

Chapter 3 at a Glance

- Since the global financial crisis, there has been remarkable growth in open-end investment funds. The total value of their net assets has quadrupled since 2008, reaching \$41 trillion in the first quarter of 2022 and accounting for approximately one-fifth of the assets of the nonbank financial sector.
- Open-end funds play an important role in financial markets, but those that offer daily redemptions while holding illiquid assets can amplify the effects of adverse shocks by raising the likelihood of investor runs and asset fire sales. This contributes to volatility in asset markets and potentially threatens financial stability.
- These concerns are particularly pertinent now as central banks normalize policy amid heightened uncertainty about the outlook. A disorderly tightening of financial conditions could trigger significant redemptions from these funds and contribute to stress in asset markets.
- Assets (particularly bonds) held by relatively illiquid funds are more “fragile,” with higher return volatility, especially in periods of market stress. A significant decline in fund liquidity such as that observed during the March 2020 market turmoil can increase bond return volatility by more than 20 percent.
- Investments by advanced economy open-end funds in emerging markets have grown significantly over the past decade, with important implications. A significant decline in the liquidity of advanced economy bond funds comparable to that observed in March 2020 can increase the return volatility of emerging market corporate bonds by more than 20 percent.
- Importantly, the adverse effects of less liquid open-end investment funds on asset prices could lead to a tightening of domestic financial conditions, reinforcing the vicious cycle between investor runs and asset market volatility.

Policy recommendations

- Policymakers should ensure that adequate liquidity management tools are used by these funds. A wide range of tools is available to potentially mitigate the vulnerabilities and systemic impact of open-end funds, but effective implementation of these tools is lacking.
- Tools that aim to limit vulnerabilities by reducing the risk of investor runs, such as swing pricing or antidilution levies, can be potentially effective to mitigate asset price fragilities associated with less liquid open-end funds. Swing pricing is routinely used by open-end funds in some jurisdictions, but to further strengthen its effectiveness, policymakers should provide guidance on its implementation, ensure that swing factors fully reflect the price impact of trades, and encourage disclosure of swing pricing practices and calibration methodologies.
- Additional liquidity management tools could include limiting the frequency of redemptions by linking it to the liquidity of funds’ portfolios to directly address the underlying vulnerability related to the liquidity mismatch.
- Tighter monitoring of funds’ liquidity risk management practices by supervisors and regulators should be considered.
- Given the adverse cross-border spillover effects, recipient economies need to take appropriate policy responses to mitigate potential systemic risks from volatile capital flows sourced from open-end funds. These should include continued deepening of domestic markets; the use of macroeconomic, prudential, and capital flow management measures; and foreign exchange intervention in line with the recommendations of the International Monetary Fund’s Institutional View.¹

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¹For additional information, see <https://www.imf.org/en/Publications/Policy-Papers/Issues/2022/03/29/Review-of-The-Institutional-View-on-The-Liberalization-and-Management-of-Capital-Flows-515883>.

Introduction

The rapid growth of open-end investment funds (OEFs) has raised concerns about financial stability. OEFs, which are mutual funds that can issue or redeem shares daily at a price set at the end of the trading day, are an important component of the nonbank financial sector and have grown significantly in the past two decades.² Their total net assets have quadrupled since the global financial crisis, reaching \$41 trillion in the first quarter of 2022 and accounting for approximately one-fifth of the nonbank financial sector's assets (Figure 3.1, panel 1). The growth of the OEF sector reflects the increasing shift in financial intermediation from banks to nonbank financial institutions, which can be attributed at least in part to the tighter regulations on banks as well as bank balance sheet deleveraging following the global financial crisis (see the April 2015 *Global Financial Stability Report* [GFSR]).³ Most OEFs are domiciled in advanced economies and invest in equities issued in advanced economies (Figure 3.1, panel 2); however, the share of funds investing in relatively less liquid assets, such as corporate bonds or emerging market bonds and equities, has been rising rapidly (Figure 3.1, panel 3).⁴ The growing importance of OEFs for the functioning and liquidity of asset markets has prompted increased scrutiny of their potential role in amplifying excessive volatility—or “fragility”—in these markets, especially when market liquidity deteriorates.⁵

²The end-of-day net asset value reflects the difference between the total value of the fund's assets and liabilities divided by the number of shares outstanding. OEFs are different from other types of investment funds such as closed-end funds, which issue a fixed number of shares initially to raise capital for investments that can later be traded on secondary markets between investors but not redeemed. They also differ from exchange-traded funds, which can be traded on exchanges throughout the day, similarly to stocks, but whose shares can be created and redeemed only by authorized participants.

³These factors may possibly be working in conjunction with an increased demand for financial products offering daily liquidity.

⁴OEFs invest in different types of assets, ranging from very liquid (such as cash or short-term, highly rated sovereign bonds) to less liquid (such as certain types of corporate bonds) to highly illiquid (such as real estate or infrastructure investments). Assets that are liquid can be bought or sold in a short period of time at a low cost (that is, without affecting their price). However, liquidity can vary across assets and over time. The focus of this chapter is primarily on funds investing in bonds and equities, and implications of their relative illiquidity are examined.

⁵Excessive volatility or fragility is induced in asset prices if they are susceptible to trading shocks that sway these prices away from their fundamental values (Greenwood and Thesmar 2011). See the April 2015 GFSR for a detailed discussion of the possible role of investment funds in generating macro-financial stability risks.

OEFs holding illiquid assets can worsen fragility in asset markets through the liquidity mismatch between their asset holdings and liabilities. In the face of adverse shocks, OEFs that offer daily redemptions to investors but hold relatively less liquid assets are vulnerable to the risk of investor runs (or large outflows) that could force these funds to sell assets to meet redemptions. The sale of assets could in turn generate downward pressure on asset prices that may amplify the initial effects of the shocks by inducing additional redemptions. These price pressures would be further intensified if funds were to engage in herding—that is, mimic other investors' trading behavior, possibly ignoring their own information and beliefs.⁶

Financial stability concerns about OEFs resurfaced during the financial market turmoil of March 2020. Amid heightened uncertainty about the economic outlook, OEFs that were invested in relatively less liquid assets experienced historic outflows and a “dash for cash” at the onset of the COVID-19 pandemic (Figure 3.2). This contributed to market dislocations and liquidity problems that were resolved only after unprecedented policy responses by major central banks—in particular, the purchase of corporate bonds and exchange-traded funds (ETFs) in primary and secondary markets (Liang 2020; Falato, Goldstein, and Hortaçsu 2021; Hespeler and Suntheim 2020; IMF 2021).

The resilience of the OEF sector may be tested again if financial conditions tighten abruptly as central banks normalize the stance of monetary policy. Amid persistent inflationary pressures, major central banks are significantly normalizing their policy stance, and financial conditions have tightened since the beginning of 2022 (see Chapter 1). This has coincided with large outflows from OEFs in recent months, especially from high-yield corporate bond funds and emerging market equity and bond funds (Figure 3.3). More aggressive monetary policy tightening by central banks against a backdrop of continued inflationary pressure, as well as increased uncertainty about the macroeconomic outlook stemming from persistent supply chain disruptions and

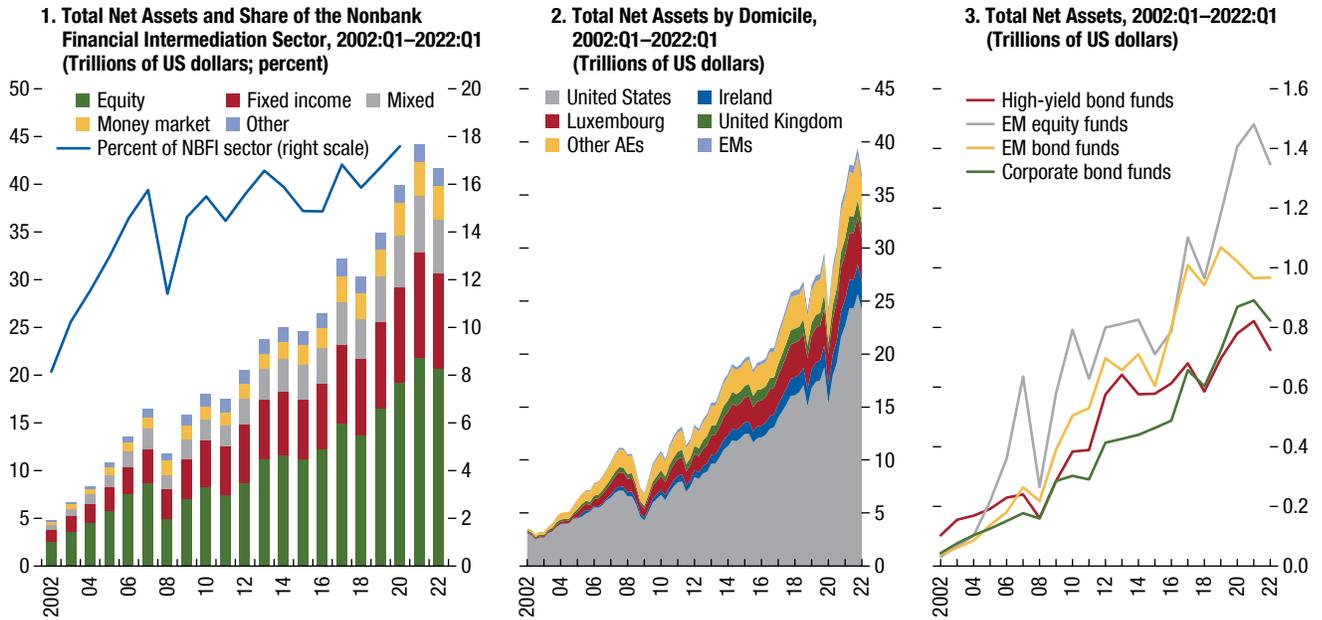
⁶Studies show evidence of herding by OEFs, especially when market stress is elevated (for example, Brown, Wei, and Wermers 2014; Cai and others 2019). Leverage is another potential factor that could exacerbate existing vulnerabilities and contribute to asset price fragility. An analysis of fund leverage is outside the scope of this chapter due to data limitations.

Figure 3.1. Developments in Open-End Investment Funds

Open-end investment funds have grown substantially and now represent approximately one-fifth of the nonbank financial sector.

Most of these funds are domiciled in advanced economies ...

... and have been increasingly investing in less liquid assets.



Sources: Financial Stability Board (2021); Morningstar; and IMF staff calculations.

Note: In panel 1, NBFIs includes all financial institutions that are not central banks, banks, or public financial institutions (Financial Stability Board 2022). Panel 3 shows groupings based on Morningstar classifications; groupings may overlap and are not mutually exclusive. EM bond funds include both corporate bond funds and sovereign bond funds. Total net asset value is the difference between the total value of a fund’s assets and liabilities. AE = advanced economy; EM = emerging market; NBFIs = nonbank financial intermediation.

Russia’s invasion of Ukraine (see Chapter 1 of the October 2022 *World Economic Outlook*) could cause a sudden repricing of risk and a disorderly tightening of global financial conditions. Such an adverse shock, combined with the inherent vulnerability of OEFs holding illiquid assets but offering daily redemptions, could trigger further outflows from these funds and amplify stress in asset markets.

An adverse shock to the OEF sector could have significant ramifications for emerging market economies. Since the global financial crisis, these economies have received large capital inflows from OEFs, especially into bond markets (Figure 3.4). At the onset of the pandemic in March 2020, emerging market economies saw large and abrupt outflows of about \$78 billion, followed by sustained and large inflows. More recently, in the face of tighter global financial conditions, investors have retrenched from emerging market economies, with outflows from equity and bond markets totaling \$69 billion since the beginning of 2022. A disorderly

tightening in global financial conditions could trigger further fund outflows and a worsening of financial conditions in these economies.⁷

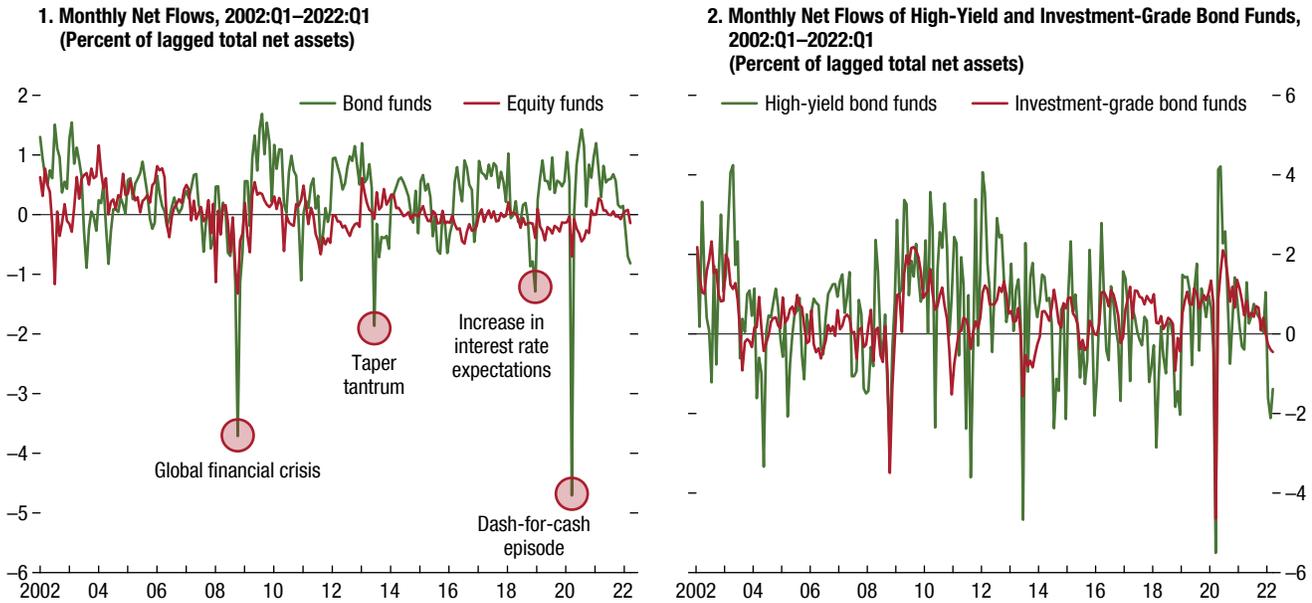
Despite the financial stability risks, effective implementation of policy measures by governments or regulatory authorities to mitigate the vulnerabilities associated with OEFs holding illiquid assets has been lacking. Several policy options are available to address these vulnerabilities and risks through better liquidity management by funds. Liquidity management tools could be applied to the asset side of funds’ balance sheets (for example, limits on investing in illiquid assets or limits on asset concentration and requirements to hold a minimum amount of liquid assets).

