the empirical values of the associated price impact for each asset in Exhibit 3. We use empirical estimates by Bouveret and Yu (2021), which represent price impacts during the 2008 financial crisis. Price impact values in Exhibit 3 represent the change in asset price per USD1 billion in asset sales across all funds. We consider price impacts for all asset classes except for cash and other securities, where we assume no price impact.¹¹ Because price impacts are not uniquely determined and vary under a time-varying distribution, we chose price impacts where market prices are sensitive to asset sales during a period of stress.¹²

In Exhibit 3, the empirical values show that fixed-income instruments have the highest price impact; these assets are less frequently traded compared to more liquid asset classes. The illiquidity of corporate bonds, particularly high-yield corporate bonds, could result in potentially large fire-sale losses for funds that hold the asset class under stressed redemptions.

For the flow-to-performance parameter, we follow the empirical work of Goldstein et al. (2017) and set the parameter for all corporate bond funds at 0.859. The model calibration from Goldstein et al. (2017) uses an econometric approach and is based on monthly US corporate bond mutual fund holding data covering January 1992 to December 2014. In total, the final sample contains 1,660 unique corporate bond funds. Estimates by Goldstein et al. (2017) for corporate bond funds show that flow-to-performance is concave, with funds being more sensitive to outflows from bad fund performance than to inflows from good fund performance. We assume a homogeneous flow-to-performance parameter across all funds to account for the sensitivity of outflows during a widespread market shock.

For the remainder of the analysis, we consider only the empirical flow-to-performance value; note that changes in fund losses and investor liquidity are linearly related to the flow-to-performance parameter.¹³ Alternatively, a heterogeneous approach to estimating the flow-to-performance parameter could be considered using the historical data on fund NAV, which could account for idiosyncratic risks. However, under this approach, the fund's flow-to-performance parameter may reflect only the specific period of the data, not necessarily periods of stress outside the sample period that can affect all funds.

¹¹ In cases where the aggregated asset classes differ from those in Bouveret and Yu (2021), we use the closest or a conservative value associated with the asset. For example, for government bonds, US Treasury bonds are used as the estimated price impact.

¹² Note that other price impact estimates could be used for this analysis. For assessing fire-sale risk, Cont and Schaanning (2017) consider a price impact function that accounts for the average daily volume of traded assets divided by the asset volatility.

¹³ As with the price impact calibration, the flow-to-performance parameter should be interpreted as one possible value for the model. Alternative calibrations could produce different values, particularly if the estimation focused only on periods of market stress, when investor redemptions may be more sensitive to fund performance. These alternative flow-to-performance estimates could also be incorporated into the analysis as sensitivity checks.

RESULTS

We simulate fund losses under a value-at-risk (VaR) approach. For VaR, we assume an initial shock to funds' asset holdings of 5%. We then add a volatility component to the shock that is computed as the standard deviation of daily price returns of assets during Q4 2024. We use ETFs associated with each asset class in Exhibit 3 (except cash and other securities), respectively, to estimate the volatility of assets. Assuming price returns are normally distributed, we multiply the daily volatility by a z-score, using a 99% confidence interval.¹⁴

The quantity LMT (gated redemptions) is set at 5%, such that investors can only redeem a maximum proportion of shares equal to 5% of the fund's NAV in a given redemption window. For example, assume the magnitude of the initial shock with the flow-to-performance parameter equals a redemption size of 10% of the fund's NAV. Then, assuming a gated redemption limit of 5%, this would restrict the redemption size in that given fund to 5% (the maximum) of the fund NAV. With gated redemptions, the smaller the gated redemption limit, the smaller the size of investor redemptions as a proportion of the fund's NAV and, correspondingly, the smaller the subsequent price impact and MtM losses. By extension, a maximum redemption of 0% would correspond to a suspension, where no shares can be redeemed, resulting in no fire sales.

For the antidilution LMT, we apply a 2% fee on the total shares redeemed by investors.¹⁵ For example, assume investor redemptions totaled USD100 million in total net assets. Then, a 2% redemption fee would decrease the total redemption size to USD98 million in total net assets.

In our analysis, we consider two shock scenarios. The first is calibrated to asset volatility in Q4 2024, which coincides with the period covered by the fund data. The second is calibrated to asset volatility in Q3 2022, corresponding to the period of the UK LDI crisis, which represented a widespread market disruption across fixed-income assets. Considering both scenarios allows us to compare asset volatility under the tailed distribution of relatively normal market conditions, represented by Q4 2024, with volatility during a more severe stress episode, represented by September 2022. This comparison provides a basis for assessing fund losses under different market conditions and how effective LMTs are in reducing such losses.

¹⁴ We follow an approach similar to that of Capponi et al. (2024) in which we use ETFs representing global market movements (or a US alternative if not available) to model daily volatility for VaR in each asset class: the iShares MSCI ACWI ETF for common and preferred stocks; the iShares Global Govt Bond UCITS ETF (IGLO) for government bonds; the iShares US & Intl High Yield Corp Bond ETF (GHYG) for high-yield corporate bonds; the iShares Core Global Aggregate Bond UCITS ETF (AGGG), which includes not only investment-grade corporate bonds but also other types of investment-grade instruments; the iShares National Muni Bond ETF (MUB) for municipal bonds; and the iShares MBS ETF (MBB) for asset-backed and mortgage-backed-securities.

¹⁵ The 2% redemption fee is an upper limit set by the SEC that may be applied during periods of market stress (see www.investor.gov/introduction-investing/investing-basics/glossary/redemption-fee). However, redemption limits may vary depending on the jurisdiction and limits set by the fund.

Q4 2024 Shock

We display the simulated initial shock to asset classes in **Exhibit 4**, which shows the magnitude of the initial shock to each asset class, based on the Q4 2024 data.

Our results show that the size of the initial shock is similar across all noncash asset classes. We find a 1% deviation between the asset classes with the largest and smallest daily volatility. There are distinctions between asset classes, including the higher volatility for common and preferred stocks relative to high-yield and investment-grade corporate bonds.¹⁶

Exhibit 4 includes a table of values of initial shocks to assets and a histogram that represents the initial shock at the fund level. For example, if the fund holds 50% in investment-grade (IG) corporate bonds and 50% in high-yield (HY) corporate bonds, the initial shock to IG corporate bonds is 5.9%, and the initial shock to HY corporate bonds is 5.8%; then, the fund is exposed to an initial shock of 5.85% ($= 0.5 \times 5.90\% + 0.5 \times 5.80\%$). Exhibit 4 shows that a large proportion of funds have a similar initial shock in Q4 2024. This finding results from the similarity of funds in terms of their asset holdings, which are mainly corporate bonds (approximately 87%, as noted earlier).

