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GLOBAL FINANCIAL STABILITY REPORT

Resilience, Risk, and Transformation

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Cover and Design: IMF CSF Creative Solutions Division

Cataloging-in-Publication Data

IMF Library

Names: International Monetary Fund.
Title: Global financial stability report.
Other titles: GFSR | World economic and financial surveys, 0258-7440
Description: Washington, DC : International Monetary Fund, 2002- | Semiannual | Some issues also have thematic titles. | Began with issue for March 2002.
Subjects: LCSH: Capital market—Statistics—Periodicals. | International finance—Forecasting—Periodicals. | Economic stabilization—Periodicals.
Classification: LCC HG4523.G557

ISBNs: 979-8-22905-567-3 (paper)
979-8-22905-571-0 (ePub)
979-8-22905-569-7 (web PDF)

Disclaimer: The *Global Financial Stability Report* is a survey by the IMF staff published twice a year, in the spring and fall. The report draws out the financial ramifications of economic issues highlighted in the IMF's *World Economic Outlook*. The report was prepared by IMF staff and has benefited from comments and suggestions from Executive Directors following their discussion of the report on September 28, 2026. The views expressed in this publication are those of the IMF staff and do not necessarily represent the views of the IMF's Executive Directors or their national authorities.

Recommended citation: International Monetary Fund. 2026. *Global Financial Stability Report: Resilience, Risk, and Transformation.* Washington, DC, October.

Please send orders to:
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ASSUMPTIONS AND CONVENTIONS

The following conventions are used throughout the *Global Financial Stability Report*:

. . . to indicate that data are not available or not applicable;

— to indicate that the figure is zero or less than half the final digit shown or that the item does not exist;

– between years or months (for example, 2021–22 or January–June) to indicate the years or months covered, including the beginning and ending years or months;

/ between years or months (for example, 2021/22) to indicate a fiscal or financial year.

"Billion" means a thousand million.

"Trillion" means a thousand billion.

"Basis points" refers to hundredths of 1 percentage point (for example, 25 basis points are equivalent to ¼ of 1 percentage point).

Minor discrepancies between sums of constituent figures and totals shown reflect rounding.

As used in this report, the terms "country" and "economy" do not in all cases refer to a territorial entity that is a state as understood by international law and practice. As used here, the term also covers some territorial entities that are not states but for which statistical data are maintained on a separate and independent basis.

The boundaries, colors, denominations, and any other information shown on the maps do not imply, on the part of the International Monetary Fund, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.

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PREFACE

The *Global Financial Stability Report* (GFSR) assesses key vulnerabilities the global financial system is exposed to. In normal times, the report seeks to play a role in preventing crises by highlighting policies that may mitigate systemic risks, thereby contributing to global financial stability and the sustained economic growth of the IMF's member countries.

The analysis in this report was coordinated by the Monetary and Capital Markets (MCM) Department. It benefited from comments and suggestions from the senior staff in the MCM Department.

Chapter 1 was led by Jason Wu, Assistant Director; Caio Ferreira, Deputy Division Chief; and Sheheryar Malik, Deputy Division Chief. Individual contributors to Chapter 1 were Sally Chen, Yingyuan Chen, Timothy Chu, Fabio Cortes, Francesco de Rossi, Andrew A. Ferrante, Deepali Gautam, Esti Kemp, Johannes Kramer, Harrison Samuel Kraus, Mindaugas Leika, Yiran Li, Xiang-Li Lim, Amanda Liu, Sangeeta Nambi, Kleopatra Nikolaou, Gurnain Kaur Pasricha, Sonal Patel, Silvia Loyda Ramirez, Juan Vera-Fernandez, Dmitry Yakovlev, and Aki Yokoyama.

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Jeremie Benzaken, Nchimunya Kabunda, Olivia Marr, and Srujana P. Tyler were responsible for excellent coordination and editorial support.

Rumit Pancholi from the Communications Department led the editorial team and managed the report's production, with editorial and typesetting services from David Einhorn, Devlan O'Connor, James Unwin, MPS Limited, Bonner Publishing Services, and Grauel Group.

This issue of the GFSR draws in part on a series of discussions with banks, securities firms, asset management companies, hedge funds, standard setters, financial consultants, pension funds, trade associations, central banks, national treasuries, and academic researchers.

This GFSR reflects information available as of September 30, 2026. The report benefited from comments and suggestions from staff in other IMF departments, as well as from Executive Directors following their discussions of the GFSR on September 28, 2026. However, the analysis and policy considerations are those of the contributing staff and should not be attributed to the IMF, its Executive Directors, or their national authorities.

EXECUTIVE SUMMARY

Financial markets have been resilient since the April 2026 *Global Financial Stability Report*, but financial stability risks are elevated. Markets have found support from strong corporate earnings and solid economic growth, as high investments in firms related to artificial intelligence (AI) have helped offset a possible drag from geopolitical tensions and policy uncertainty. On balance, financial conditions remain accommodative.

At the same time, this report highlights three salient risks that could be near-term catalysts for a sharp tightening of financial conditions and market turmoil, selected based on the likelihood of their triggering shocks and the severity of their potential market impact.

First, although core firms in the AI ecosystem have been profitable so far—easing pressure on AI-related equity valuations—weaker or less durable investment and profitability in AI could trigger a correction in AI-related asset prices, exacerbated by rising leverage, concentrated exposures, and circular financing arrangements. Jurisdictions with financial markets sensitive to global AI developments, as well as those with substantial holdings of AI assets, are likely to be more exposed to negative wealth effects or sharp market corrections.

Second, resurgent inflation or fiscal concerns could trigger a sharp rise in sovereign bond yields and spark broader market turmoil given the foundational importance of sovereign bonds. High public debt and rollover risks remain unresolved, increasing the chances that a rise in yields could occur in a disorderly manner, despite stable bond market liquidity and the recent unwinding of some leveraged trades.

Third, cyber threats constitute a growing systemic risk as financial services become more digital and interconnected. For their part, frontier AI models are emerging as both powerful enablers of cyberattacks and critical defensive tools.

These risks by themselves do not necessarily threaten financial stability, but they could become a systemic risk—impairments to key financial intermediation and credit provision, with serious negative economic effects—if they are amplified by financial vulnerabilities. This report provides updated assessments on key vulnerabilities and presents new analyses of emerging ones.

Strong core balance sheets across banks and households have aided the resilience of financial markets. A global stress test confirms that banks would remain broadly resilient under an adverse scenario featuring an energy price shock, higher inflation and bond yields, and an AI-led market correction. However, such a scenario would also reveal a significant share of vulnerable banks. Households' debt burdens have declined across countries in recent years, while their net worth has increased, making them less likely to be a source of systemic risk. That said, a correction in housing or equity prices could curb household consumption and disproportionately impact lower-income households.

In emerging market economies, policy buffers have eroded in some cases, while the greater reliance of frontier economies on opaque alternative financing could weaken debt transparency and hinder future market access.

Several other vulnerabilities that could amplify risks have worsened. Insurance and pension funds have grown their holdings of illiquid assets, increasing liquidity mismatch risks and the likelihood of forced asset sales during market stress. Higher borrower leverage and growing contingent liquidity risks faced by private direct lending funds could sharply curtail credit when financial conditions tighten, a test the sector has not yet faced. Among nonbank financial intermediaries (NBFIs), although the growing hedge fund sector tends to support market functioning in normal times, its use of leverage and pursuit of crowded trades could amplify market stress, with spillovers to prime brokers and broader financial markets (Chapter 2). Finally, although tokenized assets remain small and could offer efficiency gains in several areas, they can create new channels for the buildup of leverage and mismatches in liquidity and maturity, in addition to elevating risks related to technology and infrastructure (Chapter 3).