⁷In the case of emerging markets, the importance of benchmark-driven portfolio flows has increased significantly over the years, which poses additional risk as these flows tend to be highly sensitive to global factors, potentially increasing the risk of excessive outflows with a spike in investor risk aversion (Arslanalp and others 2020; April 2019 *Global Financial Stability Report* [GFSR]).

Figure 3.2. How the March 2020 Market Turmoil Highlighted the Vulnerabilities of Open-End Investment Funds

In March 2020, open-end investment funds experienced larger outflows than in previous market stress episodes ...

... especially from relatively less liquid funds such as high-yield bond funds.

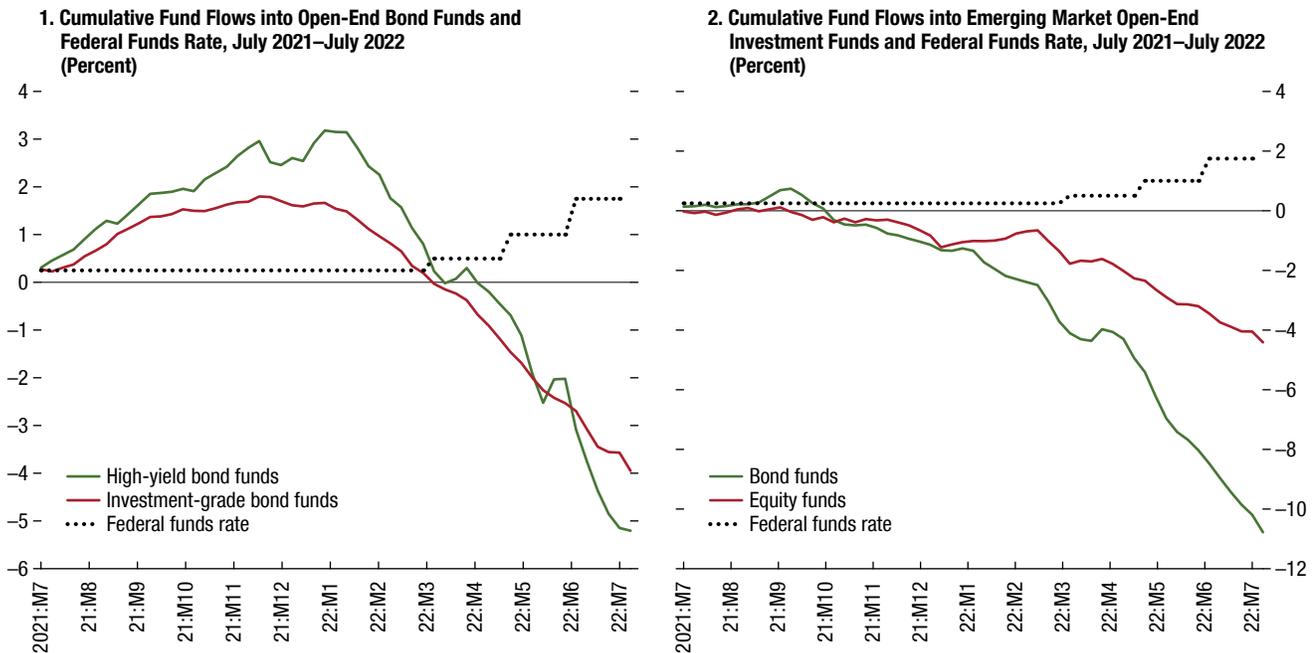


Sources: Morningstar; and IMF staff calculations.
 Note: Panel 2 shows fund groupings based on Morningstar classifications.

Figure 3.3. Large Outflows from Open-End Investment Funds amid Monetary Policy Tightening by Major Central Banks

In recent months, outflows from open-end bond funds have increased sharply in sync with the tightening of monetary policy by the Federal Reserve.

Outflows have also been pronounced from emerging market bond and equity funds.

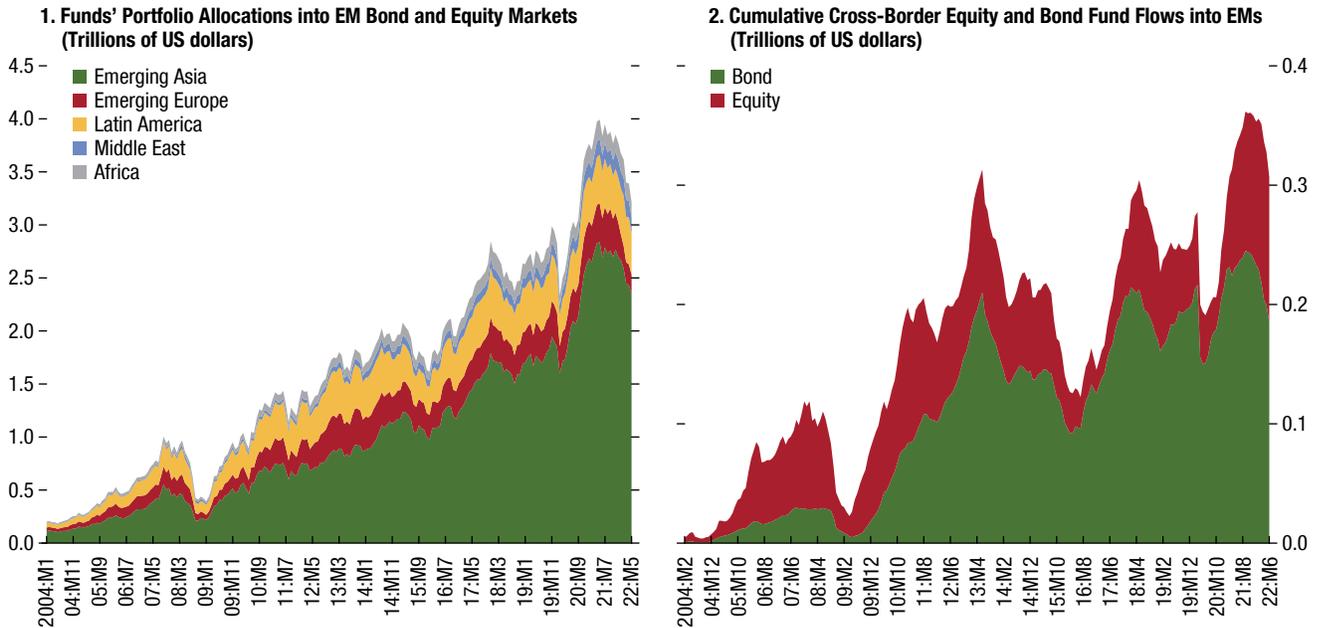


Sources: Emerging Portfolio Fund Research; and IMF staff calculations.
 Note: Cumulative flows are calculated based on US dollar flows as a percent of beginning of period's total net asset values.

Figure 3.4. Cross-Border Investment by Open-End Investment Funds in Emerging Market Economies

Open-end investment funds have been playing an increasingly important role in emerging markets ...

... and especially in bond markets.



Sources: Emerging Portfolio Fund Research; and IMF staff calculations.
 Note: EM = emerging market.

They could also be applied to the liability side (such as in-kind redemptions, redemption suspensions or gates, and side pockets, as well as price-based measures such as redemption fees, antidilution levies, and “swing pricing”).⁸

Studies point to the potential effectiveness of price-based measures such as swing pricing, redemption fees, and antidilution levies in reducing investors’ incentive to run on funds.⁹ These measures ensure that

⁸In-kind redemptions are a tool by which a fund’s portfolio assets are distributed to redeeming investors on a pro rata basis. Suspensions temporarily prevent investors from withdrawing their capital from a fund. Redemption gates restrict investors’ ability to redeem when total redemptions exceed a certain level. Side pockets are subfunds (segregated accounts) that typically hold less liquid assets and have longer redemption periods. Redemption fees are charges imposed on investors redeeming their shares, typically to discourage short-term trading. Antidilution levies are fees imposed on redeeming investors to compensate the remaining investors for the transaction costs caused by the redemptions. Swing pricing allows funds to adjust their net asset value based on the transactions of the redeeming investors such that trading costs are borne by the exiting investors.

⁹See, for example, Jin and others (2022) and Emter, Fecht, and Peia (2022).

trading costs are borne only by the exiting investors, for example, by adjusting the net asset value when facing outflows (swing pricing) or by imposing a fee on redeeming investors (antidilution levies). This is desirable from an investor protection perspective—both in normal times and in times of market stress—because it prevents dilution of the shares of the fund’s remaining investors. But it also has a systemic impact by dampening investors’ incentive to redeem ahead of others, thereby reducing the risk of investor runs. Moreover, unlike other tools, such as less frequent redemptions (or “gates”), price-based measures do not restrict funds’ ability to provide daily liquidity—which is a key feature of OEFs. However, to date, these measures have been adopted only by funds in certain jurisdictions, and there are questions about their calibration and effectiveness, especially in periods of severe market stress (Lewrick and others 2022).

In the absence of adequate liquidity management by funds, central banks have stepped in during episodes of severe market stress to provide liquidity backstops to the financial sector, including to OEFs, but such interventions may lead to underpricing of risk

by investors. Unlike banks, investment funds do not generally have access to central bank liquidity facilities or deposit insurance. They are also not subject to the same intensity of prudential oversight, or to the capital and liquidity requirements, imposed on banks. However, in episodes of severe market stress, such as during the March 2020 market turmoil, central banks have had to purchase a range of risky assets, including corporate bonds, to ease strains on liquidity to help prevent asset fire sales by funds, which could have led to a further deterioration in market liquidity. Such interventions, while at times warranted to prevent systemic crises, may result in moral hazard and systematic underpricing of risk by funds.¹⁰ It is therefore essential to work toward a policy and regulatory framework that addresses the vulnerabilities associated with OEFs, and mitigates potential risks to financial stability, while minimizing the need for central banks to intervene in financial markets.

Against this backdrop, this chapter analyzes the contribution of OEFs to asset price fragility and discusses different policy options to mitigate the risks. The chapter begins by laying out a simple conceptual framework to discuss the nature of potential financial stability risks arising from OEFs. Next, it uses a sample of 17,000 OEFs domiciled in 43 countries and holding more than 450,000 bond and equity securities and examines a period from the fourth quarter of 2013 to the second quarter of 2022 to construct quantitative measures of vulnerabilities of OEFs, defined mainly in terms of the illiquidity of their asset holdings.¹¹ The chapter then empirically analyzes the extent to which these vulnerabilities drive fragility in asset markets—measured as volatility of asset returns—especially during episodes of market stress. It also examines potential cross-border spillovers from funds domiciled in advanced economies to asset prices in emerging market economies. In addition, it investigates the channels through which fund illiquidity

¹⁰Moral hazard could arise because repeated liquidity support by central banks may incentivize funds as well as end investors to take on more risk without fully internalizing the costs of such risk-taking.

¹¹The sample period is chosen based on the availability of consistent portfolio holdings data required for the empirical analysis. See Online Annex 3.1 for a detailed description of the sample and variable definitions. All online annexes are available at www.imf.org/en/Publications/GFSR.

is transmitted to asset price fragility and assesses its impact on broader financial conditions. Finally, the chapter analyzes the role of liquidity risk management tools in mitigating the vulnerabilities and risks associated with OEFs.¹²

A Conceptual Framework to Understand the Financial Stability Risks of Open-End Investment Funds

OEFs that hold illiquid assets but offer daily redemptions to investors may experience severe outflows in periods of market stress. OEFs that offer such daily redemptions but hold assets that cannot be liquidated quickly without material loss of value are subject to an asset-liability “liquidity” mismatch. This mismatch reflects an inherent vulnerability of the fund that gives rise to the risk of sudden and large redemptions by investors (runs on funds). The risk arises because investors can redeem shares from the fund on a daily basis at its current net asset value without bearing the full transaction costs of their redemptions. These costs are then effectively borne by the investors who remain in the fund.¹³ This externality creates an incentive for investors to redeem ahead of others—known as the “first-mover advantage”—particularly from funds that hold less liquid assets that may be more difficult and costly to sell (Chen, Goldstein, and Jiang 2010; Goldstein, Jiang, and Ng 2017).