Exhibit 5 displays investor liquidity, representing the total value of investor redemptions across all funds; total fund losses, representing the total losses funds incur, which is equal to the initial market shock and the MtM losses from asset sales; and total MtM fund losses, representing fund losses that arise only from the price impact effect from asset sales.

Exhibit 5 demonstrates that total fund losses remain close to USD20 billion across the sample (6.3% of total sample assets under management), regardless of whether LMTs are applied. Moreover, the total MtM fund losses are small, amounting to less than 10% of funds' total losses, indicating that the fire-sale effect is minimal and would not lead to significant financial system stress. Note that these results are based on the sample dataset, parameter choices, and one round of redemptions. Including other institutions (aside from OEFs) with common asset holdings could lead to greater MtM losses for corporate bond funds.

Comparing the LMTs used, we find that redemption fees reduce investor liquidity from USD14.6 billion to USD14.3 billion, reflecting the 2% antidilution fee. In contrast, gated redemptions result in a smaller reduction of liquidity to USD14.56 billion, representing a marginal 0.2% decrease. The small decrease in

¹⁶ Using a representative ETF to calculate the daily volatility of asset classes can lead to variations in values—for example, volatility for government bonds is higher than that for high-yield and investment-grade corporate bonds, where one would expect it to be lower to account for the credit risk premium. Different methods can be used to represent the volatility of different asset classes, which one can consider for different shocks. Additionally, the time horizon for which the daily volatility is calculated can affect values, which could be investigated over one year (instead of quarterly).

Exhibit 4. Q4 2024 Initial Shock and Distribution of Initial Fund Losses

A. Initial Shock by Asset Class			
ABS	5.9%	IG Corporate	5.9%
Cash	0%	MBS	5.9%
Common Stocks	6.6%	Municipal Bonds	5.7%
Government Bonds	6.0%	Other Securities	5.0%
HY Corporate	5.8%	Preferred Stocks	6.6%

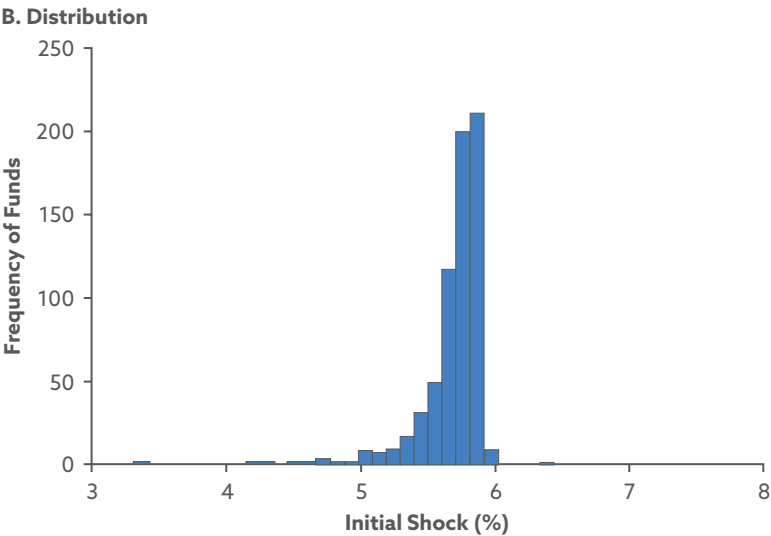
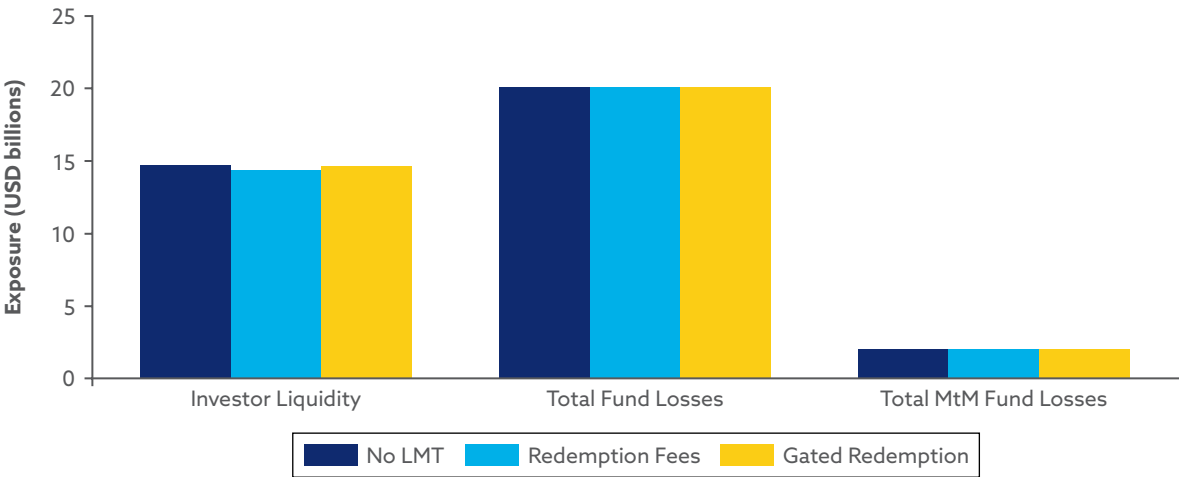


Exhibit 5. Investor Liquidity and Total Fund Losses Under a Q4 2024 Shock for Different LMTs



investor liquidity under gated redemptions is a result of the fact that most funds are exposed to an initial shock of less than 5% (after accounting for the flow-to-performance parameter). Specifically, under the model, gated redemptions are triggered if the initial shock, scaled by the flow-to-performance parameter, is above the gated redemption limit. Because we assume gated redemptions are capped at 5% for all funds, we can calculate the size of the initial shock that would trigger gated redemptions.