Policy priorities, particularly in the context of limited room for macroeconomic policy support, should focus on resilience, transparency, and preparedness. Authorities should contain leverage in AI-related exposures where excessive, put public debt on a sustainable path, and strengthen bond market infrastructure and liquidity

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backstops. Clear communications on monetary policy and preserving central bank independence can help anchor inflation expectations and further mitigate the risk of a sharp rise in bond yields. Cyber resilience should focus on the continuity of critical services, with enhanced cyber capacity, incident reporting, third-party oversight, and resilience testing. Supervisors should preserve bank capital and liquidity buffers, monitor NBFI interconnections, and improve surveillance of institutional investors and private credit. Emerging and frontier market authorities should rebuild fiscal and external buffers, maintain a coherent policy mix, and strengthen disclosure of alternative financing arrangements.

IMF EXECUTIVE BOARD DISCUSSION OF THE OUTLOOK, OCTOBER 2026

The following remarks were made by the Chair at the conclusion of the Executive Board's discussion of the Fiscal Monitor, Global Financial Stability Report, *and* World Economic Outlook *on September 28, 2026.*

Executive Directors broadly agreed with staff's assessment of the outlook, risks, and policy priorities. They concurred that the global economy is again proving resilient despite repeated shocks, even as the interaction of geopolitics and technology has produced a split global economy. Favorable terms of trade and technology related exports and investment provide a cushion to energy exporters outside the conflict region and economies with strong participation in the technology upturn. At the same time, energy importing economies with limited exposure to the technology value chain, including many low income and vulnerable countries, face stronger headwinds, underscoring the importance of continued Fund support. Looking ahead, uncertainties surrounding the sustainability of the margins of adjustment that have supported resilience underscore the need to address underlying vulnerabilities and rebuild buffers.

Directors broadly concurred that risks to the outlook remain skewed to the downside. They stressed that prolongation of wars could revive inflationary pressures, worsen fiscal and external balances, and weigh on growth, with additional disruptions to infrastructure, cyberattacks, or extreme weather events potentially amplifying the energy shock, and any renewed trade tensions adding to inflationary pressures. A reassessment of AI related prospects could sharply reduce investment, trigger equity market corrections, and tighten financial conditions, with global spillovers. Directors also noted that resurgent inflation or fiscal concerns could trigger a sharp rise in sovereign bond yields and spark broader market turmoil given the foundational importance of sovereign bonds. Cyber threats constitute a growing systemic risk as financial services become more digital and interconnected. These downside risks could be amplified by structural vulnerabilities in the financial sector—including elevated leverage and growing liquidity mismatches, especially among nonbank financial institutions—leading to systemic risks. Directors generally acknowledged the upside risks, including continued momentum in the technology cycle, faster than assumed productivity gains from AI, more predictable trade policies, and more resilient energy sources and supply chains.

Directors called for a renewed focus on rebuilding fiscal space amid more limited room to maneuver due to elevated debt levels, rising borrowing costs, and mounting demands on public budgets, while emphasizing the importance of tailoring policy responses to country circumstances. They stressed that fiscal policy should be designed in a way not to complicate the task of monetary policy and that, where support for the most vulnerable is necessary, it should be transparent, temporary, and targeted, with budgetary offsets specified upfront, especially where fiscal space is constrained. Directors noted that, in a shock prone world, the capacity to deliver targeted support is crucial, and called for strengthening delivery mechanisms that can be scaled rapidly when shocks hit, supported as needed by Fund technical assistance. Directors underscored that credible medium term consolidation should rest on well specified plans, including durable revenue measures, greater spending efficiency, and prudent debt management, supported by institutional improvements. They concurred that better tax design can support growth, and encouraged reforms to reduce distortions in the cost of capital and to recalibrate marginal rates on labor income, so as to lift investment and employment while safeguarding revenue.

Directors reaffirmed the importance of preserving price and financial stability. They generally stressed that central banks should remain agile and firmly focused on their mandates, with a few Directors cautioning that monetary policy should not overreact to inflationary pressures from fiscal policies or energy shocks. Directors agreed that the inflationary effects of geopolitical and technological developments vary across countries, calling for differentiated monetary

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policy responses. For energy importers, higher energy prices present a stagflationary challenge. Monetary policy can look through the shock only if it is temporary and second round effects remain contained. These conditions are less likely to hold when inflation is already above target and broader price pressures are expected to remain elevated, warranting a bias toward tightening. For energy exporters outside the conflict region, the positive terms of trade shock pushes income and aggregate demand up, potentially making a tightening appropriate. In economies integrated into the technology value chain, the case for tightening gets stronger, especially if inflation is already above target and broader price pressures are expected to remain elevated. Directors emphasized that clear communication and strong central bank independence are crucial for credibility.

Directors stressed the importance of maintaining orderly adjustment and financial stability in the face of large shocks, with exchange rate flexibility as the first line of defense, complemented where warranted with measures consistent with the Integrated Policy Framework. They concurred that policy priorities to mitigate financial stability risks include placing debt on a sustainable path, strengthening bond market infrastructure and liquidity backstops, containing leverage in AI related exposures, and ensuring cyber resilience, with a focus on the continuity of critical services. On detailed fiscal policy recommendations to rebuild buffers, many Directors stressed the need for evenhandedness across all country groups. Directors agreed that to mitigate structural vulnerabilities in the financial sector, authorities should ensure timely and consistent implementation of internationally agreed standards, and also closely monitor vulnerabilities arising from the increasingly important role of nonbank financial institutions. They welcomed the analysis of hedge funds and tokenization highlighting the importance of balancing innovation and market efficiency with financial resilience.

Directors highlighted the importance of reigniting structural reforms to ease macroeconomic trade offs and lift medium term growth potential. Priorities include measures to enhance business dynamism and foster energy security through diversified energy sources, with some Directors highlighting the importance of investment across all energy sources. A number of Directors also called for further strengthening the Fund's climate related work. Directors stressed that the gains from AI and digitalization will be larger if supported by investment in human capital and infrastructure, as well as robust governance for data protection, cybersecurity, competition, and responsible use. Directors reaffirmed the importance of correcting domestic imbalances to support global adjustment. A few Directors called for deeper analysis of non market policies and practices, while a few others emphasized the importance of distinguishing between policies that distort markets, including sanctions and trade restrictions, and those intended to address market failures. Directors concurred that commonly agreed international economic rules—with clear, transparent, predictable, and mutually beneficial trade policy frameworks—are essential to reduce uncertainty and limit fragmentation. They emphasized that international cooperation is essential in a shock prone world, including to manage spillovers from commodity market pressures, refugee flows, and debt vulnerabilities.

CHAPTER 1

BENEATH THE RESILIENCE: RISING RISKS, UNRESOLVED VULNERABILITIES

Introduction

Financial markets have remained resilient since the April 2026 *Global Financial Stability Report*. Economic growth has held up and corporate earnings have been strong, particularly among firms related to artificial intelligence (AI). Likely responding to higher inflationary pressures stemming from the energy shock from the war in the Middle East, 14 of 33 major central banks have hiked policy rates since the second quarter of 2026, up from just 2 in the first quarter.[1] However, inflation has been more contained than initially feared, leading to only a modest rise in policy rates. Financial conditions tightened somewhat in the first quarter, but the subsequent tailwind from corporate valuations more than offset the tightening from higher interest rates, leaving overall financial conditions accommodative on net (Figure 1.1). Non-China emerging market economies are a notable exception, with financial conditions tightening this year to date, mostly in the first quarter.