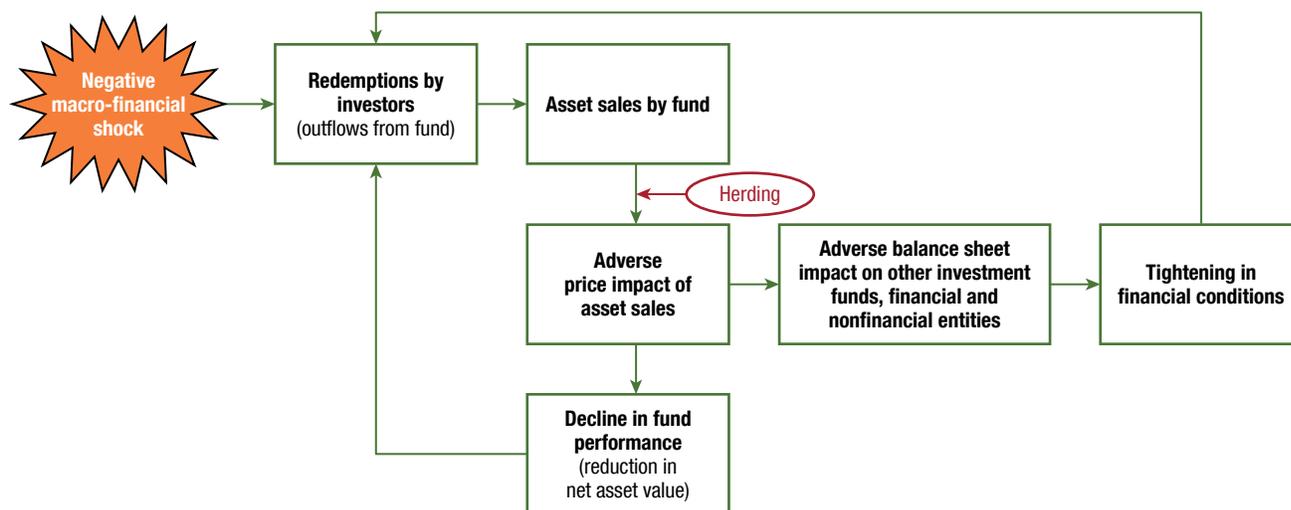
Funds facing outflows may be forced to sell assets, putting downward pressure on asset prices. In the face of redemptions, OEFs may need to sell assets to pay out investors if the funds do not have enough cash or cash-like assets. This could depress asset prices, particularly of less liquid assets, amid tight

¹²Several studies have assessed the role of funds in generating fragility in corporate bond and equity markets. The main contribution of this chapter is to use a global sample of funds, composed of both equity and bond funds, investing in a large group of advanced and emerging market economies. In addition, the chapter looks at the transmission of shocks from OEFs to broader financial conditions, examines the cross-border spillover effects of fund vulnerabilities on asset prices and financial conditions, compares OEFs with ETFs, and analyzes several policy options.

¹³Transaction costs include direct costs such as commissions and fees, as well as indirect costs such as the impact on asset prices resulting from their sale by the fund to meet redemption requests. The price impact tends to be larger when the underlying market liquidity is poor.

Figure 3.5. Liquidity Mismatch of Open-End Investment Funds and Systemic Risk

Redemptions from open-end funds can trigger fire sales of assets that can result in tighter overall financial conditions.



Source: Prepared by IMF staff.

Note: In addition to the adverse price impact, asset sales by the fund can incur other transaction costs such as commissions and fees, which will adversely affect its net asset value. High leverage and low levels of liquidity provision in the market could further amplify the impact of redemptions on asset sales.

financial conditions (Figure 3.5).¹⁴ Moreover, in the presence of herding by funds, trading activity in the same direction could exacerbate selling pressure and cause asset prices to diverge from fundamental values.

Depressed asset values can, in turn, lower the performance of funds and induce further redemptions and asset fire sales, amplifying the impact of shocks. Lower asset prices could also adversely affect the balance sheets of other financial and nonfinancial entities, including funds not originally affected by the shock, and potentially lead to a broad-based tightening

¹⁴Jiang and others (2022) find that redemptions from corporate bond funds generate price pressures and that during the COVID-19 crisis bonds held largely by more illiquid funds experienced more negative returns. By contrast, Choi and others (2020) find little evidence for such price pressures after controlling for issuer-time fixed effects, which they attribute to funds' liquidity management strategies. Ma, Xiao, and Zeng (2022) reconcile the findings by showing that the price impact generated by the unprecedented outflows during the COVID-19 pandemic depended on the pecking order of liquidation adopted by funds. In periods of stress, price pressures can emerge even in otherwise liquid assets. In equity markets, Coval and Stafford (2007) show, outflows from mutual funds put price pressure on securities that are sold by distressed funds.

of financial conditions that could reinforce the vicious cycle of redemptions and asset fire sales, thus threatening macro-financial stability.¹⁵

Vulnerabilities of Open-End Investment Funds and Asset Markets: Some Stylized Facts

OEFs that invest in corporate bonds, especially high-yield bonds, tend to be much more illiquid than equity funds. Because the first-mover advantage for investors will generally be greater in less liquid funds, the level of illiquidity of a fund's portfolio is a useful gauge of its vulnerability. Illiquidity is measured here as the value-weighted average of the bid-ask spreads of the securities held by the fund.¹⁶ By that measure, illiquidity tends to be much higher for bond funds than for equity funds (Figure 3.6, panel 1). Among bond funds,

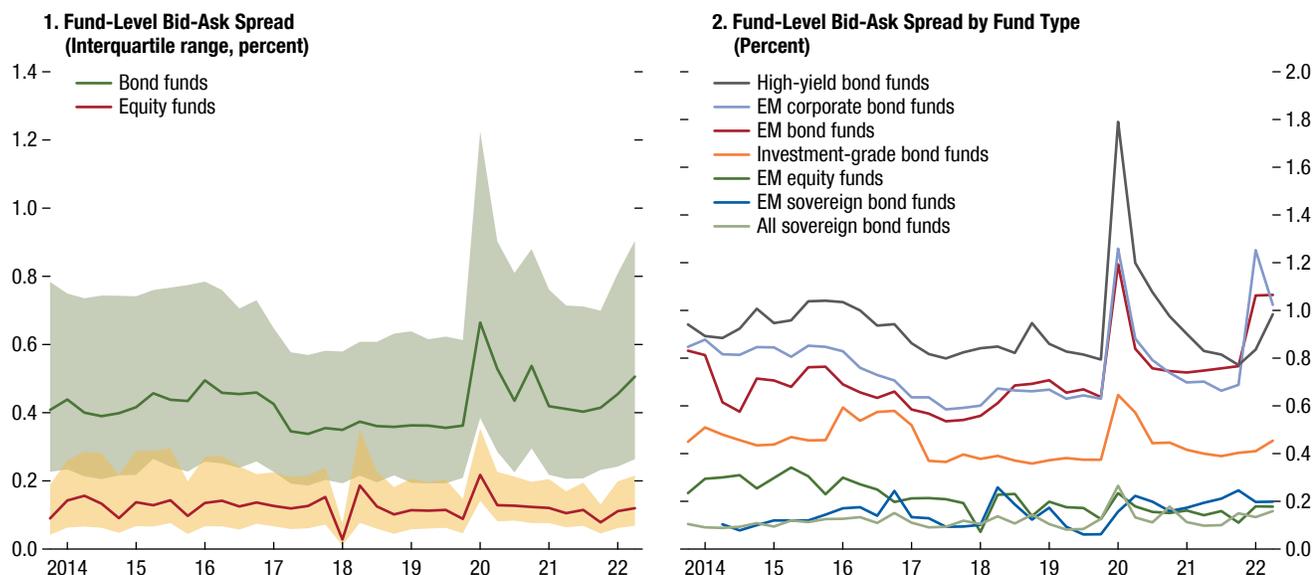
¹⁵Depressed asset prices can also adversely affect the ability of firms to raise capital (Zhu 2021).

¹⁶Bid-ask spreads are a widely used measure of liquidity that reflect the difference between "sell" and "buy" prices quoted by market participants, such as broker dealers. Alternative measures rely on higher-frequency price data or transaction data, which are not available for the global sample and various asset classes considered in this chapter.

Figure 3.6. Liquidity of the Portfolio Holdings of Open-End Investment Funds

The liquidity of funds' portfolios has generally been stable but deteriorated dramatically in March 2020 ...

... particularly for high-yield and EM bond funds.



Sources: FactSet; Morningstar; Refinitiv; and IMF staff calculations.

Note: Fund-level illiquidity is the weighted average of the bid-ask spreads of the fund's portfolio of securities. In panel 1, the solid lines indicate the median, and the shaded area indicates the interquartile range of fund-level illiquidity. In panel 2, the median fund-level bid-ask spreads are shown for groupings of assets based on Morningstar classifications; these groupings are not mutually exclusive. EM = emerging market.

those holding corporate high-yield bonds and emerging market bonds tend to be the most illiquid, while those investing in sovereign bonds are the most liquid (Figure 3.6, panel 2).

The liquidity of funds' portfolios deteriorated dramatically during the March 2020 market turmoil and has been worsening again in recent months. The liquidity of OEF portfolios had been relatively stable for several years before the COVID-19 pandemic but deteriorated rapidly in March 2020 amid heightened uncertainty about the outlook. The deterioration in fund-level liquidity, indicated by the increase in bid-ask spreads of funds' portfolios, was particularly severe for funds invested in relatively less liquid assets, such as high-yield and emerging market bonds. Consistent with the view that liquidity mismatches heighten the risk of runs on funds, redemptions from these funds reached record levels, as shown in Figure 3.2. The liquidity of funds' portfolios worsened again in the first half of 2022, especially for high-yield and emerging market bond funds. In fact, for the latter, liquidity reached levels similar to that observed in March 2020 (Figure 3.6).

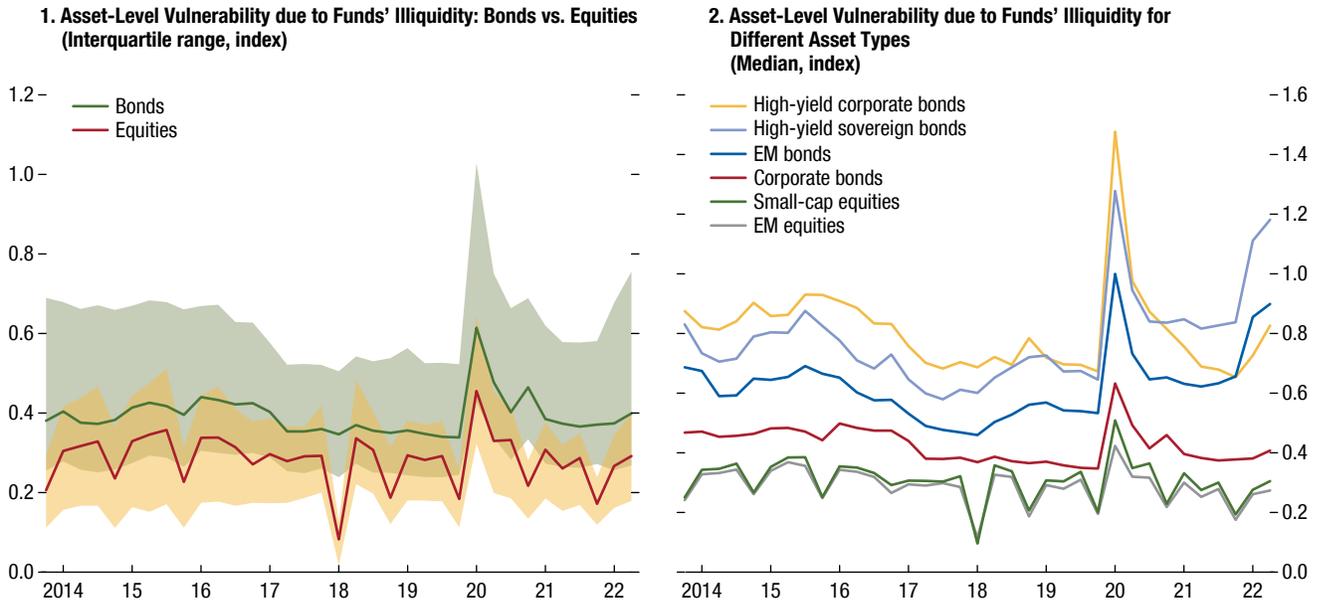
Assets held by more illiquid funds may be more susceptible to selling pressure caused by large redemptions from funds. To gauge the extent to which assets are vulnerable to selling pressure stemming from fund redemptions, the analysis constructs an asset-level "vulnerability measure" that captures the illiquidity of the portfolios of funds holding that asset.¹⁷ Not surprisingly, the data show that less liquid assets such as bonds are generally held by more illiquid funds and are therefore more vulnerable to selling pressure than equities (Figure 3.7, panel 1). Across different types of bonds, corporate high-yield and emerging market bonds are more likely to be held by more illiquid funds and are hence highly vulnerable to fund redemptions (Figure 3.7, panel 2). The vulnerability of these assets increased dramatically during the COVID-19 crisis, when liquidity mismatches in

¹⁷The measure is constructed following Jiang and others (2022) and captures the weighted-average liquidity of the funds holding the assets, with liquidity defined as the value-weighted quoted bid-ask spread of funds' portfolios and the weights reflecting the share of a fund's ownership of the asset. See Online Annex 3.2 for further details.