The shock that triggers gated redemptions is equal to the gated redemption limit divided by the flow-to-performance parameter. Given that the gated redemption limit is 5% and the assumed flow-to-performance parameter is 0.859, funds need to be exposed to an initial shock of 5.82% or higher for gated redemptions to be triggered. From the histogram in Exhibit 4, we find only a small number of funds are exposed to a shock greater than this threshold. The small number of funds that trigger a gated redemption means that under this scenario, investor redemptions, whether gated redemptions are implemented or not, are similar for all funds. And therefore, for the corresponding metrics, investor liquidity and total fund losses remain similar.

Liability-Driven Investment Crisis

In this section, we consider a scenario based on the volatility of price returns during the UK liability-driven investment (LDI) crisis in September 2022. Although the funds in our sample are European corporate bond funds rather than UK LDI funds, this episode provides a useful market-wide stress calibration because it captures a period in which volatility and liquidity pressures in fixed-income assets were significantly higher than normal.

ESMA (2026) details the role of funds that are domiciled in the EU, holding British pound assets using LDI strategies in the September 2022 episode. While the report concludes that the ability of LDI funds to meet liquidity demands has improved since September 2022, they may still face liquidity pressures if exposed to large enough interest rate shocks.

Here, we apply our redemption model to examine the extent of corporate bond fund losses under a type of scenario equivalent to this historical event.

As before, we use a VaR approach, with an initial shock magnitude of 5% and a volatility component under a 99% confidence interval. However, we use the daily volatility based on asset price returns during the LDI crisis of Q3 2022.¹⁷ This LDI crisis occurred after the UK “mini budget” in September 2022. As described by Alexander et al. (2023), the fiscal policies announced by the government sharply decreased the value of gilts. This impact was observed in 30-year gilts, where the fall in price sent the yield up by 130 bps. Government bond yield changes represented a yield move three times larger than any historical event over the same period. Because LDI funds were particularly exposed, the decrease in gilt

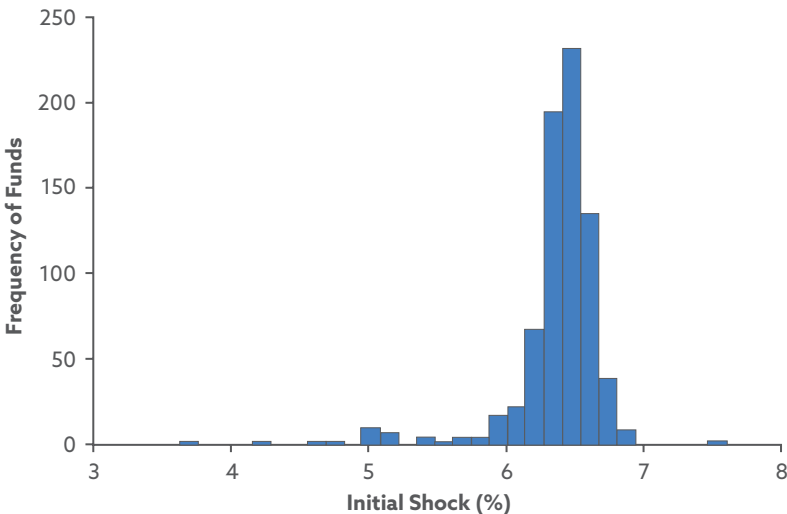
¹⁷ We calculate the daily volatility for each asset class between 1 July 2022 and 30 September 2022.

Exhibit 6. LDI-Type Event Initial Shock (Q3 2022) and Distribution of Initial Fund Losses

A. Initial Shock by Asset Class

ABS	6.4%	IG Corporate	6.5%
Cash	0%	MBS	6.4%
Common Stocks	8.0%	Municipal Bonds	5.7%
Government Bonds	6.5%	Other Securities	5.0%
HY Corporate	7.0%	Preferred Stocks	8.0%

B. Distribution



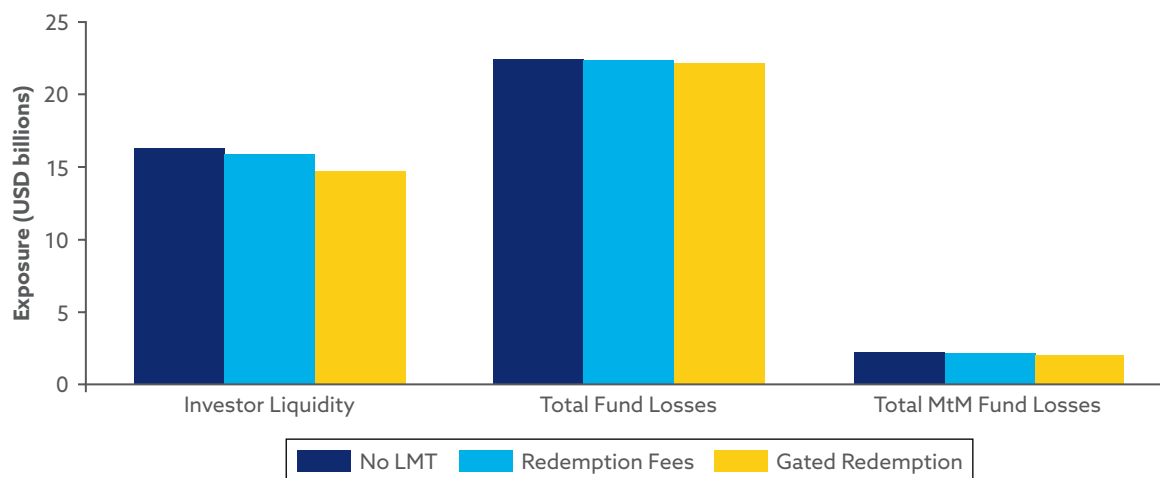
prices increased their leverage ratios, which strained the ability of funds to meet margin calls in derivative positions. LDI funds responded by selling massive gilt holdings, further depreciating prices and increasing market illiquidity. This volatility required the Bank of England to intervene to mitigate a potential spiral of financial instability. While European corporate bond funds were less exposed to the economic shock, it did impact international financial market conditions.

Exhibit 6 shows the initial shock to asset classes based on the daily volatility during the LDI crisis and an associated histogram representing the initial shock to funds. Values during the LDI crisis for the initial shock to assets and the fund are calculated in the same way as for the Q4 2024 shock. We assume all other parameters, including the flow-to-performance parameters and price impact values, remain the same.

Our results show that volatility was higher for most asset classes relative to Q4 2024.¹⁸

¹⁸ The shock is similar for municipal bonds because the estimates are based on US bonds, representing the largest market for municipal bonds.