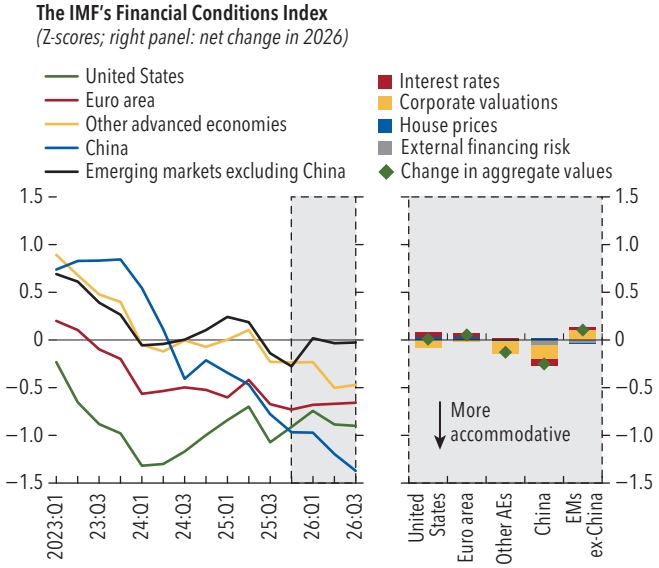
The chapter identifies three salient risks ahead: an AI-driven market correction, a sharp rise in sovereign bond yields, and cyber threats. These risks are plausible near-term catalysts for a sharp tightening of financial conditions and market turmoil, selected based on the likelihood of their triggering shocks and the severity of their potential market impact. Weaker or less durable investment and profitability in AI would not only undermine a key engine of growth that has helped offset the economic drag from the war in the Middle East and heightened policy uncertainty, but also lead to a correction in AI-linked equities and credit, which now account for a large share of both markets. Inflationary pressures from a prolonged war in the Middle East and persistent fiscal concerns can further drive up yields in a fragile bond market, repricing assets broadly through higher discount rates. Severe cyber incidents could undermine market confidence and disrupt critical financial market infrastructure and operations.

These risks by themselves do not necessarily threaten financial stability but could become systemic—impairments to financial intermediation and credit provision, with serious negative economic effects—if they are amplified by underlying vulnerabilities. This chapter provides assessments on such key vulnerabilities. Global stress tests suggest that the banking system would remain adequately capitalized in a bond yield spike and AI-led correction scenario, although a significant share of vulnerable institutions would emerge, and some banks' growing interconnectedness with nonbank financial intermediaries (NBFIs) could prove a source of fragility. Emerging market vulnerabilities stem from eroding external buffers in some economies

[1]These 33 central banks are the *Reserve Bank of Australia*, Banco Central do Brasil, Bank of Canada, Banco Central de Chile, *Banco de la República*, Hrvatska narodna banka, *Czech National Bank*, Central Bank of Egypt, *European Central Bank*, Bank of Ghana, Magyar Nemzeti Bank, Reserve Bank of India, *Bank Indonesia*, *Bank of Japan*, *Bank of Korea*, Bank Negara Malaysia, Banco de México, Reserve Bank of New Zealand, *Norges Bank*, *State Bank of Pakistan*, Banco Central de Reserva del Perú, *Bangko Sentral ng Pilipinas*, Narodowy Bank Polski, Banca Națională a României, Central Bank of the Russian Federation, *South African Reserve Bank*, Sveriges Riksbank, Swiss National Bank, Bank of Thailand, Central Bank of the Republic of Türkiye, *National Bank of Ukraine*, Bank of England, and the US Federal Reserve. Some central banks that hiked rates in the second or third quarter of 2026 did so more than once. Italicized central bank names have tightened policy rates since the start of the second quarter of 2026.

Figure 1.1. Global Financial Conditions across Regions

Financial conditions have remained accommodative, on net, across regions.



Sources: Bloomberg Finance L.P.; Dealogic; EUROPACE AG/Haver Analytics; national data sources; and IMF staff calculations.

Note: The Financial Conditions Index incorporates various pricing indicators. For calculation details, see Online Annex 1.1 in the October 2018 *Global Financial Stability Report*. Indices could differ from other FCIs, depending on the variables included and aggregation methodologies. Changes are calculated at the component level and aggregate values could differ marginally from headline FCI. AE = advanced economies; EMs = emerging markets; FCI = Financial Conditions Index.

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Table 1.1. Summary of Financial Stability Risks and Vulnerabilities

	Trend	Summary Assessment	Policy Recommendations
Salient Risks That Could Sharply Tighten Financial Conditions and Catalyze Market Turmoil			
Artificial Intelligence (AI)-driven market correction	About the same	*Triggering shocks: weaker or less durable AI investments and profitability* Impact could be significant given the growing size of AI-related assets. While the profitability of core AI firms has been strong and valuation pressure has eased, leverage is rising in the AI ecosystem.	Contain leverage used by investors to gain exposures to AI where excessive, including limits on derivatives, exchange-traded products, and margin loans. Strengthen system resilience using tools such as sector capital requirements, concentration limits, and capital buffers, as needed.
Sharp rise in sovereign bond yields	Worse	*Triggering shocks: resurgent inflation, term premium rises due to fiscal shocks* Impact could be severe given the foundational importance of sovereign bond markets. High debt and rollover risks remain unresolved, making the bond market susceptible to more frequent fiscal and inflation shocks. On the other hand, market functioning has been orderly.	Put public debt on a sustainable path and improve bond market structure, like central clearing.
Cyber threats	Worse	*Triggering shocks: successful cyberattacks on critical financial institutions or market infrastructure* Impact could be severe as rapid digitization has increased the attack surface. Frontier AI models could be used in both attacks and defense.	Build specialized cyber capacity and enhance incident reporting, third-party risk oversight, and operational resilience.
Structural Vulnerabilities That Could Amplify the Risks			
Weak banks in a stress scenario	About the same	The global banking system remains resilient in an adverse scenario, but vulnerable institutions remain and linkages of some banks to NBFIs have deepened.	Ensure prudent provisioning and robust buffers, monitor interconnections with NBFIs, and implement international standards.
Emerging market buffer erosion and alternative financing	Worse	Foreign exchange reserve buffers of weaker emerging markets have eroded, and frontier economies are increasingly using less transparent and alternative forms of financing.	Rebuild buffers, ensure policy mix is consistent with the IMF Integrated Policy Framework, and ensure robust disclosure of alternative borrowing sources.
Liquidity mismatches of institutional investors	Worse	Insurer and pension fund holdings of illiquid assets have increased and have become more concentrated, with liquidity mismatches rising.	Monitor and stress test liquidity gaps, align fund liquidity with underlying asset liquidity.
Leverage and liquidity risks in private credit	About the same	Default rates have fallen, but liquidity pressure is elevated and borrowers are more leveraged.	Strengthen surveillance of interconnected risks and address excessive exposures of regulated entities to private credit.
Household debt burden	Better	Debt burden has eased and households have sizable assets, but tighter financial conditions could erode wealth.	Use macroprudential tools to ensure ongoing household resilience.

Source: IMF staff assessment based on the findings in this chapter.

Note: IMF staff's assessment of trends refers either to the period since the April 2026 *Global Financial Stability Report* or when the risk or vulnerability was last analyzed by the report. Risks and vulnerabilities are not always distinct; for example, bond market fragilities could reflect underlying vulnerabilities like the use of leverage in cash-futures basis trades by NBFIs. See Box 1.1 for details on the risks and vulnerabilities framework. AI = artificial intelligence; NBFIs = nonbank financial intermediaries.

and growing reliance on alternative, often opaque, financing among frontier economies. Vulnerabilities also persist among institutional investors through rising liquidity mismatches and concentrated investments, particularly in private credit direct lending through higher leverage and liquidity mismatches, which could emerge alongside banking sector stress and interact in nonlinear ways, magnifying systemwide strains. On the positive side, household debt remains relatively low in aggregate. Box 1.1 documents the definitions of risks, vulnerabilities, and systemic risk, as well as the selection process and the assessment approach.