Figure 3.7. Asset-Level Vulnerability Measure

Fixed-income securities are held by more illiquid funds and are thus on average more vulnerable than equity securities.

Less liquid securities such as high-yield and EM bonds are generally held by more illiquid funds, and recently their vulnerabilities have reached levels almost as high as in March 2020.



Sources: FactSet; Morningstar; Refinitiv; and IMF staff calculations.

Note: Panel 1 displays the evolution of asset-level vulnerabilities for bonds and equities. The vulnerability measure is constructed following Jiang and others (2022) and captures the weighted average liquidity of its owners, with liquidity defined as the portfolio-level bid-ask spread. See Online Appendix 3.2 for further details. In panel 1, the solid line indicates the median, and the shaded area is the interquartile range for the asset-level vulnerability measure. In panel 2, the lines indicate the median asset-level vulnerability for specific asset classes. EM = emerging market.

OEFs increased (as shown in Figure 3.6), and it has risen again in 2022, in some cases close to levels seen during the early days of the pandemic.

More vulnerable assets experience sharper price declines than other assets in periods of market stress. The higher vulnerability of assets held by less liquid funds is visible during two recent episodes of market stress. In March 2020, at the height of the financial market turmoil driven by the COVID-19 pandemic, fixed-income securities held by more illiquid funds experienced a sharper drop in prices (that is, lower returns) than those held by liquid funds (Figure 3.8, panel 1). This pattern was repeated in the first half of 2022, when global asset markets declined in response to monetary policy tightening by major central banks and the war in Ukraine (Figure 3.8, panel 2).¹⁸

¹⁸For equities, no meaningful difference is found between the returns of those held by more vulnerable funds relative to less vulnerable funds, consistent with the notion that liquidity mismatches play a less important role in more liquid markets such as the equity market.

Taken together, these initial observations suggest that the vulnerabilities of OEFs could indeed adversely affect asset markets. In the discussion that follows, the chapter investigates the strength of the relationship between fund-level vulnerabilities and the fragility in asset markets (measured by the volatility of equity and bond returns).

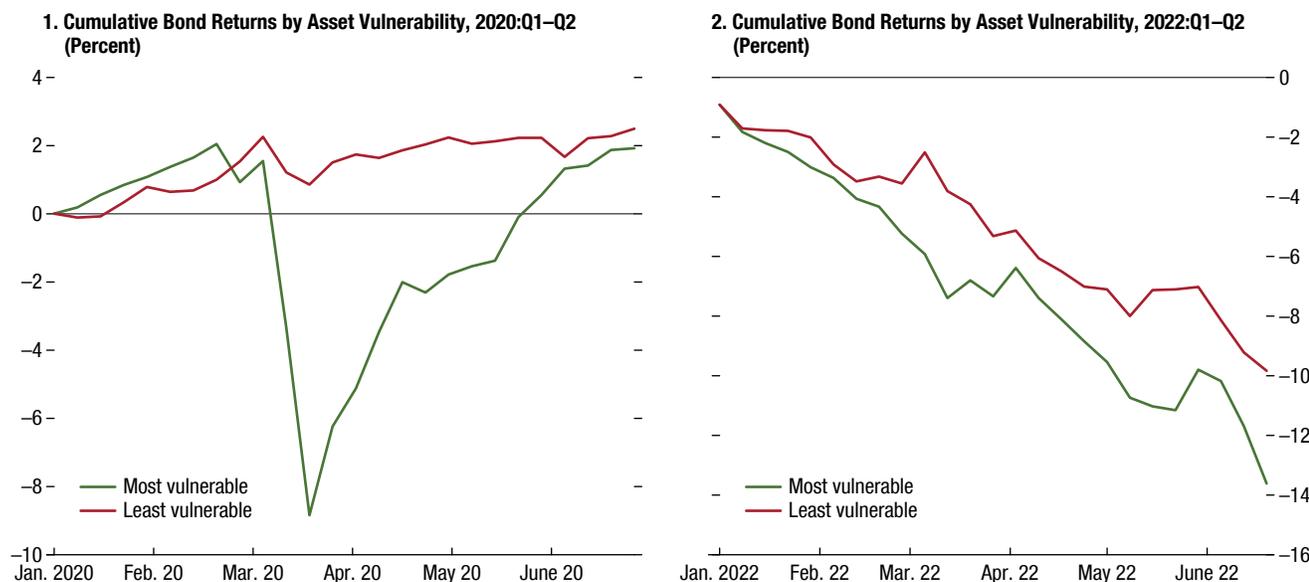
How Open-End Investment Fund Vulnerabilities Can Contribute to the Fragility of Asset Prices

Individual fixed-income securities that are held by less liquid funds tend to have more volatile returns than those held by liquid funds, after taking into account a wide range of other security characteristics that could affect the volatility of returns. The empirical analysis shows that the illiquidity of OEFs contributes to the fragility of bond returns in addition to what can be expected based on other bond characteristics, including their liquidity, rating, and

Figure 3.8. Bonds Held by Vulnerable Funds Have Underperformed in 2020 and 2022

During the dash-for-cash episode in March 2020, bonds held by more illiquid funds had lower returns.

Vulnerable securities have also underperformed so far in the 2022 bear market.



Sources: Morningstar; and IMF staff calculations.

Note: Most (least) vulnerable bonds are those in the top (bottom) tercile of the distribution of the asset-level vulnerability measure in 2019:Q4 (panel 1) and 2021:Q4 (panel 2). Average cumulative returns are weighted by market value. See Online Annex 3.2 for a more comprehensive econometric analysis confirming results in this descriptive analysis.

maturity (Figure 3.9).¹⁹ A one standard deviation increase in the vulnerability measure of an average bond increases its return volatility by 23 percent relative to the median return volatility of the bond (first bar on the left).²⁰ By contrast, the volatility of returns of relatively more liquid assets, such as sovereign bonds and equities, does not appear to be strongly affected by the liquidity of the funds that hold them.

The sensitivity of asset price fragility to fund vulnerabilities increases in periods of market stress. The analysis considers two measures of stress: (1) uncertainty (or fear) in financial markets, proxied by the Chicago Board Options Exchange Volatility (VIX) Index; and (2) US monetary

policy uncertainty.²¹ The analysis shows that the previously documented adverse impact of asset-level vulnerability on bond return volatility is more pronounced when financial or monetary policy uncertainty is elevated (Figure 3.10, panel 1). A one standard deviation increase in the vulnerability measure is associated with about a 20 percent increase in bond return volatility (relative to median volatility) when the VIX Index or monetary policy uncertainty is high (at the 75th percentile of their distribution) relative to when they are low (at the 25th percentile of their distribution).

Notably, in periods of high macro-financial uncertainty, the return volatility of more liquid assets such as sovereign bonds also appears to increase. This could be consistent with funds following a “pecking order” when liquidating assets

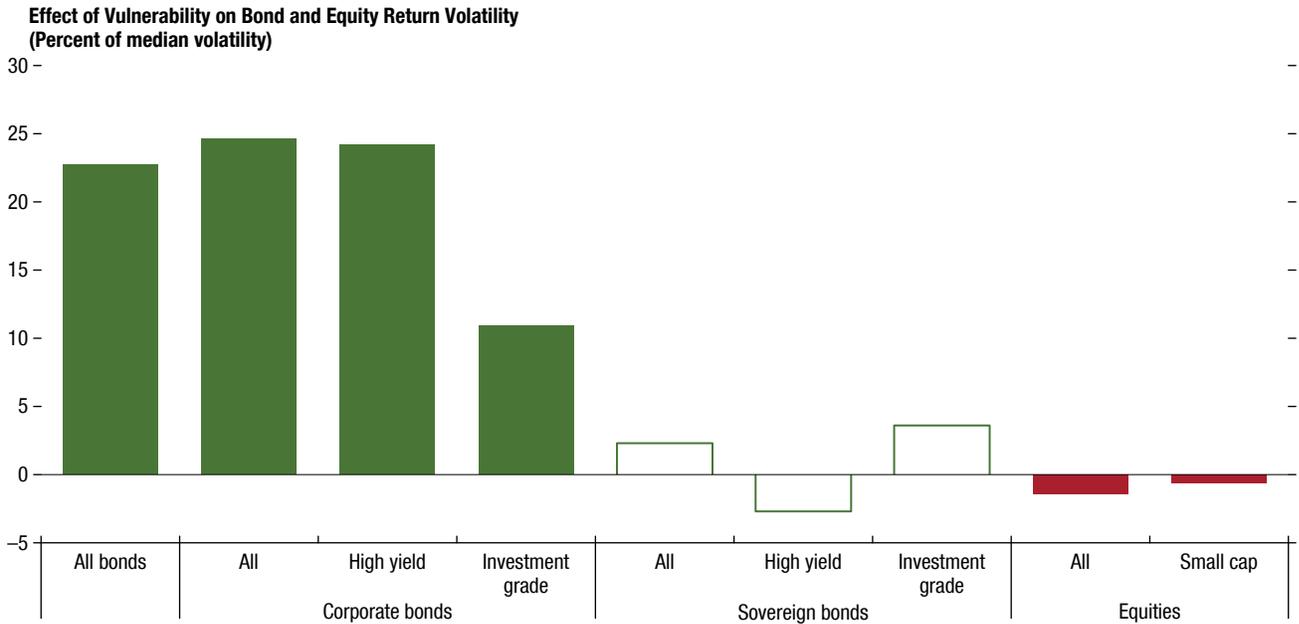
¹⁹The analysis is robust to the use of security and issuer fixed effects combined with time fixed effects, which controls for time-varying issuer characteristics such as credit risk. See Online Annex 3.2 for a detailed description of the empirical approach and robustness tests.

²⁰This finding is comparable to that reported by Jiang and others (2022), who find that a one standard deviation increase in the vulnerability of US corporate bonds is associated with a 16 percent higher return volatility.

²¹US monetary policy uncertainty is measured based on textual analysis of newspaper articles (Husted, Rogers, and Sun 2020). Based on this measure, monetary policy uncertainty was elevated in 2019 and has been rising since the end of 2021. The VIX Index spiked during the market turbulence in March 2020, when uncertainty about the effect of the COVID-19 pandemic was high (see Online Annex 3.2).

Figure 3.9. Open-End Investment Fund Vulnerabilities Contribute to Fragility in Corporate Bond Markets

Corporate bonds held by less liquid funds tend to experience significant return volatility, but more liquid asset classes, such as sovereign bonds or equities, do not.



Sources: FactSet; Morningstar; Refinitiv; and IMF staff calculations.

Note: The figure shows the coefficient on the asset-level vulnerability measure in a regression of quarterly asset return volatility on the lagged vulnerability measure over the period 2013:Q4–2021:Q4. Asset-level vulnerability is calculated based on the illiquidity of the funds holding that asset (following Jiang and others 2022). Coefficients are shown by asset class. Asset return volatility is calculated based on weekly returns over one quarter and is expressed relative to the sample median of the respective asset class. Asset-level vulnerability is defined as a z-score (de-measured and divided by the standard deviation of the respective subsample). For details of the estimated regression models, see Online Annex 3.2. Solid bars indicate statistical significance at 10 percent or lower.

in times of stress (Ma, Xiao, and Zeng 2022). Funds with sufficient liquid assets may sell those first to raise cash before selling their illiquid assets. In such cases, even otherwise liquid assets can become fragile.²²

Herding can further amplify the effect of fund vulnerabilities on asset prices. As discussed earlier, the simultaneous selling of assets by investment funds that hold similar portfolios or have similar strategies and behaviors could drive asset prices away from fundamentals and induce more volatility, especially under strained market liquidity conditions. The results of the analysis show that this is indeed the case: the impact of fund-level illiquidity on volatility is higher for securities that experience higher levels of herding (where herding is measured as the

tendency of funds to trade in the same direction, following Cai and others 2019). A one standard deviation increase in the vulnerability measure has a 3 percent to 5 percent larger effect on return volatility (relative to the median) for securities exposed to sell-herding compared with those that are not exposed (Figure 3.10, panel 2).