Exhibit 7. Investor Liquidity and Total Fund Losses Under an LDI-Type Market Shock for Different LMTs



As shown in Exhibit 6, the majority of funds experience an initial shock of between 6% and 7% of net asset value. The grouping of funds within a relatively tight range for the initial shock is a result of the similarity of asset holdings across funds—that is, corporate bonds. Because the volatility of assets under the LDI event is higher, it leads to a higher initial shock to assets and a subsequent higher initial shock to funds than in Q4 2024.

Exhibit 7 shows investor liquidity, total fund losses, and total MtM fund losses assuming an LDI-type scenario as the initial shock. For LMTs, as in Exhibit 5, we assume a redemption fee of 2% and a gated redemption equal to 5% of the fund NAV.

Our results show that investor liquidity declines from USD16.2 billion in redemptions when no LMT is used to USD14.7 billion when gated redemptions are used, representing a 9% reduction in liquidity. In contrast, the use of redemption fees leads to a smaller decrease in investor liquidity of 2% (equating to the redemption fee), resulting in redemptions of USD15.9 billion.

The greater reduction in investor liquidity under gated redemptions reflects the higher initial shock experienced by funds in the LDI-type scenario compared to the Q4 2024 scenario. Specifically, the majority of funds experience an initial shock of close to 6.5% (per Exhibit 6)—above the 5.8% threshold under which redemption gates are triggered after accounting for the flow-to-performance parameter. This reduces the accessible liquidity for investors during a stress event.

Similar to Exhibit 5, the results show that the differences in total fund losses with and without LMTs remain minimal. While total fund losses are slightly

higher with redemption fees than with gated redemptions, the decrease for both LMTs is less than 1%.

Overall, under the LDI-type scenario, we find that gated redemptions lead to a marginal reduction in total fund losses but come at the cost of a relatively larger reduction in investor liquidity. Total MtM fund losses account for less than 10% of total fund losses, a similarly small proportion as in the Q4 2024 scenario, indicating that second-round price effects from forced asset sales remain contained.

Large Shocks

In this section, we examine investor liquidity and total fund losses when the magnitude of the initial market shock is high. To do so, we vary the size of the shock while preserving the relative differences in volatility across asset classes. This allows us to assess whether LMTs become more effective, or more costly to investors, under stress levels beyond historically observed calibrations.

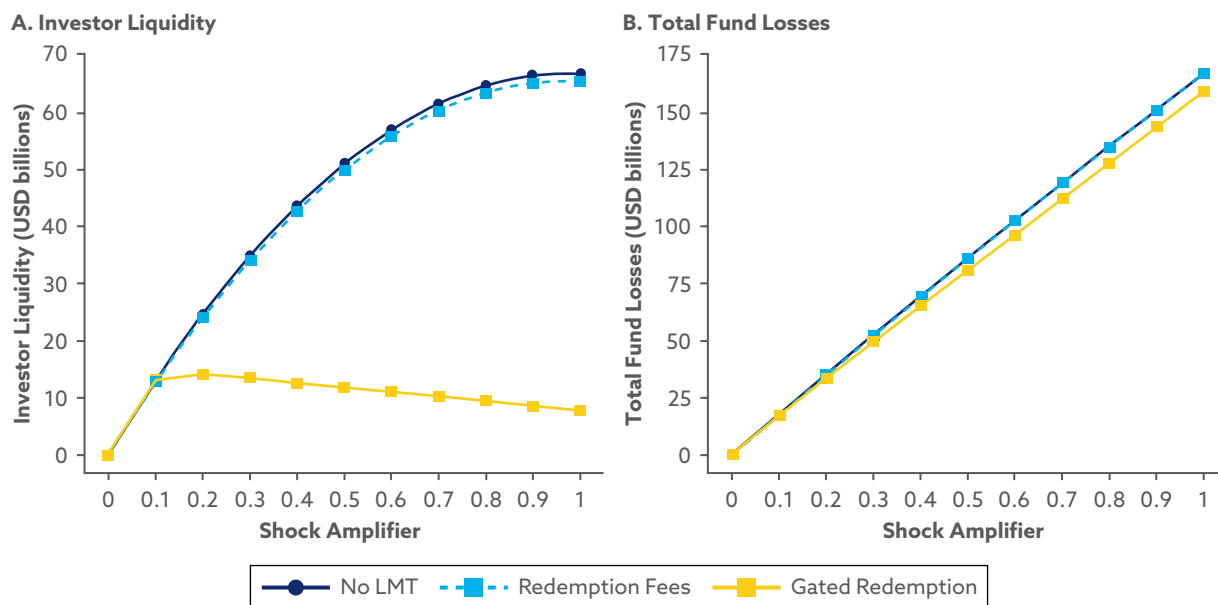
We examine a range of higher-magnitude shock scenarios, which are constructed from the relative volatility of price returns in the asset classes used in the previous sections. We scale shocks based on the relative volatility of assets to reflect that assets with typically higher volatility can experience higher shocks than less volatile assets under a stress scenario. We then scale those relative volatilities by a multiplier, which we refer to as the *shock amplifier*. The shock amplifier determines how strongly the relative volatility of each asset class translates into the initial shock applied to funds' asset holdings.

For example, assume there are four asset classes and the volatility of each asset class is equal to (0.2, 0.2, 0.1, 0), respectively. The relative volatility for each asset class is calculated as the volatility of assets divided by the maximum volatility across all assets. Based on our example (0.2, 0.2, 0.1, 0), 0.2 represents the highest volatility across all asset classes. Therefore, dividing each asset class's volatility by 0.2 gives the relative volatility of (1, 1, 0.5, 0). We then convert the relative volatility values to a shock by multiplying them by a shock amplifier. For example, if we chose a shock amplifier with magnitude of 0.5, then the initial shock would equal (0.5, 0.5, 0.25, 0). This scenario would represent a 50% initial market shock to the first and second asset classes, a 25% initial market shock to the third asset class, and a 0% shock to the fourth asset class.

In our analysis, we determine the volatility of price returns during Q4 2024 and choose shock amplifier values no greater than 1, which ensures the initial shock to any given asset is no greater than 100%. All other parameters, including the flow-to-performance parameter and price impact values, remain the same.¹⁹ Note that a shock amplifier of 1 means values are scaled such that the asset

¹⁹ We focus our scenario analysis on the first-order parameters of the market shock. This research could be extended, however, to vary the parameters of the second-round effects, such as the flow-to-performance parameter and price impact.