Against this backdrop, the chapter argues that financial stability risks remain elevated. Resilient markets face rising risks and unresolved vulnerabilities ahead. Fiscal and monetary policy space to mitigate the economic consequences of financial instability is more limited today than it was during much of the past two decades, given high debt levels and inflation that remains above central bank targets in many jurisdictions. Therefore, policies that prevent the crystallization of risks and the buildup of vulnerabilities should be pursued proactively. Table 1.1 presents the risks and vulnerabilities the chapter analyzes and IMF staff's

assessment of their trends. The last section of the chapter discusses specific policy recommendations.

Three Salient Risks to Financial Markets

Artificial Intelligence-Driven Market Correction

AI has become an important source of support for the global economy and financial markets. Spending on data centers, semiconductors, and related infrastructure has supported broader economic activity and has helped offset possible negative effects from the war in the Middle East and overall policy uncertainty (see the October 2026 *World Economic Outlook*). Firms at the center of the AI value chain have experienced strong equity price appreciation as they have delivered exceptional earnings growth. As a result, valuation pressure measures such as forward price-to-earnings ratios have eased in several equity markets (see Background Analysis 1.1, "Rising Leverage in the AI Ecosystem").

Weaker or less durable AI investments and profitability could be a shock that triggers a market correction. Growing evidence suggests that AI capabilities can be delivered at lower investment levels (Nicol-Schwarz and Vania 2026) or that potential economic gains may not be as large as expected. The *World Economic Outlook* considers a scenario whereby an unwinding of AI investment reduces global GDP, investment, and consumption (through wealth effects) by as much as 0.4, 1.3, and 0.6 percent, respectively, by 2028. Market participant surveys increasingly identify the associated market correction as a major risk to financial markets.[2]

Leverage could exacerbate this shock. AI-related firms and their investors use three growing sources of leverage. First, since 2024, hyperscalers' share of global investment-grade bond issuance has increased to 10 percent from less than 1 percent.[3] Hyperscalers have strong earnings from their core businesses. Yet, free cash flows are rapidly declining as hyperscalers try to sustain large AI investment needs, leaving debt financing increasingly necessary (Figure 1.2, panel 1; see also Background Analysis 1.1, "Rising Leverage in the AI Ecosystem"). Other types of AI firms, like

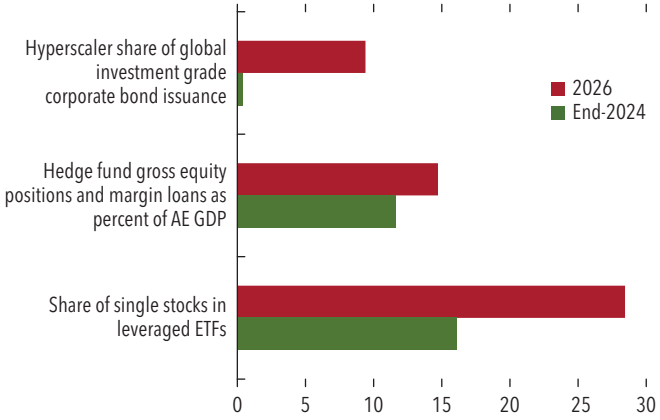
[2]See the Bank of America's Global Fund Manager Survey conducted in August 2026 (Bank of America 2026). Respondents identified the "AI boom" as the most important risk.

[3]Investment-grade bond issuance accounted for 40 percent of total bond issuance—including sovereign bonds—in the euro area, the United Kingdom, and the United States on a duration-weighted basis in the first quarter of 2026. Large AI-related investment-grade bond issuance could therefore compete with sovereign bond issuance. Overall, quarter-on-quarter credit growth in the private nonfinancial sector has turned positive in the first quarter of 2026 for the first time since 2023, based on data from the Bank for International

Figure 1.2. Leverage and Debt Used in Artificial Intelligence

Leverage throughout the AI ecosystem has increased.

1. Equity Leverage and Debt related to Artificial Intelligence
(Percent)

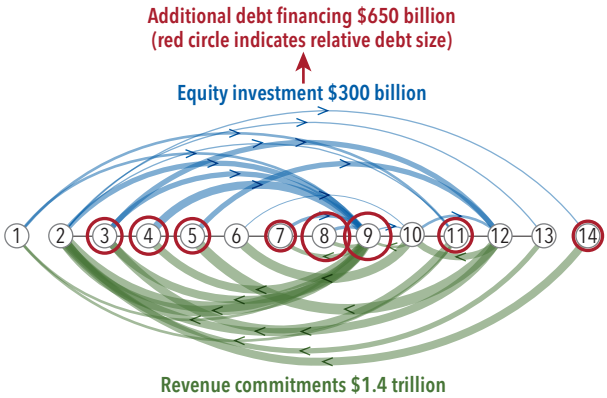


Sources: Bank for International Settlements; Bloomberg Finance L.P.; Dealogic; Federal Reserve Bank of New York; Financial Industry Regulatory Authority; Japan Exchange Group; Korea Financial Investment Association; Office of Financial Research; Shanghai and Shenzhen Stock Exchange; and IMF staff calculations.

Note: "Hyperscalers" is based on Bloomberg's definition (massive cloud computing and data center operators). Margin loans data cover China, Japan, Korea, and the United States. Hedge fund gross equity positions are notional exposures. The 2026 data are as of July for leveraged ETFs and hyperscaler shares and June for hedge fund statistics. AE = advanced economies; AI = artificial intelligence; ETFs = exchange-traded funds.

AI circular financing: Equity and debt financing in exchange for future revenue commitments.

2. Equity Investment, Debt, and Revenue
(Size of lines and bubbles indicate dollar amount)



Numbered circles denote firms | 1–10: investors | 9–14: investees

Sources: Bloomberg Finance L.P.; Chen, Gautam, and Wu 2026; and IMF staff calculations.

Note: Each number is a firm engaged in AI circular financing. Firms 1 to 10 are investors, firms 9 to 14 are investees, with some overlap. Blue and green lines indicate the size of equity investments and future revenue commitments, respectively. Red circles indicate debt issued as part of the circular deals. About $320 billion of the $650 billion debt is taken on by investees in circular financing deals, including debt backed by investor guarantees, contingent financing, and other off-balance-sheet debt. AI = artificial intelligence.

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neocloud operators, have higher debt burdens and lower profitability, raising the possibility of weak links in the ecosystem.[4] Second, also since 2024, hedge funds' gross equity positions plus equity margin loans have grown from 10 percent to about 15 percent of advanced economy GDP, reflecting an increase in levered positions in AI-related equities. Third, over the same period, the share of single stocks in leveraged exchange-traded funds has increased to 28 percent from 16 percent, as retail investors have used these funds to gain levered exposures to AI stocks. These growing sources of leverage heighten the potential for forced selling and surges in equity volatility and credit spreads in the event of lackluster and less durable AI investment and profitability.

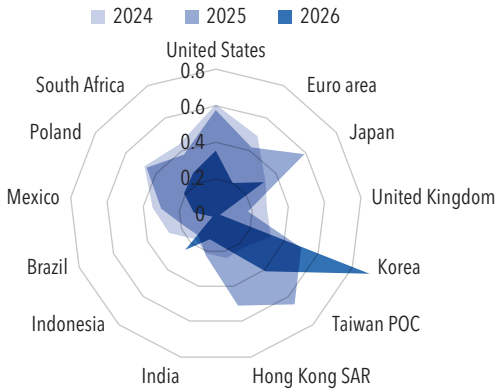
Circular financing further reinforces leverage-driven interdependencies among AI firms. Fourteen publicly disclosed transactions since 2023 account for approximately $300 billion of aggregate equity investments led by hyperscalers in financially weaker AI firms, supplemented by $650 billion in debt, in exchange for $1.4 trillion in future revenue commitments through services or chip orders (Figure 1.2, panel 2), with a significant concentration of financing and revenue promises in a handful of investees. While investors (firms 1 to 10) are generally financially sound, distress at key investee firms could present significant "wrong-way risk" to the AI ecosystem: Equity and debt investments in the firms depreciate in value precisely when future revenue streams tied to them are impaired.