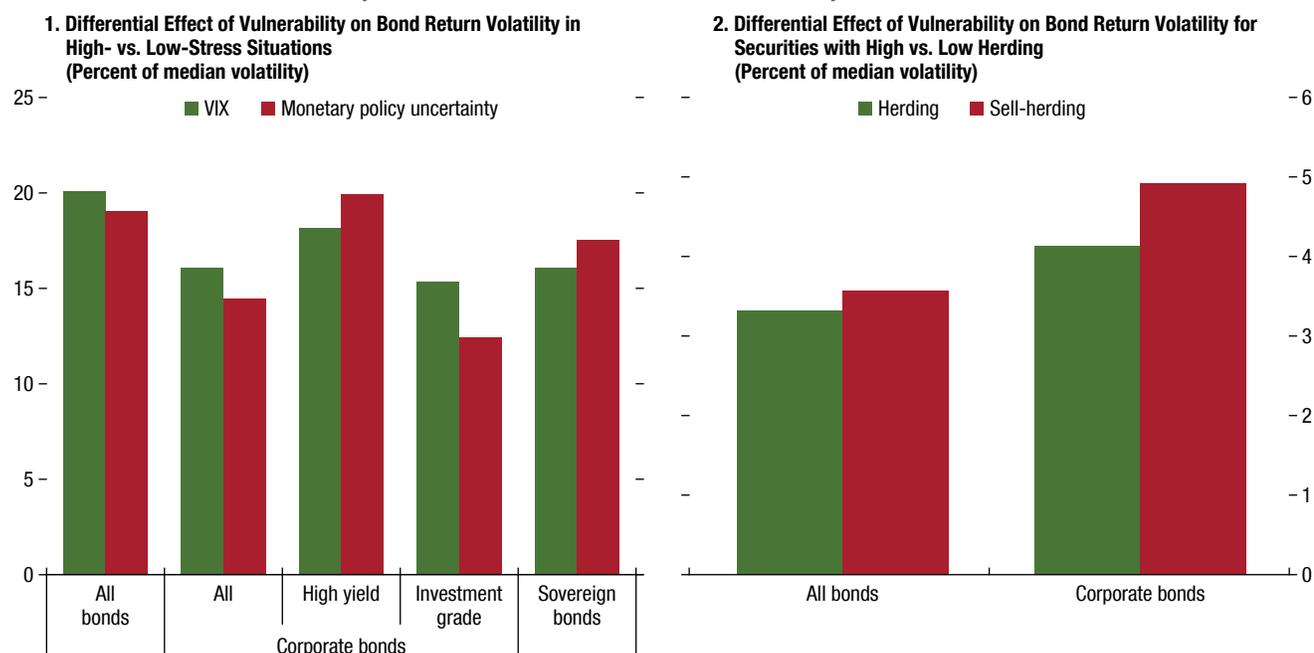
Emerging markets are particularly vulnerable to sharp outflows from OEFs. Fund-level vulnerabilities in advanced economies tend to spill over to asset prices in emerging market economies, particularly to corporate bond prices (Figure 3.11, panel 1). A one standard deviation increase in the vulnerability measure of emerging market corporate bonds held by funds domiciled in advanced economies is associated with a 23 percent increase in their return volatility relative to their median volatility. The impact is magnified during market stress: a one standard deviation increase in vulnerability is associated with a 14 percent higher impact on bond return volatility

²²Empirical analysis conducted later in the chapter supports the view that funds follow a pecking order of liquidation in times of stress.

Figure 3.10. Asset-Level Vulnerabilities Amplified by Market Stress and Herding

The return volatility of fixed-income assets held by more illiquid funds increases as macro-financial uncertainty rises.

Herding by funds can also amplify the adverse effect of vulnerabilities on return volatility.



Sources: FactSet; Morningstar; Refinitiv; and IMF staff calculations.

Note: Panel 1 shows the difference in the impact of the asset-level vulnerability measure on asset return volatility at high and low levels of the Chicago Board Options Exchange Volatility (VIX) Index and the monetary policy uncertainty measure (where high and low refer to the 75th and 25th percentiles of the sample distribution of the corresponding stress variables, respectively). Panel 2 shows the difference in the impact of the asset-level vulnerability measure on asset return volatility at high and low levels of sell-herding (where high and low are defined as the 75th and 25th percentiles of the sample distribution of the herding measure, respectively). The herding measure is based on Cai and others (2019); sell-herding considers only securities with more sellers than buyers. See Online Annex 3.2 for further details on the estimated regressions. Solid bars indicate statistical significance at 10 percent or lower.

in periods when the VIX Index is high compared with periods when it is low (Figure 3.11, panel 2).

These findings suggest that vulnerabilities associated with funds' liquidity mismatches generate fragility in asset markets, especially in fixed-income markets. The results also show that this fragility is amplified when macro-financial uncertainty is high and funds engage in herding. The next section will shed light on some of the underlying mechanisms through which fund vulnerabilities tend to influence asset return volatility.

Transmission of Risks from Open-End Investment Funds to Asset Price Fragility

An adverse shock can create a vicious circle, especially for less liquid funds, whereby investor redemptions force funds to liquidate portfolios, generating selling pressures that reduce the market

value of securities and lead to further redemptions.

This vicious circle is illustrated in Figure 3.5, and the analysis confirms the empirical relevance of this mechanism through three main findings:

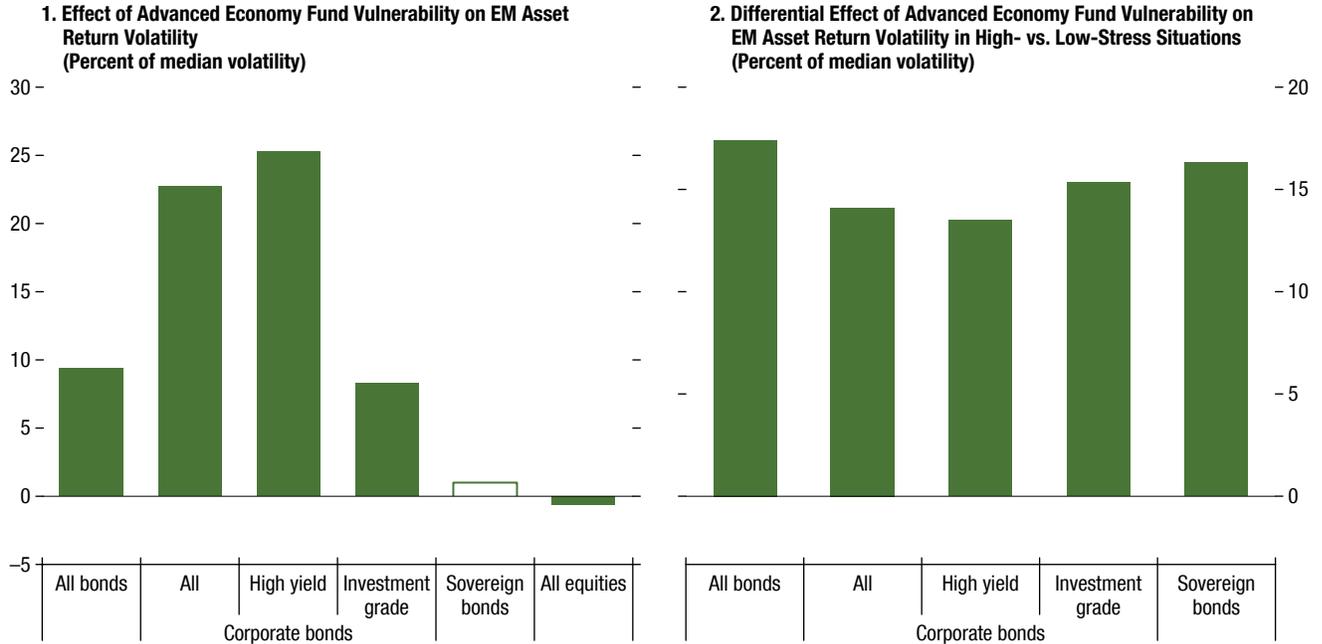
- Less liquid funds tend to face larger outflows, particularly during periods of high uncertainty and volatility, as measured by an increase in the VIX Index (Figure 3.12, panel 1).²³
- Outflows from funds lead to selling pressure. Bonds with higher vulnerability—that is, those held by less liquid funds—are more likely to be liquidated when funds experience large outflows, with the effects being particularly pronounced for

²³The higher sensitivity of fund outflows to fund illiquidity during periods of stress complements previous findings by Chen, Goldstein, and Jiang (2010) and Goldstein, Jiang, and Ng (2017), who show a stronger sensitivity of outflows to the poor performance of illiquid funds.

Figure 3.11. Spillovers from Advanced Economy Open-End Investment Funds to Asset Prices in Emerging Market Economies

Vulnerabilities from funds domiciled in advanced economies can spill over to bond markets in emerging markets ...

... and the effect is particularly pronounced in periods of high financial uncertainty.



Sources: Morningstar; and IMF staff calculations.

Note: Panel 1 shows the spillover effect of vulnerabilities from funds domiciled in advanced economies on EM securities markets by regressing EM bond and equity return volatility on asset-level vulnerability measures that are calculated considering advanced economy funds only and relevant controls. Panel 2 shows the difference in the impact of the asset-level vulnerability measure at high and low levels of the Chicago Board Options Exchange Volatility Index (for which high and low refer to the 75th and 25th percentile of the sample distribution, respectively). See Online Annex 3.2 for a detailed description of the regression models. Solid bars indicate statistical significance at 10 percent or lower. EM = emerging market.

high-yield bonds (Figure 3.12, panel 2).²⁴ Further analysis shows that in periods of market stress, such as during the COVID-19 market turmoil, funds appear to follow a pecking order of liquidation, selling relatively more liquid assets within their portfolio first (Figure 3.12, panel 3).²⁵ This result

implies that selling pressure on funds can also have a sizable price impact on asset markets that are usually considered liquid (such as sovereign bonds) when uncertainty is high, as illustrated in Figure 3.10, panel 1.

- Selling pressures induced by fund outflows lead to significant price movements in the underlying assets. Estimating the impact of selling pressure on the abnormal returns of different assets during the COVID-19 market turmoil suggests that selling pressures can cause substantial price movements and negative abnormal returns for bonds (Figure 3.12, panel 4).²⁶

²⁴The selling pressure measure captures the difference between sales and purchases of bonds by OEFs that experience extreme outflows and inflows, respectively, with a large positive (negative) value indicating strong selling (buying) pressure.

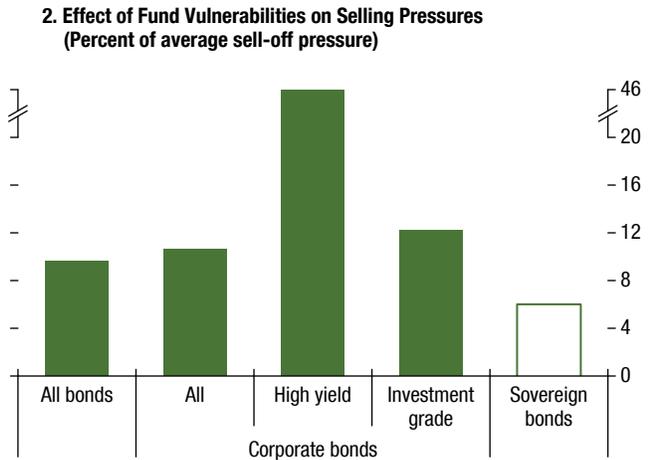
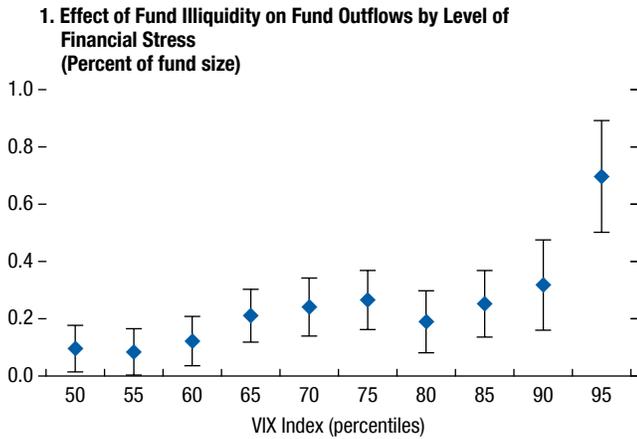
²⁵Such a pecking order—known as horizontal slicing—implies that the likelihood of a fund’s sale of a given security depends not only on the absolute level of liquidity of the security but also on its liquidity relative to other assets in the fund’s portfolio; that is, its liquidation rank (Ma, Xiao, and Zeng 2022). The liquidation rank of a security in a fund’s portfolio corresponds to the portfolio share of other bonds held by the same fund that are less liquid. This implies, for example, that an investment-grade bond held by a high-yield fund might be among the first assets to be sold, while the same bond held by an investment-grade fund might be liquidated much later in the pecking order (as more liquid assets might be available in the investment-grade fund). See Online Annex 3.3 for further details.

²⁶The measure of selling pressure used here accounts for funds’ liquidation policies. Intuitively, the “liquidation-adjusted” outflow of two securities held by the same fund will depend on the pecking order followed by the fund, since securities higher up in the pecking order are more likely to be sold by the fund to raise the cash needed when facing outflows.