Exhibit 8. Investor Liquidity and Total Fund Losses Under Higher-Magnitude Shocks



with the highest relative volatility is equal to 100%, which is not the same as a 100% initial market shock for all assets. In this regard, the extent to which funds are exposed to large shocks depends on the asset price data for which relative volatility values are calculated.

Exhibit 8 illustrates investor liquidity and total fund losses across varying shock amplifiers. The relative volatility values were calculated from the volatility of daily price returns observed in Q4 2024. Shock amplifier values range from 0 to 1. The largest shock is associated with the common and preferred shares asset classes, which showed the highest volatility across all asset classes.

We depict changes in investor liquidity and total fund losses for three cases: without LMTs, when redemption fees are applied at 2%, and when gated redemptions are applied capping total redemptions at 5% of fund NAV. All other nonspecified parameters, including flow-to-performance and price impact assumptions, remain consistent with previous analyses.

From Exhibit 8, we find a significant difference in investor liquidity under a higher shock amplifier. When no LMT is applied, investor liquidity (redemption value) is around USD67 billion under a shock amplifier of 1. Under gated redemptions, however, investor liquidity is limited to only USD7.73 billion. Generally, the difference in investor liquidity between LMTs increases as the size of the initial market shock increases and becomes much more pronounced under high-order market shocks than those observed in the previous sections.

However, the difference in total fund losses with or without LMTs is smaller compared with investor liquidity. Under a shock amplifier of 1, the total fund

losses with no LMT equal USD168.8 billion. While this total is higher compared with funds applying LMTs, the difference is small (USD168.6 billion under redemption fees and USD160.7 billion under gated redemptions). Crucially, there is a small change in total fund losses whether LMTs are applied or not because the largest proportion of losses derive from the initial market shock. This is a result of the fact the price impact parameter used in the model is small relative to the total assets of corporate bond funds, which leads to limited fire-sale amplification and similar total fund losses across different LMTs.

As noted earlier, the price impact estimates are informed by Bouveret and Yu (2021), whose calibration is based on a broader set of asset holders. By contrast, our empirical application focuses only on corporate bond funds. As a result, the calibrated price impact may understate fire-sale effects that could arise within a specific segment of the investment fund sector. Although this does not change the main message regarding the allocation of liquidity costs between redeeming investors and the fund, it highlights the importance of extending the analysis to other institutions and asset holders for a holistic understanding of fire-sale effects. In a broader system-wide setting, total asset sales and the resulting price impacts may be larger, which could lead to larger total fund losses. Overall, across a range of scenarios, we find that fire-sale effects appear less consequential for total fund losses, with market shocks more pronounced for investor liquidity.

MULTIPLE LMTs

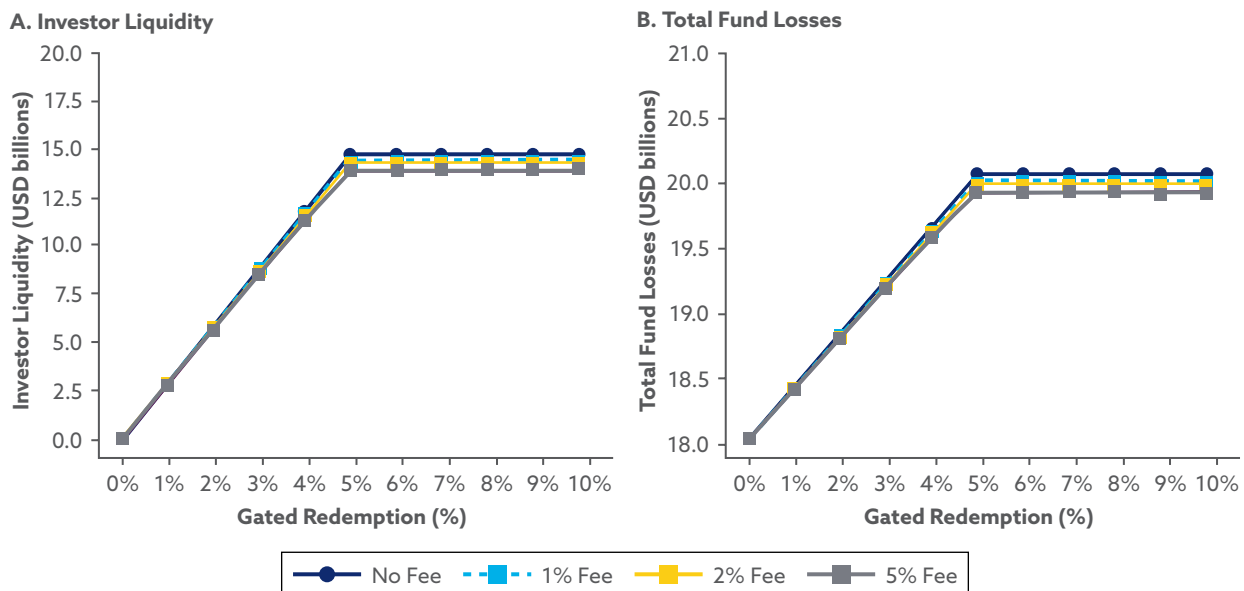
Previously, we assumed that funds only implement one type of LMT. In this section, we consider when funds can use multiple LMTs to mitigate fire-sale losses. This analysis is pertinent to the regulatory debate; as discussed previously, policy authorities, including ESMA, have proposed that funds adopt at least one tool in each LMT category.

For the following analysis, we assume that funds are exposed to an initial market shock based on the volatility distribution in Q4 2024, where other model parameters remain the same—namely, price impact and flow-to-performance.

The key issue we explore is whether the combination of redemption fees and gated redemptions applies overlapping costs to redeeming investors that outweighs the reduction in liquidity pressures for funds. This makes calibration of multiple LMTs important to ensure LMTs reduce fire sales without unnecessarily restricting investor access to liquidity. **Exhibit 9** illustrates investor liquidity and total fund losses. Each panel shows multiple lines that represent varying levels of redemption fees and the resulting changes in investor liquidity and total fund losses as gated redemptions increase.

As an illustration, Panel A in Exhibit 9 shows that when funds impose a 1% redemption fee and a redemption gate of 1%, investor liquidity (amount redeemed) is USD2.5 billion. Panel B can be read in the same way; for example, the point on the 5% fee line at a 6% gated redemption indicates that when funds impose a 5% redemption fee and redemption gates at 6%, total fund losses are USD20 billion.