The consequences of an AI correction could be global, with some jurisdictions more sensitive than others. A sharp slowdown in AI investment could weaken earnings, expose the accumulated leverage by making repayments more difficult for firms or equity investors, and weigh on equity prices. Advanced Asian equity markets that exhibit high betas to a proxy of global AI equity returns will likely suffer the most (Figure 1.3, panel 1). In comparison, the euro area and the United Kingdom appear to have low betas, as do most emerging markets. Most of these markets' betas to AI have moderated this year. But even for jurisdictions with low equity market beta to AI, stress in AI could be transmitted through the sharp increase in holdings of US equities from 2022 to 2026, much of which reflect greater allocations to hyperscalers and other AI-related firms (Figure 1.3, panel 2).

Figure 1.3. Equity Market Exposures to Artificial Intelligence

Equity market sensitivity to AI varies across jurisdictions ...

1. Equity Return Beta to the Global AI Index



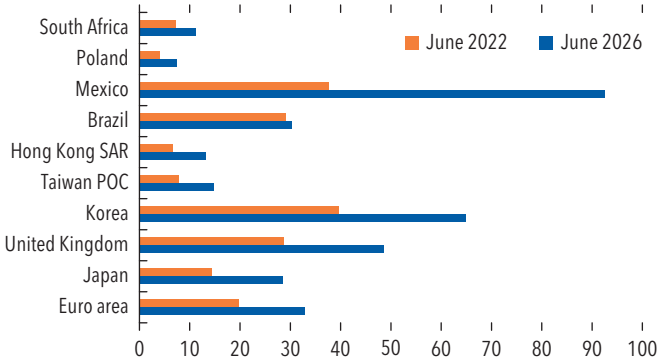
Sources: Bloomberg Finance L.P.; and IMF staff calculations.

Note: "Global AI Equity Returns" is proxied by Indxx Artificial Intelligence and Big Data Index (IAIQ). Jurisdictions' stock indices are the S&P 500 (United States), Stoxx 50 (euro area), TOPIX (Japan), FTSE (United Kingdom), KOSPI (Korea), TAIEX (Taiwan Province of China), Hang Seng (Hong Kong SAR), NIFTY 50 (India), JSX Composite (Indonesia), Ibovespa (Brazil), S&P/BMV (Mexico), WIG20 (Poland), and FTSE/JSE (South Africa). Betas are regression coefficients from weekly regression of jurisdictional index returns on IAIQ returns by year.

... but many have increased their exposures to US equities, a sign of AI chasing.

2. US Equity Holdings across Jurisdictions

(Percent of jurisdictions' foreign portfolio investment assets)



Sources: Coordinated Portfolio Investment Survey; Treasury International Capital System (TIC); and IMF staff calculations.

Note: Holdings of US equities are from TIC's SLT table. Portfolio investment assets by residents are from International Investment Positions data. The two data sources may not capture the same sources, as TIC data are based on US securities custodian reporting. AI = artificial intelligence.

A Sharp Rise in Sovereign Bond Yields

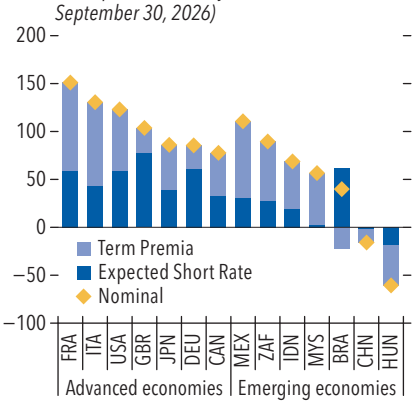
Global sovereign bond yields have risen, driven by higher energy prices and increases in term premiums. Since the beginning of the war in the Middle East,

[4]Chen, Gautam, and Wu (2026) conduct an analysis on the financial health of 74 firms in the AI ecosystem and find that many firms upstream and downstream from the hyperscalers have weaker balance sheets. See also Figure 1.17 of Chapter 1 of the April 2026 *Global Financial Stability Report*.

Figure 1.4. Sovereign Bond Market Fragilities

Increase in longer-term yields has been driven by both expected short rate and term premium.

1. Change Decomposition in 10-Year Government Bond Yields
(Basis points; February 27 to September 30, 2026)

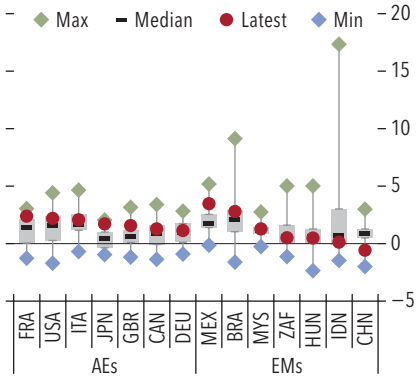


Sources: Bank of England; Bloomberg Finance L.P.; US Federal Reserve; and IMF staff calculations.

Note: Regression-based term premium model used. The exact model (i.e., data window and other specifications) used for a given country is selected based on minimizing yield curve pricing errors. Uncertainty bands around estimates may vary substantially across time, depending on market liquidity and other conditions. Data labels in the figure use International Organization for Standardization (ISO) country codes.

Term premiums are at the upper end of historical ranges, especially for advanced economy bonds.

2. 10-Year Government Bond Term Premium Historical Ranges
(Percent; 2000–2026)

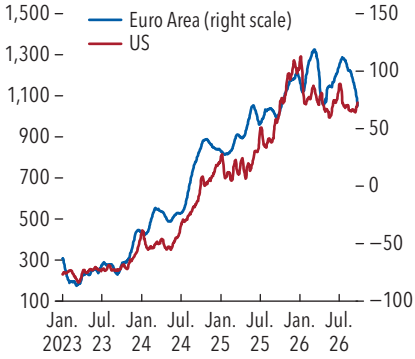


Sources: Bank of England; Bloomberg Finance L.P.; US Federal Reserve; and IMF staff calculations.

Note: Ranges of estimates are based on daily data since the start of 2000 or the start of data series. Data availability for Brazil starts in March 2007, Mexico August 2003, Indonesia May 2003, Hungary March 2001, Malaysia September 2001, and China April 2004. Shaded regions show the interquartile range. Data labels in the figure use International Organization for Standardization (ISO) country codes. AEs = advanced economies. EMs = emerging markets.

Cash-futures basis trade in government bonds has partly unwound in an orderly manner.

3. Hedge Funds' Repo Borrowing Collateralized by Government Bonds
(Billions of dollars)



Sources: Banque de France (2026); Office of Financial Research (OFR); and IMF staff calculations.