Figure 3.12. Transmission Channels of Open-End Investment Fund Vulnerabilities

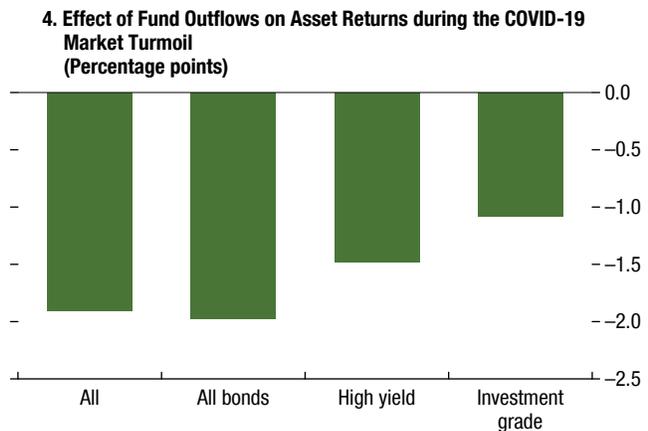
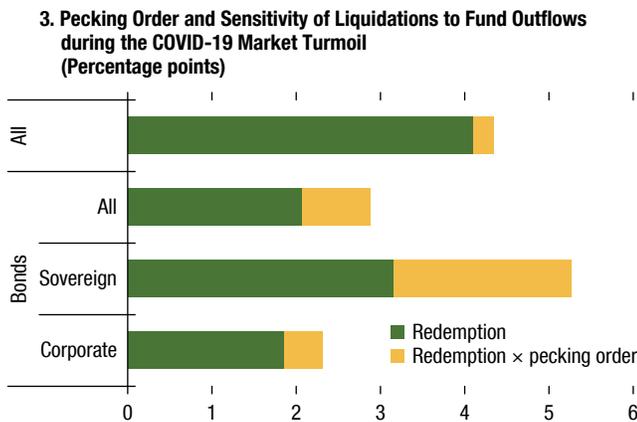
Illiquid funds tend to face larger outflows, especially at high levels of stress.

Assets held by less liquid funds face stronger selling pressures.



During periods of market stress, more liquid securities are more likely to be sold first following large investor redemptions ...

... and subsequent selling pressure can lead to significant price movements in the underlying assets.



Sources: Bloomberg Finance L.P.; FactSet; Haver Analytics; Morningstar; and IMF staff calculations.

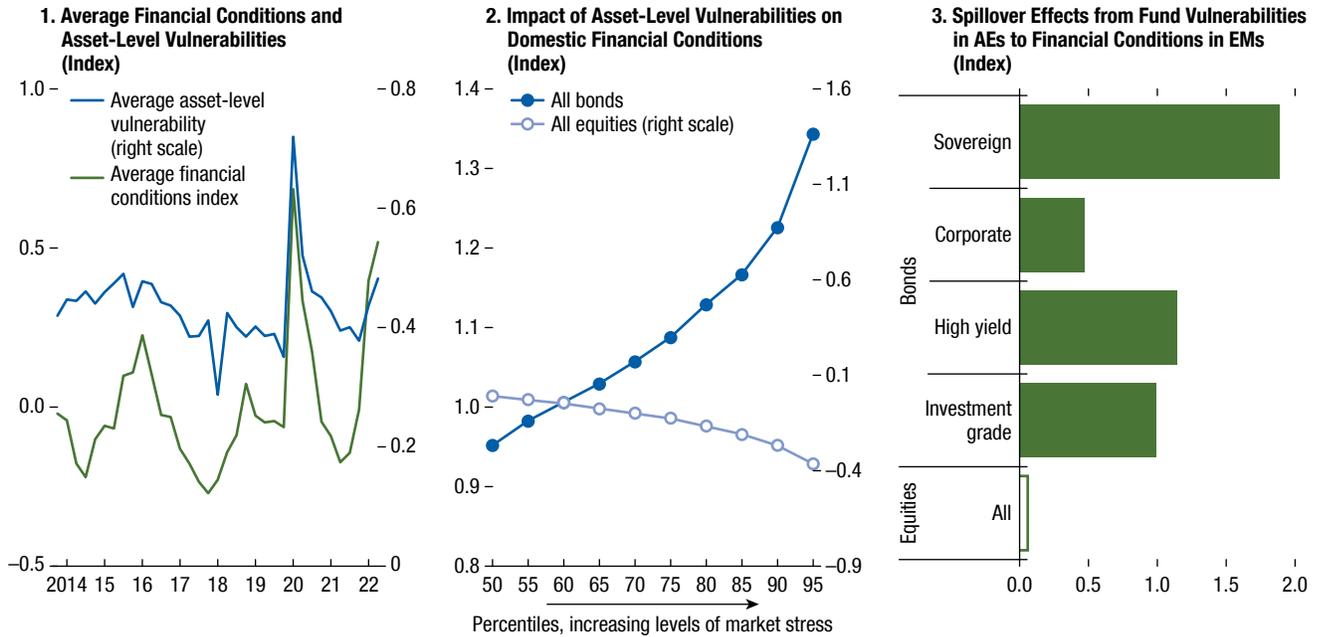
Note: Panel 1 shows the results of fund-level panel regressions in which outflows from funds are regressed on fund-level illiquidity measures while controlling for fund-level characteristics and country-time fixed effects. The results are presented at different levels of market stress identified as periods when the Chicago Board Options Exchange Volatility (VIX) Index is above a given percentile of its sample distribution. Error bars correspond to 90 percent confidence intervals. In panels 2–4, “All” refers to all securities in the sample, including equities. Panel 2 shows the effect of the asset-level vulnerability measure on selling pressures of assets over the sample period. The indicator of selling pressure is constructed following Jiang and others (2022) and is based on realized fund trades conditional on large fund flows to capture selling pressures for a given asset. A large positive (negative) value of the measure indicates strong selling (buying) pressure. The value of the estimated coefficient for high-yield corporate bonds is equal to 46 percent (the y-axis is truncated for visual clarity). Panels 3 and 4 show the results of an event study analysis focusing on the COVID-19–induced market turmoil in the first quarter of 2020. Panel 3 shows the effect of 10 percent fund outflows (“redemptions”) on securities liquidations when the outflow is interacted with a fund-security-level pecking order indicator for each security. The pecking order of a security in a given fund’s portfolio corresponds to its liquidation rank as defined in Ma, Xiao, and Zeng (2022). It is computed for each asset held by a given fund as the total portfolio share of other securities held by the same fund that are relatively less liquid (that is, have a higher bid-ask spread). Panel 4 shows the effect of liquidation-adjusted outflows from funds on abnormal returns of different assets. Abnormal returns are calculated as the difference between a security’s return and the average return of assets with a similar maturity and rating. Solid bars indicate statistical significance at 10 percent or lower. See Online Annex 3.2 for a detailed description of the variables and empirical methodology.

Figure 3.13. Open-End Investment Fund Vulnerabilities and Financial Conditions

An increase in asset holdings by more illiquid open-end investment funds is associated with tighter financial conditions ...

... and the relationship is stronger when financial conditions are tight.

Fund vulnerabilities imply negative cross-border spillovers for EMs.



Sources: Bloomberg Finance L.P.; FactSet; Haver Analytics; Morningstar; and IMF staff calculations.
 Note: Panel 1 shows the average asset-level vulnerability and domestic financial conditions index across countries. Higher values of the financial conditions index indicate a tightening of financial conditions. The index is set to zero at its historical average. See Online Appendix 3.2 for a description of the domestic financial conditions index. Panels 2–3 show the results from country-level panel regressions with fixed effects in which the domestic financial conditions index in period $t + 1$ is regressed on asset-level vulnerabilities averaged at the issuer-country level in period t . Panel 2 is estimated using panel quantile regressions to assess the relationship between financial conditions and fund vulnerabilities at different levels of market stress. The model controls for domestic macro-financial factors and external shocks such as domestic and US monetary policy shocks, average GDP growth of foreign economies, changes in global liquidity conditions, and commodity price shocks. In panel 3, spillover analysis is performed by substituting domestic fund vulnerabilities with a measure capturing foreign fund vulnerabilities, which is computed as the average asset-level vulnerability from holdings of funds domiciled in advanced economies. Panel 3 shows the effect when restricting the country-level panel regressions to EMs. Solid dots and solid bars indicate statistical significance at 10 percent or lower. AE = advanced economy; EM = emerging market.

Spillovers to Financial Markets from Vulnerabilities in Open-End Investment Funds

Through their effect on asset prices, fund vulnerabilities may generate broader macro-financial stability risks. As shown in the previous section, investor redemptions from funds lead to selling pressure that increases market volatility and depresses asset prices. The reduction in asset prices could in turn adversely affect the balance sheets of other financial and non-financial entities and lead to a broader tightening of financial conditions, generating macro-financial stability risks. A preliminary look at the data suggests that average financial conditions across countries are indeed correlated with average asset-level vulnerability (the extent to which assets are held by illiquid funds).

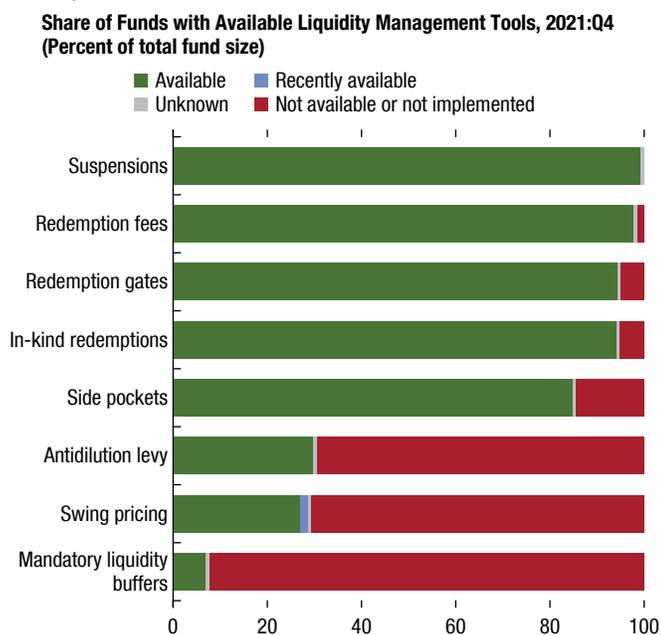
That is, financial conditions appear to tighten with an increase in asset holdings by less liquid OEFs, and vice versa (Figure 3.13, panel 1).

Formal empirical analysis confirms that fund vulnerabilities can lead to market-wide effects, and that the strength of the relationship varies with the level of market stress.²⁷ On average, an increase in the vulnerability measure for less liquid assets such as bonds is associated with a significant tightening of financial

²⁷Country-level panel regressions are estimated looking at the impact of average asset-level vulnerabilities (that is, the extent to which domestic securities are held by more illiquid funds) on future domestic financial conditions while controlling for other relevant domestic and external factors such as domestic and US monetary policy shocks, average GDP growth of foreign economies, changes in global liquidity conditions, and commodity price shocks.

Figure 3.14. Availability and Implementation of Liquidity Management Tools

The availability and implementation of liquidity management tools vary across jurisdictions.



Sources: European Securities and Markets Authority (2020); International Organization of Securities Commissions (2015); Morningstar; and IMF staff calculations.

Note: Bars represent the total net assets of funds across jurisdictions that can and do implement liquidity management tools.

conditions in the next period (Figure 3.13, panel 2). No similar effect is visible for more liquid equity securities. Furthermore, this effect is amplified as financial conditions tighten.

The impact of fund vulnerabilities in source countries can also spill over to financial conditions in recipient economies. On average, increased holdings of domestic assets by nonresident advanced economy illiquid funds are associated with significant tightening in domestic financial conditions of recipient countries in the period that follows (Figure 3.13, panel 3). While such spillover effects from advanced economy funds are present for the full sample of countries, they are much stronger for emerging market economies (Online Annex Figure 3.2.2).

Overall, these results show that OEFs can transmit shocks to financial conditions, both domestically and

across borders. Reducing the vulnerabilities associated with these funds could thus help mitigate asset price fragility and risks to macro-financial stability. In this context, the next section looks at the role that liquidity risk management tools can play to enhance the resilience of the sector.

Liquidity Management Tools to Address the Risks from Open-End Investment Funds

Liquidity management tools can potentially reduce the vulnerabilities associated with OEFs and mitigate their potential to amplify asset price fragility. The availability of liquidity management tools varies by jurisdiction, but in general a wide range of tools is available to OEFs across all major jurisdictions (Figure 3.14). Tools that limit investors' ability to redeem when funds experience severe outflows—such as redemption suspensions, redemption fees, redemption gates, or in-kind redemptions—are the most widely available. However, these are generally deployed only in periods of extreme market stress, and funds tend to be concerned about the stigma associated with their use.²⁸ Antidilution levies and swing pricing are tools that can potentially reduce OEF vulnerabilities ex ante by passing on transaction costs (including asset liquidation costs) to investors exiting the fund, thus reducing their incentives to run. However, antidilution levies and swing pricing are available only in a limited number of jurisdictions, and their utilization remains limited.²⁹ Mandatory requirements on holding minimum liquidity buffers appear to be the least-used tools across jurisdictions.

²⁸For example, Grill, Vivar, and Wedow (2021) document that during the COVID-19 market turmoil, at least 215 funds suspended redemptions and that those funds subsequently experienced larger outflows than comparable funds, suggesting reputational costs associated with fund suspensions.