Exhibit 9. Investor Liquidity and Total Fund Losses Using Multiple LMTs



Our results show that when redemption fees are implemented, higher fees correspond with lower investor liquidity. Investor liquidity increases up to the 5% gated redemption limit, above which investor liquidity is capped at approximately USD14 billion. For total fund losses, we find higher redemption fees correspond with reduced losses. As with the trend in investor liquidity, total fund losses increase until the gated redemption limit of 5% is triggered, after which total fund losses remain unchanged, at approximately USD20 billion.

The dynamics in Exhibit 9 are different from the dynamics observed in Exhibit 8 because in Exhibit 9, the size of the shock is unchanged and, therefore, changes to liquidity and total fund losses only occur for different calibrations of redemption fees or gated redemptions. In contrast, in Exhibit 8, both LMTs and the size of the initial shock vary.

Because the initial market shock remains the same in Exhibit 9, there is a point at which even if gated redemptions are applied, there is no impact to the size of investor redemptions across all funds. In this case, because the initial shock to most funds under the Q4 2024 volatility values, as in Exhibit 4, are below 6%, increasing the gated redemptions to 7%, 8%, or 10% results in no change to the size of investor redemptions. Although both panels display analogous trends in their respective metrics, the magnitude of variation is distinct. Investor liquidity may increase by up to USD14 billion, while total fund losses may increase by USD2 billion (from an initial loss of USD18 billion up to a maximum of USD20 billion), representing an 11% change.

Our results indicate that funds should calibrate LMTs across a range of plausible stress scenarios. In this way, investment funds can identify the level of liquidity restriction needed to mitigate fire-sale risks, while avoiding unnecessarily severe constraints on investor redemptions. In this regard, LMTs can be applied proportionately, balancing financial stability concerns with the need to provide adequate liquidity to investors.

OTHER LMTs

Although we considered two LMTs in our analysis, there are other LMTs, including both antidilution and quantity-based LMTs,²⁰ that funds may use to address liquidity risk. We outline these other tools in this section.

Swing pricing is a prevalent antidilution LMT used by funds. Swing pricing is a tool that reallocates liquidity costs from investors that remain in the fund (denoted as second movers) to investors that redeem early (denoted as first movers). Swing pricing aims to redistribute these liquidity costs by decreasing the share price at which first movers redeem. It swings the redemption price from mid-market NAV to a price that incorporates a swing factor that reflects the cost of liquidating the underlying assets. This decreases the quantity of assets needing to be sold by the fund and subsequently reduces market-to-market losses for second movers. For further detail, Capponi et al. (2023) provide a survey on swing-pricing regulation and theoretical and empirical results.

If implementing swing pricing, it is important to determine thresholds and the extent for which swing pricing is applied. This includes whether to adopt full swing pricing, where all liquidity costs from second movers are borne by first movers; or partial swing pricing, where only a portion of costs are transferred. As with other LMTs, however, swing pricing may conflict with the fund's fiduciary responsibility to fairly provide liquidity to all investors. From a modeling perspective, the framework proposed by Capponi et al. (2024) incorporates swing-pricing dynamics, accounting for interactions between first and second movers.

One challenge in applying (and modeling) swing pricing is accurately estimating the proportion of investors acting as first or second movers within each fund. While proxies can be used—for example, institutional or retail share classes to determine first and second movers as used in Capponi et al. (2024)—the validity of such proxies is questionable, as is whether retail investors are more or less likely to act as first movers compared to institutional investors. Further research could use empirical techniques to estimate first- or second-mover behavior from historical data, which would enhance liquidity risk and stress-test modeling.

Similar to swing pricing, funds may also implement dual pricing, which establishes two distinct prices: an offer price representing the price at which investors purchase shares/units, and a bid price representing the price at which investors redeem. However, establishing appropriate spreads for entry and exit under dual pricing can be complicated by the market environment. In a market stress event, spreads may widen and accessing firm bid and offer prices

²⁰ Antidilution LMTs include swing pricing (valuation at bid or ask prices), dual pricing, and antidilution levy. Quantity based LMTs include redemption gates (including suspensions), extension of notice periods, and extension of settlement periods.

in the underlying securities may be problematic, challenging the reliability of fund prices.

Another LMT that funds can use is redemption in-kind (RIK, also referred to as *in-specie redemptions*). Rather than liquidating assets to fulfill investor redemptions with cash, funds can transfer underlying assets directly to investors on a pro-rata basis. From a financial stability standpoint, RIK can help mitigate spillover effects associated with fire-sale losses by reducing the volume of assets sold by funds. This can limit price dislocations and subsequent sales by other funds. Furthermore, this approach reduces reliance on other LMTs, such as swing pricing or dual pricing, because there is no liquidity cost imposed on the fund by redeeming investors. For RIK, Agarwal et al. (2023) empirically found that funds offering RIK tend to attract lower fund flows, which could be due to investor concerns regarding access to liquidity during periods of market stress. Moreover, RIK is mostly practicable for institutional investors and carries limited appeal for retail investors given the higher costs of custody and administration from receiving underlying assets in lieu of cash.

Investment funds can also manage liquidity costs by using cash buffers first to meet investor redemptions. Compared with proportional selling, this represents a waterfall-style approach: Funds first use available cash and then sell other assets. Using cash first can mitigate fire-sale effects because the use of cash does not generate price impact, while still allowing the fund to provide liquidity to redeeming investors. However, prioritizing cash buffers may leave the fund more vulnerable to subsequent rounds of redemptions or fire-sale shocks, particularly if market stress persists. In addition, funds that rely heavily on cash buffers need to balance the liquidity benefits against the potential drag on performance since holding more cash may reduce returns and make the fund less attractive to investors. Therefore, assessing losses from both the fund and investor perspectives is important for evaluating whether LMTs support financial stability while maintaining adequate investor liquidity.

DISCUSSION

The use of LMTs has been focused on liquidity risks associated with the asset-liability mismatch of OEFs. Other types of funds could be included that can contribute to spillover effects under market stress, such as ETFs. An ETF is an investment vehicle representing a basket of securities, where the ETF itself can be traded similarly to a publicly listed stock. The advantages of ETFs compared with OEFs are the intraday liquidity and lower product fees compared with traditional investment funds with active strategies. However, the rise of ETFs can increase the commonality and interconnectedness of funds arising from overlapping constituent assets, which could exacerbate systemic risk in a fire-sale situation. Hence, it is important to understand potential contagion effects associated with ETFs, particularly if less liquid underlying assets are included.