Note: "US" refers to aggregate daily repo volumes transacted via the Fixed Income Clearing Corporation's sponsored repo platform, in 10-day moving averages. "Euro Area" refers to euro area's net repo positions collateralized by European Government bonds, based on securities financing reporting. Repo = repurchase agreement.

increases in 10-year bond yields have been driven by both higher-than-expected short-term rates—reflecting expectations for higher inflation and a tighter monetary policy stance—and higher term premiums demanded by investors (Figure 1.4, panel 1). Higher expected short-term rates have driven yields in most advanced economies, while term premiums have played a larger role elsewhere, including in emerging markets. Across economies, the rise in term premiums reflects compensation for several risks, most notably renewed concerns about persistent fiscal deficits and high government debt levels (see April 2026 *Fiscal Monitor*), and the associated forthcoming increase in bond supply. For emerging market economies, higher term premiums may have resulted from spillovers from higher yields in advanced economies. More recently, surging AI-related debt issuances that may compete with sovereign bonds for investor demand has also been cited as an additional source of pressure on bond markets.[5] Current term premiums are at the upper end of historical ranges, especially for advanced economy bonds (Figure 1.4, panel 2).

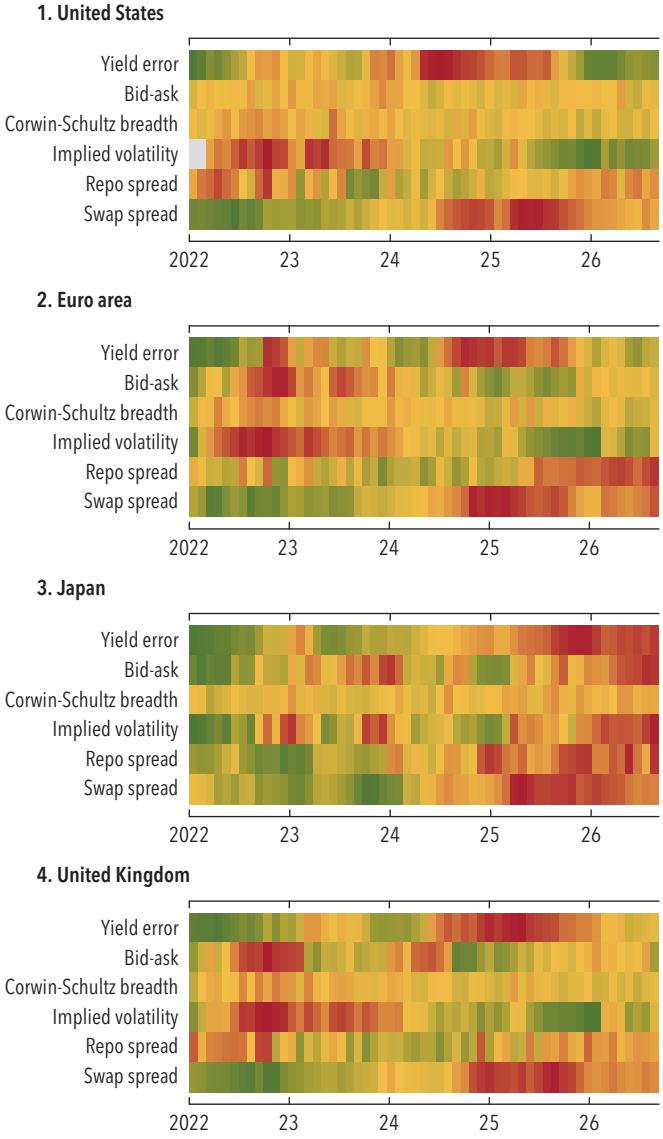
Bond markets are susceptible to further rises in energy prices reigniting inflation and forcing the tightening of monetary policy. This downside scenario could propagate through several channels, beyond the need for higher monetary policy rates to rein in inflation. First, at higher inflation and policy rates, rollover risks would increase for governments that have recently shortened the maturities of their debt, potentially raising debt burdens and term premiums. Second, the growing presence of price-sensitive investors, including foreign investors, investment funds, and households and other funds, may amplify upward pressure on term premiums by selling longer-term bonds as energy prices and inflation rise. These two channels have been documented in the April 2026 *Global Financial Stability Report*. Third, market liquidity may also deteriorate when volatility rises, as the bond market still depends on dealers for intermediation and constraints on their balance sheets could scale back activities. All three channels could abruptly raise bond yields through term premium shocks; the *World Economic Outlook* analyzes

[5]See, for example, "Are Big Tech Bonds Crowding Out the US Treasury?" Financial Times, September 27, 2026, and PIMCO Perspectives (Seidner and Dhawan 2026).

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Figure 1.5. Bond Market Liquidity Metrics
(Percentile rank heatmap, history = 2022–26)

Liquidity metrics have been stable in the euro area, United Kingdom and United States.



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

Note: Green = favorable liquidity (0th percentile of 2022-to-date own-history range); red = unfavorable (100th percentile); direction pre-adjusted per metric (Swap spread inverted) so red always means worse. Grey = no data that month. Monthly mean of the market-cap tenor-weighted daily aggregate (2y/5y/7y/10y/30y); Repo Spread is a simple mean of three repo-curve legs. Cell values are intentionally not displayed on the swatches–see ChartData for the numbers–so the sheet reads as close as possible to the plotted chart. See ReadMe for full scope and vintage.

macroeconomic outcomes under a scenario featuring such a shock.

That said, some fragilities in bond markets have improved. Repurchase agreement (repo) borrowing by hedge funds collateralized by sovereign bonds in the euro area and the United States—a proxy for the size of cash-futures basis trades—has partly unwound without notable pressure in repo markets (Figure 1.4, panel 3); nevertheless, the substantial leverage still deployed in these trades continues to leave the bond market susceptible to a disorderly unwind. Market liquidity metrics have improved for the euro area and the United Kingdom, especially yield curve fitting errors and market breadth metrics (Figure 1.5). Market liquidity metrics have continued to deteriorate in the Japanese government bond market, driven by yield volatility that has risen since the end of yield curve control and amid ongoing monetary policy normalization, and wider bid-ask spreads, especially for long-term bonds.[6] In the US Treasury market, yield curve fitting errors, implied volatility, and bid-ask spreads point to favorable liquidity conditions in recent months. Finally, fiscal initiatives have reduced sovereign funding spreads in some economies (see Box 1.2 for a case study on such a program in the euro area).

Other fragilities may have worsened. Rollover risk remains high and could be exacerbated by debt management strategies that replace long-term debt with short-term debt or available cash if done on a large scale. Furthermore, historically high government debt levels—the root cause of a more fragile bond market—remain unresolved, and persistently high fiscal deficits in major economies continue to add pressure. On balance, these developments suggest that bond market risks have worsened since the April 2026 *Global Financial Stability Report*.

A crystallization of these fragilities could lead to market turmoil. Given government bonds' foundational importance to financial markets, a sharp rise in bond yields would depreciate asset valuations through higher discount rates—including on AI-related assets—and erode the value of government bonds used as collateral in derivatives and other financial transactions.

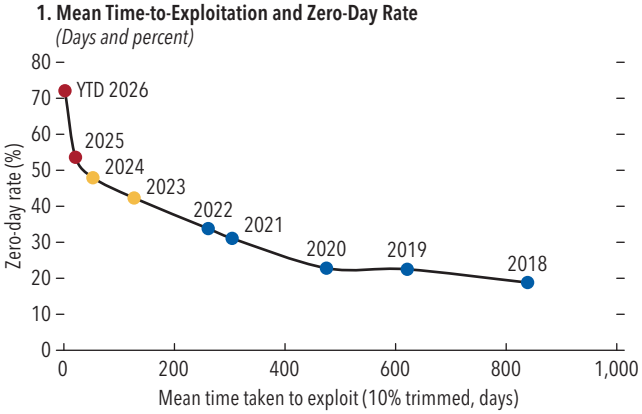
Cyber Threats

As finance becomes more digital and interconnected, cyber disruptions have emerged as a growing source

[6]Meanwhile, the Bank of Japan's bond market survey in August 2026 shows that the difference between the shares of respondents' viewing bond market functioning as "high" and "low" stood at minus 12 percentage points, the highest level since 2016.