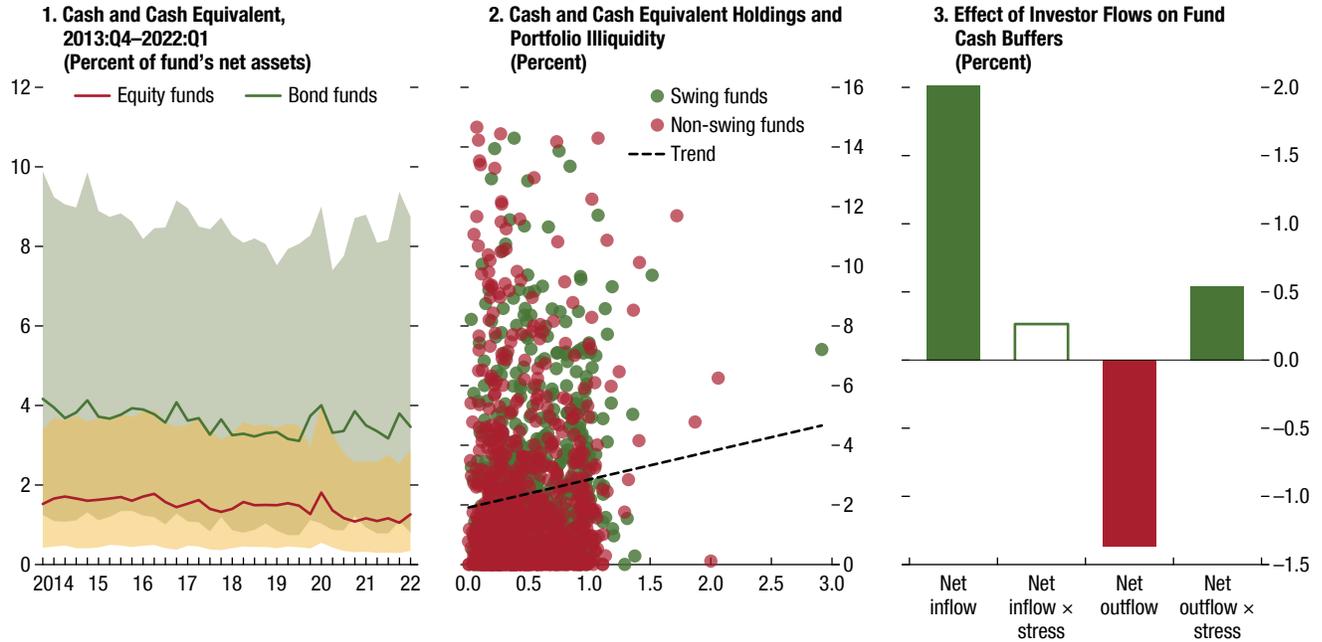
²⁹Swing pricing is commonly used by funds in Europe (Bank of England and Financial Conduct Authority 2021; European Securities and Markets Authority 2020) but has not been implemented by funds in the United States, despite approval to do so by the Securities and Exchange Commission in 2018. A key reason for this lack of adoption in the United States is that funds there may not necessarily know the size of net flows into the fund before the price of a fund is determined. This precludes them from applying a swing factor that is based on net flows.

Figure 3.15. Liquid Asset Holdings of Open-End Investment Funds

Cash buffers vary widely within and across funds ...

... but tend to increase with the illiquidity of a fund's portfolio, with no notable difference between funds that use swing pricing and those that do not.

Funds appear to rely less on cash buffers to manage investor redemptions in periods of stress.



Sources: Morningstar; and IMF staff calculations.

Note: Cash and cash equivalents include cash held in bank accounts as well as certificates of deposit, currency, money market holdings, and other high-quality fixed-income securities with a maturity of less than 92 days. Panel 1 shows the median level of cash and cash equivalents relative to a fund's total net assets, and the green and yellow areas indicate the interquartile range. Panel 2 shows the average portfolio illiquidity of funds (over the sample) relative to their cash holdings in percent of total net assets. Panel 3 shows the coefficients from a regression of the percentage change in fund-level cash holdings on net inflows as a percent of fund assets, net outflows as a percent of fund assets, and interaction terms with a stress dummy equal to 1 when the Chicago Board Options Exchange Volatility Index is above its 90th sample percentile. Net inflows are equal to positive net fund flows and zero otherwise. Net outflows are calculated as the negative of net fund flows when fund flows are negative and are zero otherwise. See Online Annex 3.4 for further details on the regression models and variables. Solid bars indicate statistical significance at 10 percent or lower.

There is no clear consensus yet on the effectiveness of liquidity buffers in mitigating fund vulnerabilities.³⁰ Liquidity buffers could provide funds with additional flexibility to time their asset sales when facing outflows. However, they do not eliminate the first-mover advantage and can also adversely impact long-term fund performance by constraining the capacity of

funds to provide investors with exposure to particular investment themes or asset classes.

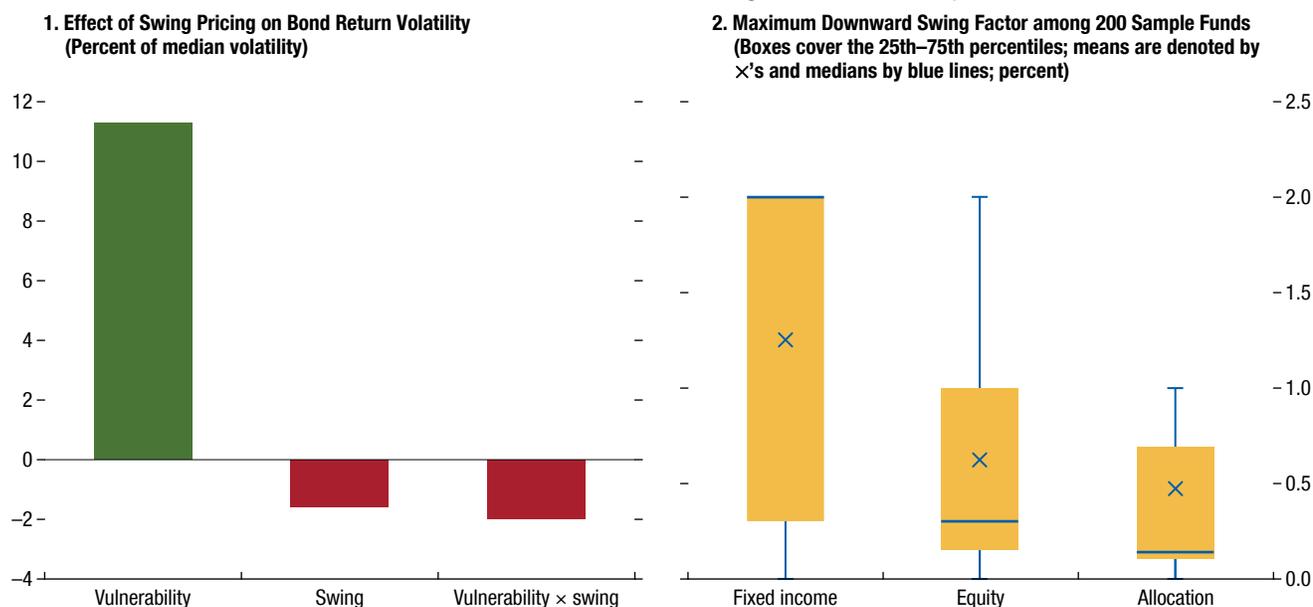
In general, funds holding relatively less liquid securities tend to have higher cash buffers, even if not mandated. Liquidity buffers of OEFs vary widely across and within fund types, ranging from 0.5 percent to 4 percent for equity funds and from 1 percent to 9 percent for bond funds (Figure 3.15, panel 1). Funds holding relatively illiquid securities—as measured by their bid-ask spread—on average hold larger cash buffers, which could provide them with the ability to pay redeeming investors without forcing asset sales in stressed market conditions (Figure 3.15, panel 2). There is, however, no meaningful difference between the cash holdings of funds that use swing pricing as a liquidity management tool and those

³⁰For example, Giuzio and others (2021) argue that cash buffers can reduce run risks and costly sales of illiquid assets. Di Lasio, Kaufmann and Wicknig (2022) argue that liquidity buffers could reduce bond sales by funds that are hit by large redemptions. However, dynamic cash rebuilding by funds after outflows could also exacerbate rather than reduce run risks (Zeng 2017). Jiang, Li, and Wang (2021) further show that corporate bond funds may not necessarily use their more liquid asset holdings relative to illiquid assets during periods of market stress to maintain portfolio liquidity.

Figure 3.16. Effectiveness of Swing Pricing in Reducing Asset Price Fragility

Swing pricing can partially mitigate asset price fragility due to fund vulnerabilities.

However, swing factors are often capped at low levels, potentially reducing their effectiveness in periods of market stress.



Sources: FactSet; Morningstar; Refinitiv; and IMF staff calculations.
 Note: Panel 1 shows the coefficients from a regression of return volatility on asset-level vulnerabilities and an asset-level swing pricing exposure variable, in which swing pricing funds are defined as funds domiciled in Luxembourg or the United Kingdom. Effects are based on weekly asset price volatilities. See Online Annex 3.2 for further details on the empirical framework. Solid bars indicate statistical significance at 10 percent or lower.

that do not. Analyzing the impact of redemptions on funds’ cash buffers suggests that in normal times funds facing outflows deplete their cash buffers to pay out investors, though this does not necessarily hold in times of severe market stress, when funds appear to preserve the liquidity of their portfolios (Figure 3.15, panel 3).³¹

Swing pricing appears to be an effective tool to reduce fund-induced asset price fragility, but calibration is key. In contrast to ex post liquidity management tools such as gates or suspensions, which address runs on funds once they occur, swing pricing is an ex ante tool that eliminates first-mover advantages in OEFs by directly imposing the transaction costs associated with redemptions on the redeeming investors (such as in ETFs; Box 3.1). However, this requires “swing factors” (that is, the adjustment factor applied to the fund price at which investors can redeem or subscribe to mutual fund shares) to be calibrated to

reflect the full cost of outflows, including the price impact of asset liquidations.³² This calibration could be challenging for highly illiquid assets or in periods of extreme market stress when assessing the price impact of trades may be difficult due to price dislocation.³³ Swing pricing mitigates vulnerabilities from OEFs, but investor run risks remain if swing factors are set too low. The chapter’s analysis shows that the adverse impact of fund vulnerabilities on the volatility of bond returns is reduced by about one-third if more funds implement swing pricing (Figure 3.16, panel 1).³⁴ However, this mitigating effect is not

³¹This finding is consistent with Jiang, Li, and Wang (2021), who show that during tranquil market conditions, corporate bond funds tend to reduce liquid asset holdings to meet investor redemptions, but in periods with heightened uncertainty, they tend to preserve portfolio liquidity.

³²Antidilution levies can have a similar effect by imposing a fee on redeeming investors.

³³The expected price impact will depend not only on the trading needs of a single fund but also on those of other funds, making it particularly difficult for funds to accurately estimate price impact in times of stress. Optimally, swing factors would incorporate the trading behaviors of the overall fund sector.

³⁴This result is in line with Jin and others (2022), who show that swing pricing can eliminate the first-mover advantage arising from the traditional pricing rule and significantly reduce outflows during market stress. However, the result of swing pricing needs to be interpreted with caution because limited data about the use of swing pricing by funds make it difficult to accurately identify its effect. The empirical analysis proxies for swing pricing by classifying funds domiciled in countries where swing pricing is ubiquitous as

sufficient to fully offset the increase in return volatility induced by illiquid funds' holdings of the bonds.³⁵ The limited effectiveness of swing pricing could be the result of insufficient calibration of the swing factor. Studies estimating the optimal swing factor for OEFs that would fully eliminate run risks and the associated vulnerabilities find it to be in the range of 0 to 9 percent, with the higher end of the range applying to periods of stress when price impact is high and for funds whose investors react strongly to poor performance (Capponi, Glasserman, and Weber 2020; Anadu and others 2022).³⁶ Currently, many funds are constrained by maximum swing factors, which they typically set substantially below 9 percent (Figure 3.16, panel 2) and define in their prospectuses.³⁷ These caps tend to be set based on direct trading costs, such as commissions and bid-ask spreads, without fully accounting for indirect costs such as the price impact of asset sales. Funds may also set the swing factors low out of competitive pressure because some investors may value liquidity provision and prefer funds with low caps on the size of the swing factors. Such caps may limit the ability of funds to adjust swing factors sufficiently to cover the impact of redemptions in times of stress on asset prices, thereby reducing the effectiveness of swing pricing in eliminating run risk.

Conclusion and Policy Recommendations

Open-end investment funds play an increasingly important role in financial markets but raise financial stability concerns. The share of global financial assets

“swinging funds” and the rest as “nonswinging funds.” See Online Annex 3.2 for a description of the empirical methodology.

³⁵These results capture only the direct effect from funds' adoption of swing pricing on the price volatility of bonds in their portfolio. The introduction of swing pricing at the fund level likely offers additional benefits by reducing run risks for other funds holding similar assets, thereby stabilizing the fund market segment as a whole.