One aspect of fire-sale risk not addressed in this report (due to our focus on UCITS funds) is leverage. Leverage can significantly amplify fire-sale losses in funds and other institutions that permit leverage. For example, hedge funds that use leverage, such as collateralized borrowing from prime brokers, may be forced to liquidate assets under market stress to maintain collateral requirements. Consequently, assets sold can cause price impacts that depreciate asset prices and lead to further rounds of asset sales. The procyclical nature of leverage, as discussed by Adrian and Shin (2010), can create a spiral of losses and amplify fire-sale risk. UCITS open-end funds are subject to stringent limits regarding leverage—generally capped at borrowing only 10% of assets and solely on a temporary basis for purposes other than investment (European Union 2009). This restriction exists because, unlike deposit-holding institutions, such as banks, UCITS open-end funds function as pass-through investment vehicles rather than leveraged intermediaries.

Due to the absence of significant leverage, some argue that OEFs contribute less to fire-sale dynamics and systemic risk compared to other types of institutions. Nevertheless, it remains crucial to assess the risks posed by OEFs, given their substantial holdings in less liquid assets, such as corporate bonds and emerging market debt. Lewrick and Claessens (2022) observe spillover effects for common assets held by OEFs on leveraged institutions, such as banks, pension funds, and insurance funds. Although we find corporate bond funds do not currently exhibit heightened vulnerability to fire-sale risk, continued growth in these vehicles could increase their impact and interconnectedness within the financial system.

Another potential amplifier of fire-sale losses and systemic risk is in the use of derivatives. Some investment funds use derivatives to expand their market exposure, creating synthetic leverage that can magnify losses during stress. This can go beyond traditional leverage limits; global derivative exposures for UCITS funds are permitted up to 100% of NAV for some funds (Committee of European Securities Regulators 2010). Derivatives could amplify systemic

risk because large quantities of assets can be sold in meeting the underlying margin requirements.

While UCITS funds might attain high levels of exposure to derivatives, it is uncommon for them to approach these limits; ESMA (2025) noted that highly leveraged UCITS funds only account for 2% of total UCITS NAV. However, the rise of “alternative UCITS” funds—which pursue hedge fund-type strategies, subject to strict limits on leverage, diversification, and counterparty risks (ESMA 2025)—is a development that warrants regulatory monitoring. The asset holdings of these vehicles can affect asset prices that are amplified by derivatives.

UCITS funds could also manage liquidity risks using repurchase agreements (repos). Funds can use repos by pledging liquid assets, within leverage limits, to address short-term cash requirements. Additionally, reverse repos allow funds to obtain high-quality collateral in exchange for supplying cash. Both repos and reverse repos, as well as the use of financial derivatives, are classified as securities financing transactions and represent efficient portfolio management (EPM) strategies. EPM strategies are intended to lower costs or risks to the fund and generate extra capital in line with the fund’s objectives (ESMA 2024a).

Repos can mitigate liquidity risk by providing short-term liquidity to funds, which would reduce the need for large-scale asset sales because funds could unwind asset positions under more favorable market conditions. However, repo transactions may heighten liquidity risks if there is a sudden increase in haircuts from the counterparty to the fund. In such stress periods, the fund could be forced to quickly raise cash to meet those haircuts, leading to an increase in liquidity risk. While repo transactions reduce the liquidity risks to investors, they increase funding risks that the fund is exposed to. When using repos, fund managers must monitor the proportion of assets pledged as collateral because higher encumbrance increases liquidity risk. It is also important for funds to assess the potential impact from haircut shocks, as well as redemption shocks from investors.

CONCLUSION

This report evaluates how LMTs affect fund losses and investor liquidity in OEFs during market shocks. The analysis is motivated by the liquidity mismatch in OEFs, where investors may redeem daily while the underlying assets may be less liquid, particularly during periods of market stress. This mismatch creates a practical policy and fiduciary challenge: Tools that reduce pressure on the fund and wider market may also reduce the value or quantity of liquidity available to redeeming investors.

Using European corporate bond fund data, we find that asset-sale spillovers from stressed redemptions and MtM losses are present but only to a small extent and are not the dominant source of total fund losses. Under the Q4 2024 and LDI-style stress scenarios, most losses arise from the initial market shock rather than from subsequent MtM losses caused by asset sales. When LMTs are used, we find the implementation is unlikely to materially offset large market-wide shocks on their own. Antidilution tools, such as redemption fees, reduce the amount received by redeeming investors, but they have only a limited effect on total fund losses in our scenarios. Quantity-based tools, such as redemption gates, can reduce forced sales and lower total fund losses under larger shocks, but they do so by materially restricting investor liquidity. For quantity-based tools, this effect becomes more pronounced in severe stress scenarios, where the reduction in investor liquidity can be large relative to the reduction in total fund losses.

For policymakers, the key implication is that LMT frameworks should prioritize flexibility, calibration, and governance rather than prescriptive one-size-fits-all requirements. Funds differ in their asset liquidity, investor base, redemption terms, and vulnerability to stress. A framework that incorporates a range of tools and allows tools to be calibrated to these characteristics is more likely to balance financial stability objectives with investor protection. Where quantity-based tools are allowed, policymakers should ensure that their use is supported by clear activation criteria, escalation procedures, review requirements, and communication expectations that ultimately account for investor needs.

A clear allocation of responsibility is essential to this framework: Primary accountability for liquidity risk management, including the selection, calibration, activation, and deactivation of LMTs, most appropriately rests with the asset manager. This reflects the agency nature of OEFs and the manager's proximity to the fund-specific information needed to make these judgments. It also marks a meaningful distinction between the securities market and prudential perspectives on this debate. While prudential frameworks are designed around principal risk taking by deposit-taking institutions, OEFs operate as pass-through vehicles in which investors bear investment outcomes directly.

Managers should avoid layering multiple tools without assessing their combined effect. As displayed in the sensitivity results, combining antidilution and quantity-based tools may reduce liquidity pressure, but it may also impose overlapping costs on redeeming investors.

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APPENDIX

Exhibit A1 describes proposed liquidity management tools that investment funds can use. ESMA adopts a broadly similar classification for the EU framework. Tools are divided into three main categories: antidilution LMTs, quantity-based LMTs, and other measures.