Figure 1.6. Cyber Defense Is Getting More Difficult

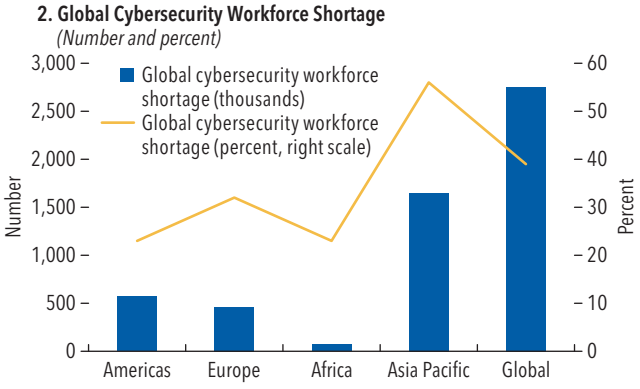
The time between the publication of vulnerabilities and their confirmed exploitation has tightened sharply.



Source: zerodayclock.com.

Note: "Time to exploit" measures the gap between common vulnerabilities and the public disclosure and first confirmed exploitation of exposures. The zero-day rate is the percentage of exploited common vulnerabilities and exposures where exploitation occurred before or on the day of disclosure.

Cybersecurity progress is constrained by a persistent shortage of talent.



Source: Global Cybersecurity Forum.

Note: The shortage is measured as a share of the current workforce. The study covers 48 countries and estimates workforce demand and supply using five archetypes based on cyber maturity and macroeconomic indicators, adjusted for industry and firm size. See the Global Cybersecurity Forum (2024).

of systemic risk. A major attack affecting payments, trading, or access to deposits could cause immediate losses and undermine confidence. If an operational disruption strikes a critical node, such as a major bank or financial market utility, cloud provider, or software vendor, it could quickly evolve into a broader confidence shock or impairment of the provision of credit and financial services, transmitting stress through both operational and financial linkages.

Three trends are driving these risks. First, rapid digitalization has expanded the attack surface. Financial institutions depend increasingly on interconnected technologies, cloud services, third-party providers, and real-time payment and settlement systems. Second, growing reliance on a small number of critical technology providers, together with increasingly complex and often opaque third-party dependency chains, has increased concentration risk and created potential common points of failure across financial institutions. Third, cyber threats are becoming more sophisticated. State-sponsored actors, ransomware groups, and insiders now have access to increasingly powerful tools, including frontier AI models that have demonstrated strong capabilities in network-attack simulations (Adrian and others 2026).

These developments are making cyber defense more challenging. The number of reported vulnerabilities has risen sharply as the time between the disclosure and exploitation of vulnerabilities has compressed significantly. In more than 70 percent of cases thus far in 2026, software providers have had almost no time to patch vulnerabilities before exploitation began, a jump of 20 percentage points from just a year ago (Figure 1.6, panel 1). At the same time, regions such as Asia face significant shortages of cybersecurity talent (Figure 1.6, panel 2). AI can help address shortages of cyber expertise through stronger monitoring, threat detection, and automated response. But AI also increases the urgency of strengthening foundational cyber resilience, including cyber hygiene, incident reporting, crisis preparedness, and oversight of critical third-party providers, particularly in emerging markets where capacity constraints remain significant.[7]

Vulnerabilities and Trends That Could Amplify Risks

Global Banks Remain Resilient, but a Significant Share of Weak Institutions Remain

Global banking stress tests demonstrate that most banks remain resilient. The IMF's 2026 Global Bank Stress Test evaluates banks' ability to withstand an adverse scenario that combines weaker-than-expected

[7]Emerging markets face similar exposures to cyber threats, but often with fewer defensive resources, more limited supervisory capacity, and less access to frontier tools. See Adrian and others (2026) and Kopp, Kaffenberger, and Wilson (2017).

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productivity gains from AI with higher interest rates amid bond market fragilities and energy supply disruptions, in line with two of the key risks analyzed in this chapter. It assumes that a reassessment of the productivity gains expected from AI triggers a sharp correction in technology valuations, generating broad spillovers across global financial markets. Together with disruptions in repo and bond markets—short- and long-term bond yields rise by 150 and 300 basis points, respectively—this sharply tightens financial conditions, raising borrowing costs across sectors and economies. As a result, global real GDP growth falls about 3 percentage points below baseline in the first two years of the scenario and only partly recovers thereafter. Global unemployment rises 3.5 percentage points, while inflation increases by over 4 percentage points by 2027 (see Background Analysis 1.2, "2026 IMF Global Banking Stress Test"). Under this scenario, the global banking system's aggregate Common Equity Tier 1 (CET1) ratio declines by about 150 basis points to approximately 11.5 percent. This remains well above regulatory minimums, with the decline driven primarily by credit impairments partly offset by stronger net interest income.

However, aggregate resilience masks pockets of weakness. Banks representing 22 percent of global banking assets are classified as weak—weak banks being those with post-stress CET1 ratios falling below 7 percent. Moreover, this share has increased since the 2025 stress test, which found that weak banks accounted for 18 percent of global banking assets. While banks' starting capital positions were broadly unchanged, the more severe energy supply shock and sharper rise in long-term government bond yields in the 2026 scenario generate substantially larger losses in some jurisdictions, leading to greater capital depletion (Figure 1.7, panel 1).

Stress test outcomes vary considerably across regions. In North America, the increase in the share of weak banks is driven by market risk, as a sharp increase in long-term government bond yields triggers asset valuation losses, particularly in a small number of large banks. In Asia, the share of weak institutions reflects significant capital depletions in oil- and gas-importing economies.[8] By contrast, banks in most other regions, particularly emerging markets, experience more limited capital depletion, supported by stronger net interest and fee income generation (see Background Analysis 1.2, "2026 IMF Global Banking Stress Test").

Banks' NBFI exposures appear manageable but are growing. In the United States, loans to NBFIs increased by 18 percent in 2026, while exposures to private equity and private credit firms rose by 30 percent. Although these exposures do not appear to pose systemic risks on their own, they could become a meaningful source of losses under severe stress. In a scenario whereby bank losses equal 20 percent of their exposures to private assets, aggregate CET1 capital would decline by about 2 percentage points, and banks representing less than 1.6 percent of assets in the sample would see their Tier 1 capital ratios fall below 7 percent (Figure 1.7, panel 2). In the European Union and the United Kingdom, under the same shock, losses represent 1 percentage point of CET1 capital and no banks fall below the 7 percent Tier 1 threshold. Although banks appear well positioned to absorb losses from stand-alone NBFIs and private asset stress events, vulnerabilities could be amplified if such losses were to coincide with a severe economic downturn, as many banks with large NBFI exposures are also among those experiencing the largest capital declines under the adverse global stress test scenario.

Eroding Buffers in Some Emerging Markets

Emerging market and frontier economies have proved relatively resilient during recent shocks as they deployed policy measures, with risk premiums retracing to levels last seen before the war in the Middle East. The widening of emerging market risk premiums at the outbreak of the war was concentrated mainly in currencies, local rates, and equities but premiums have now retraced to historically compressed levels (Figure 1.8, panel 1). Emerging market authorities have deployed a broad range of measures to cushion the energy shock. Targeted fiscal support has helped contain the pass-through of energy prices to inflation and eased pressure for additional monetary tightening, and monetary policy action alongside targeted currency interventions and capital flow measures have limited near-term financial stress.