³⁶Capponi, Glasserman, and Weber (2020) calibrate the optimal swing factor as a function of the direct price impact on assets that would result from funds' transactions following investor redemptions. Anadu and others (2022) consider ETF premiums and discounts to derive the optimal swing factors for funds investing in short-term corporate bonds. The latter approach may have several limitations because ETF premiums and discounts may also be driven by factors such as the ability of authorized participants to provide liquidity. In addition, ETF investors may differ (have different liquidity preferences) from OEF investors.

³⁷In most jurisdictions where swing pricing is permitted, funds are required to publish the maximum swing factors they may apply in their prospectus and cannot apply a larger swing factor without changing the prospectus.

held by OEFs has grown dramatically over the past two decades. However, vulnerabilities associated with the liquidity mismatch between their asset holdings and liabilities can subject some funds to investor run risk that can lead to severe dislocations in financial markets and amplify the adverse macro-financial impact of exogenous shocks.

The analysis in this chapter shows that OEFs holding illiquid assets that offer daily redemptions to investors are a key driver of asset price fragility. The most affected assets are those in less liquid markets, such as corporate bonds. The volatility of their returns increases significantly—especially in times of market stress—if these assets are held by more illiquid funds. The impact of fund vulnerabilities can have significant cross-border spillover effects and lead to greater asset price volatility in emerging market economies. They may also have system-wide implications by contributing to a tightening of domestic financial conditions, thereby reinforcing the vicious cycle between redemptions, fund asset sales, and the price impact of these sales.

Policy action is needed to mitigate the risks associated with OEFs. A wide range of liquidity management tools is available that could potentially mitigate the vulnerabilities associated with OEFs and reduce their systemic impact, but effective implementation of these tools is lacking.

Policy tools that limit vulnerabilities *ex ante* by reducing the risk of investor runs may be preferable to those that attempt to mitigate the impact of such runs once they are underway. Liquidity management tools that limit investors' ability to redeem—such as redemption suspensions or gates—do not address the intrinsic first-mover advantage problem associated with some OEFs and are typically adopted by funds already facing significant outflow pressures, which may limit their effectiveness in mitigating systemic risks.³⁸ Holding cash and other liquidity buffers may give funds the flexibility to respond to shocks but do not necessarily reduce the risk of investor runs and hence may also be insufficient to address the systemic risks associated with less liquid OEFs.³⁹ By contrast, price-based tools, such as swing pricing or antidilution

³⁸Such tools could even exacerbate run risks because investors may try to redeem before the measures are applied by the fund.

³⁹Tools such as redemption suspensions and liquidity buffers may also be less desirable from an end-investor perspective because they restrict access to liquidity and constrain funds' investment mandates, respectively.

levies, can reduce investors' incentives to front-run others by passing on transaction costs to redeeming investors, thereby protecting investors and mitigating systemic risks. However, more widespread adoption by funds and appropriate calibration of these tools is key to their effectiveness.

Policy interventions may be necessary to ensure that price-based measures are set at adequate levels, especially in periods of stress and poor market liquidity. Swing pricing, for example, has been a market-led innovation in many jurisdictions, introduced to protect investors from the dilution of their fund shares. However, fund-imposed caps on swing factors could constrain funds' ability to fully pass on the transaction costs to redeeming investors and, thus far, may have limited the effectiveness of swing pricing as a macroprudential tool in times of stress. Funds could therefore be required to eliminate caps and to calibrate swing factors such that they fully reflect the price impact of a fund's asset sales.⁴⁰ Policymakers should further investigate how to enhance the effectiveness of swing pricing and other price-based liquidity management tools—for example, by encouraging the disclosure of swing pricing practices and calibration methodologies and by improving the availability of aggregate fund flow data in real time to help funds determine the appropriate swing factors, especially during times of stress. Tighter monitoring of liquidity risk management practices by supervisors and regulators should also be considered to ensure the appropriate implementation of liquidity management tools. To this end, the collection of additional data on funds' liquidity risks may be necessary.

Other liquidity management tools could include linking the frequency of redemptions to the liquidity of funds' portfolios in order to directly address the underlying vulnerability related to liquidity mismatch. This option may be suitable for funds holding very illiquid assets (for example, real estate) for which the appropriate calibration of price-based tools is difficult even in normal times. It may also be suitable for funds

based in jurisdictions where price-based tools cannot be effectively implemented for operational reasons. In such cases, investors could be offered the opportunity to redeem early in exchange for a redemption fee that is calibrated to reflect stress conditions and prevent dilution of the shares of remaining investors.

Given the adverse cross-border spillover effects of fund vulnerabilities, recipient countries will also need to take appropriate policy steps to mitigate potential systemic risks arising from the volatility of capital flows sourced from international funds. Recipient countries need to be mindful of the volatility of capital flows originating from funds in advanced economies and emphasize continued deepening of domestic markets; appropriate use of debt management tools; and use of macroeconomic, prudential, capital flow management, and foreign exchange intervention tools in line with the IMF's Institutional View to address risks arising from surges and sharp reversals in portfolio investments by OEFs (IMF 2012, 2022).

Policymakers should further analyze exchange-traded funds (ETFs) which do not appear to be subject to the same liquidity vulnerabilities as OEFs (Box 3.1). Empirical analysis shows that bonds held by ETFs experience a smaller increase in volatility during periods of stress than comparable bonds held by OEFs. However, other evidence also shows that ETFs can increase nonfundamental volatility in asset markets and amplify the sensitivity of cross-border capital flows to global financial conditions.

Policymakers should put in place adequate disclosure requirements to allow for a proper assessment of the role of leverage in amplifying vulnerabilities from OEFs (IMF 2021). At present, the reporting of leverage, especially via the use of derivatives (synthetic leverage), is limited, which prevents a comprehensive assessment of its role in contributing to OEF vulnerabilities.

Policymakers should consider measures to bolster the provision of liquidity and market resilience. Regardless of the vulnerabilities associated with some OEFs, large-scale redemptions and asset sales by OEFs or other market participants could result in fire sales and dislocation of asset prices if markets are not sufficiently liquid. Measures to improve liquidity provision, such as encouraging central clearing and supporting greater transparency in bond trading, should be considered to reduce risks from liquidity mismatch in OEFs and to support the functioning of securities

⁴⁰In periods of extreme stress when market liquidity is very poor, swing factors or antidilution levies may be very large or difficult to calibrate. In such cases, redemption suspensions or gates may be an alternative, easier-to-implement tool. In a similar vein, IMF (2021) proposes a "waterfall" approach of progressively more aggressive liquidity management tools, such as redemption deferrals in case of moderate shocks, followed by in-kind redemption for moderate to large shocks, and market-wide fees or gates for large shocks.

markets in periods of stress (see the April 2015 GFSR and IMF 2021).

Competitive pressure and concerns about stigma may prevent funds from voluntarily implementing optimal policy solutions; policymakers should therefore consider mandating the adoption of liquidity management tools and enhanced disclosure. Over the past 15 years, central banks have had to intervene several times in financial markets during stress episodes to provide emergency liquidity support. To the extent

that entities not included in the traditional regulatory perimeter continue to benefit from such support, policymakers may have to consider more extensive regulation of investment funds in the absence of adequate liquidity management practices to limit financial stability risks. Given the global operations of funds and their cross-border spillover effects, liquidity management practices should be deployed consistently at the global level to ensure their effectiveness, which calls for greater international regulatory coordination.

Box 3.1. Exchange-Traded Funds Generate Less Asset Price Fragility but May Also Be Vulnerable

Exchange-traded funds (ETFs) allow investors to buy and sell shares within a trading day, but unlike open-end investment funds (OEFs) they are not vulnerable to investor runs. ETFs have grown rapidly and constitute a substantial part of the investment fund universe (Figure 3.1.1, panel 1). They differ from OEFs in that they do not guarantee investors the ability to redeem shares at the funds’ net asset value (that is, the price at the end of the trading day). Instead, ETFs are traded continuously in secondary markets at varying prices. These market prices are determined primarily by supply and demand for the ETF, and investors bear their own transaction costs when buying or selling. As a result, ETFs are not subject to the same first-mover advantage that gives rise to run risk

in OEFs. Empirical analysis shows that bonds held by ETFs experience less of an increase in volatility during periods of stress than comparable bonds held by OEFs (Figure 3.1.1, panel 2).

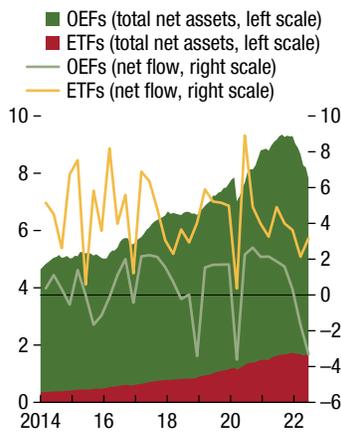
ETF discounts reflect market liquidity costs. ETF prices are tied to the ETFs’ net asset value through an arbitrage mechanism. Authorized participants, which tend to be large broker dealers, have the exclusive right to create and redeem ETF shares in exchange for a basket of portfolio securities. This process ensures that the secondary market price of ETFs remains close to the fund’s net asset value. However, when market liquidity deteriorates and the balance sheets of broker dealers are constrained such that they may be limited in their ability to match buyers and sellers (that is, make markets), the gap between the net asset value and the ETF’s share price could increase (Pan and

The author of this box is Anna-Theresa Helmke.

Figure 3.1.1. Asset Price Fragility and Exchange-Traded Funds

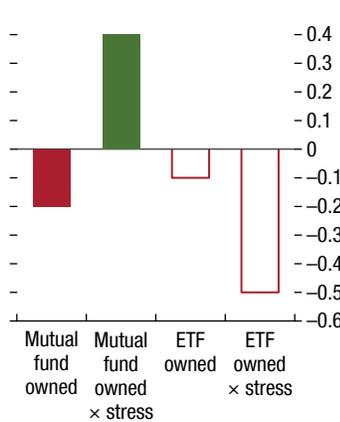
Inflows of ETFs have been large over the past decade.

1. Total Net Assets and Flows of Bond ETFs and OEFs (Trillions of US dollars; percent of total lagged net assets)



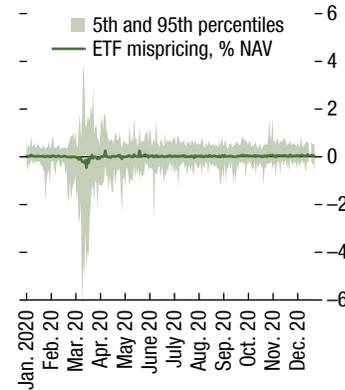
In periods of stress, ownership by OEFs is associated with higher asset price fragility than ownership of ETFs ...

2. Effect of OEF Ownership and ETF Ownership on Bond Return Volatility (Percent of median volatility)



... and at the same time, ETF discounts tend to increase when aggregate liquidity deteriorates.

3. Difference between ETF Price and Fund Net Asset Value in Percent of the Fund Net Asset Value for Bond ETFs (Percent)



Sources: FactSet; Morningstar; Refinitiv; and IMF staff calculations.

Note: Panel 2 shows the coefficients from a regression of return volatility on asset ownership and an interaction term between asset ownership and a stress dummy equal to 1 when the Chicago Board Options Exchange Volatility (VIX) Index is above its 90th sample percentile and zero otherwise. “Mutual fund owned” refers to the total amount of an asset held by OEFs, but not by ETFs, as a percentage of its market capitalization. Effects are based on weekly asset price volatilities. The regression includes asset and issuer fixed effects. Standard errors are clustered at the asset and quarter levels. Solid bars indicate statistical significance at 10 percent or lower. Panel 3 shows the distribution of ETF mispricing for the sample of bond ETFs domiciled in the United States or Luxembourg. ETF mispricing is calculated at daily frequency as the difference between the ETF closing price and the fund NAV divided by the fund NAV. ETF = exchange-traded fund; OEF = open-end investment fund; NAV = net asset value.

Box 3.1 (continued)

Zeng 2019). Similar to the way in which mutual funds pass on transaction costs to redeeming investors when using swing pricing, this difference between the net asset value and the ETF price (referred to as the *ETF discount*) reflects transaction costs borne by investors who want to buy or sell the ETF. For example, during the March 2020 stress episode, when liquidity conditions were poor, the discounts on ETFs increased dramatically, reaching more than 5 percent across all bond ETFs (up to 27 percent for high-yield bond ETFs and up to 13 percent for investment-grade bond ETFs; see Figure 3.1.1, panel 3). These discounts are indicative of the swing factor that would be required by an OEF with a similar portfolio structure and investor base.

ETFs are also subject to vulnerabilities. The provision of intraday liquidity by ETFs makes

them attractive for liquidity traders with short-term horizons. Together with the arbitrage activities of authorized participants who create and redeem ETF shares, this facilitates the transmission of nonfundamental shocks from short-term liquidity traders to securities markets. Consistent with this transmission, ETFs can increase nonfundamental volatility in asset markets (Ben-David, Franzoni, and Moussawi 2018) and amplify the sensitivity of cross-border capital flows to global financial conditions (Converse, Levy-Yeyati, and Williams 2020). Moreover, leveraged and inverse ETFs that rely on derivatives and short sales to amplify returns can introduce additional volatility in securities markets because of the need to rebalance the leveraged positions at the end of the trading day.

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