Exhibit A1. Description of Liquidity Management Tools

Liquidity Management Tool	Definition
Antidilution LMTs	
Swing pricing	Adjusting a fund's NAV (typically calculated at mid-price) by applying a swing factor that reflects the liquidity cost stemming from net subscriptions or redemptions
Valuation at bid or ask prices	An asset valuation procedure that switches from valuation at mid-price to valuation according to bid or ask price, depending on the direction of net fund flows
Dual pricing	Refers to the calculation of two NAVs per valuation point
Antidilution levy	Refers to a process whereby a variable levy/fee for the benefit of the fund is added to or deducted from the fund's NAV, increasing the final price paid by subscribing investors or decreasing the price received by redeeming investors, to pass on the liquidity cost
Subscription/redemption fees	A process whereby a fixed levy/fee is added to/deducted from the fund's NAV in case of subscriptions/redemptions
Quantity-based LMTs	
Suspension of redemptions and subscriptions	Suspension is an action a fund or its manager takes to prevent investors in the OEF from withdrawing their capital and new potential investors from investing in it.
Redemption gates	Partial and temporary restrictions to investors' ability to redeem their capital, generally on a pro-rata basis, that aim to spread redemption requests and asset sales over time in the best interest of all investors, alleviating the redemption pressures on the responsible entity
Extension of notice periods	Subject to the applicable laws and regulations and the terms as set out in the OEF's offering documents, responsible entities may decide to extend the OEF's notice period in case of liquidity issues if they are confident that required asset sales can be completed within a set time frame. This extension will enable them to sell assets over a longer period to meet the redemption request orderly, without selling assets urgently at discounted prices. It would mean reduced liquidity and accessibility for investors who need quick access to their money.
Extension of settlement periods	Settlement periods refer to the time between the trade date when a redemption request is made and the date when the transaction of fund units and money is completed and settled. Managers may extend the settlement periods to allow them to sell assets over a longer period to meet redemption requests in an orderly manner.

(continued)

Exhibit A1. Description of Liquidity Management Tools (Continued)

Liquidity Management Tool	Definition
Other measures	
Side pockets	A mechanism by which a fund manager segregates specific assets from the fund's overall portfolio. The manager, through unit segregation, can better manage the unique liquidity or valuation of the different underlying assets.
Redemptions in-kind	A mechanism by which OEFs can distribute the underlying assets, generally on a pro rata basis to investors, versus paying cash, to honor redemptions

Source: IOSCO (2024a).

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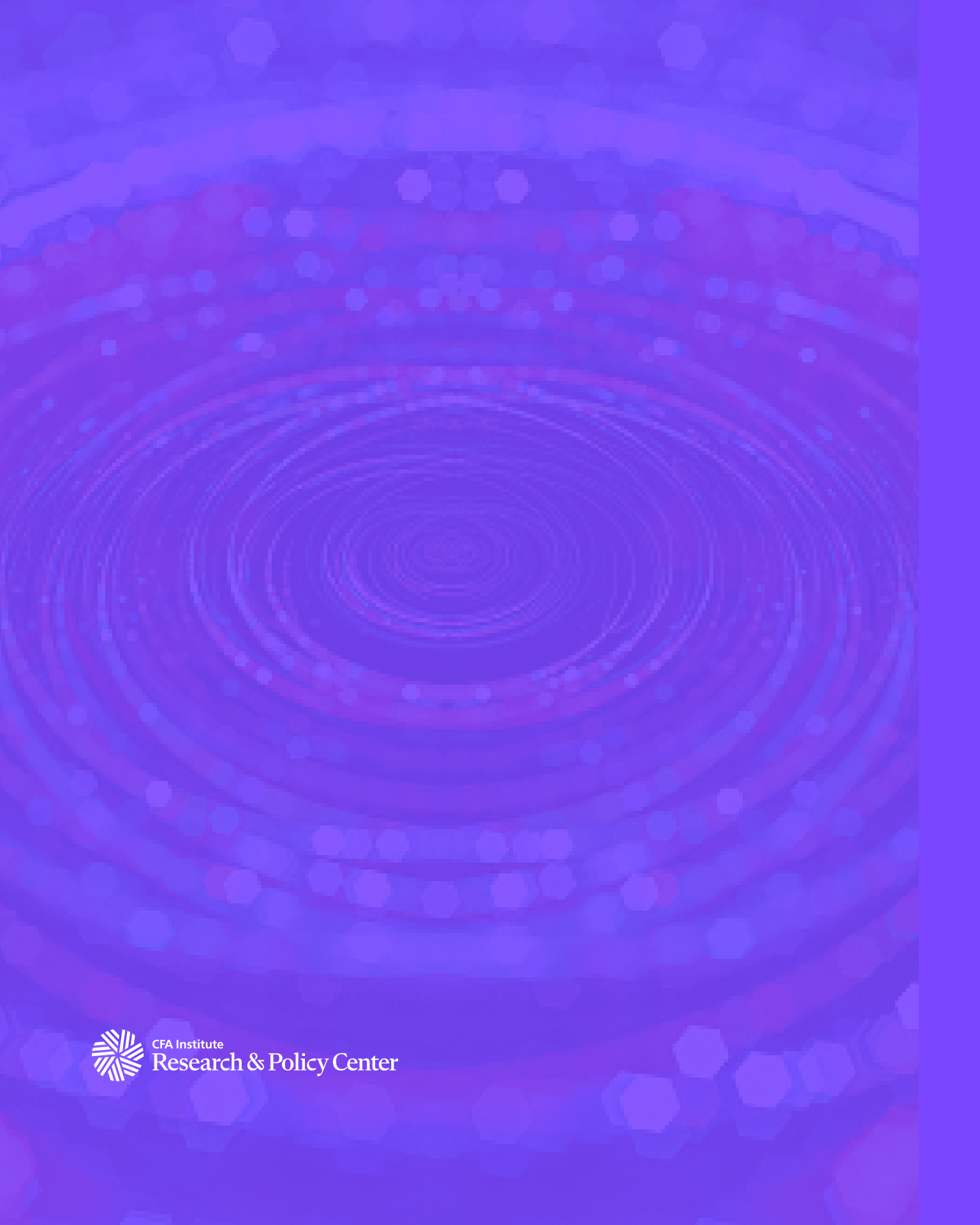
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