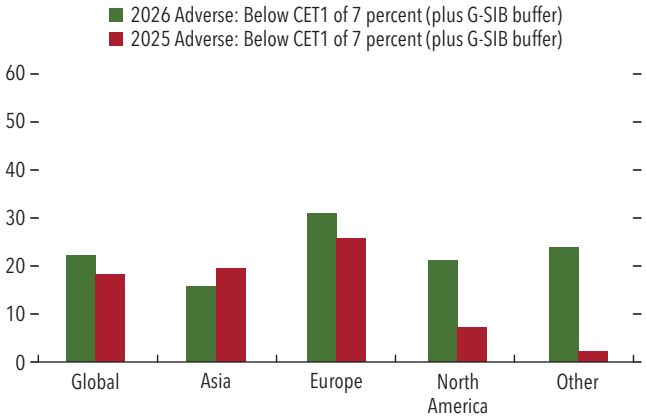
Partly because of these measures, policy buffers have weakened in some cases. Measures to cushion the energy shock have weighed on fiscal space and reserve buffers, leaving less room to maneuver if energy price pressures intensify or global finan-

[8]Banks in oil- and gas-importing economies are projected to face higher short-term interest rates, reflecting a de-anchoring of inflation expectations amid elevated oil and gas prices. Higher short-term rates, combined with contracting real GDP and sharply rising unemployment, have amplified the credit-risk-induced and loan-loss-induced capital shortfalls in these economies.

Figure 1.7. The Global Share of Weak Banks Is Significant

A resilient global banking sector in aggregate masks pockets of vulnerabilities.

1. Share of Total Assets in Weak Banks
(Percent of bank assets)

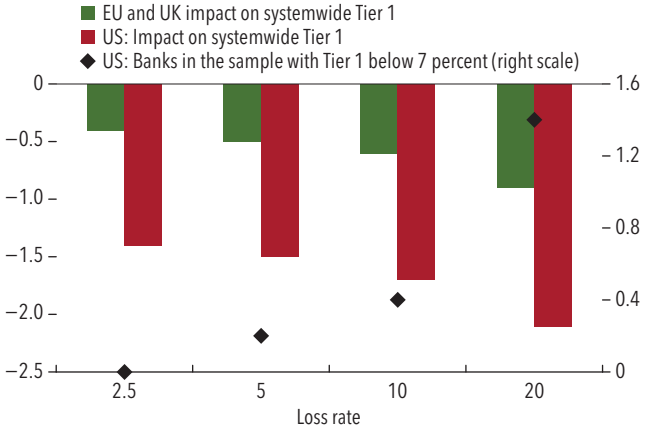


Sources: Fitch Connect; Fitch Solutions; and IMF staff calculations.

Note: The analysis includes 665 banks excluding foreign subsidiaries across 29 countries. The "adverse" scenario using the 2026 stress test features stagflation, an energy supply disruption, higher interest rates, and weaker-than-expected artificial intelligence gains. CET1 = Common Equity Tier 1 ratio; G-SIB = global systemically important bank.

Banks appear well positioned to withstand losses from stand-alone private assets stress events.

2. Sensitivity Analysis of Banks' Private Assets Exposures
(Percentage points, percent of total assets)



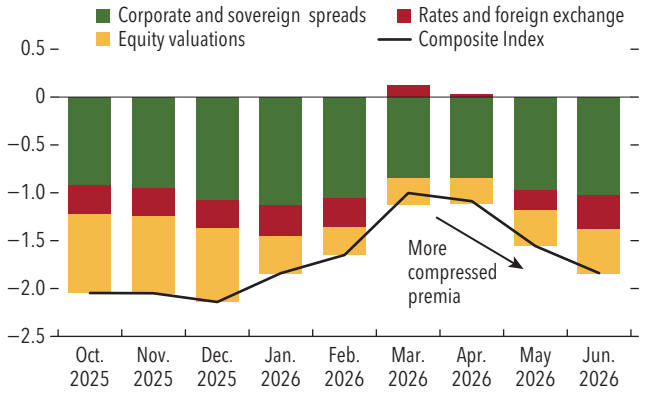
Sources: Consolidated Reports of Condition and Income; S&P Capital IQ Pro; and IMF staff calculations.

Note: The chart is based on 2026 first quarter data for 131 banks in the United States and considers exposures to private equity and business credit intermediaries. For the European Union and the United Kingdom, the chart is based on 13 major banks and considers exposures to private equity and private credit as reported by them.

Figure 1.8. Emerging Market Risk Premiums and Foreign Exchange Reserves

Emerging market risk premiums are back to compressed levels across asset classes.

1. Emerging Market Composite Risk Index
(Z-scores since 2015)

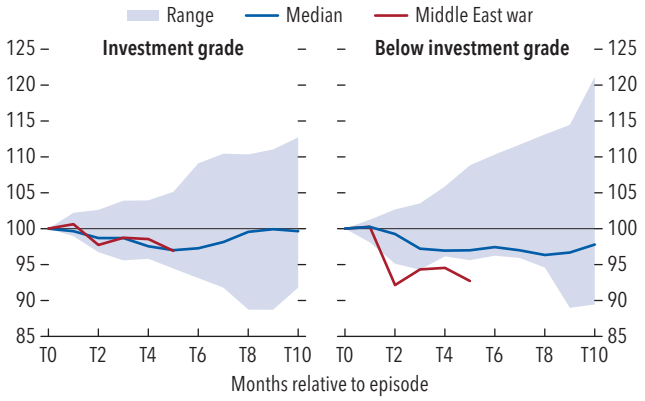


Sources: Bloomberg Finance L.P.; and IMF staff calculations.

Note: The Composite Index is based on aggregating 15 measures of premiums across a sample of 14 countries. See Figure 1.6 of the April 2026 *Global Financial Stability Report* for the methodology.

Below-investment-grade emerging markets experienced sharper official reserve drawdowns from weaker starting positions.

2. Cumulative Changes in Official Reserves
(Index, month before the episode = 100)



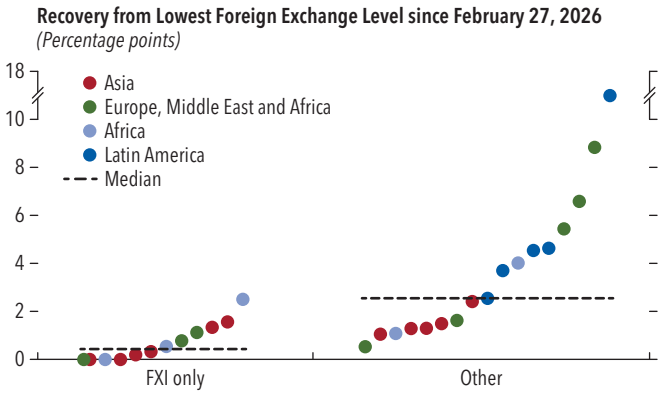
Sources: Bloomberg Finance L.P.; IMF, International Reserve and Foreign Currency Liquidity dataset; and IMF staff calculations.

Note: Historical episodes include the April 2025 US tariff announcement, February 2022 Russia-Ukraine war, February 2020 COVID-19 outbreak, February 2018 "Volmageddon," August 2015 renminbi devaluation, and May 2013 "taper tantrum." The sample includes 13 investment-grade and 21 below-investment-grade countries and is based on monthly data. The median reserve adequacy ratio as of June 2026 for the two groups is 135 and 117 percent, respectively.

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Figure 1.9. Emerging Market Exchange Rates and Policy Responses

Exchange rate recovery has varied along with monetary and exchange rate policy responses.



Sources: IMF, Global Policy Tracker; Bloomberg Finance L.P.; and IMF staff calculations.

Note: Foreign exchange intervention is defined more broadly than in the Global Policy Tracker and includes foreign exchange sales/purchases, swap lines, verbal intervention, and intervention in the noncash markets such as nondeliverable forwards. "FXI only" category includes countries that conducted FXI without changing monetary policy. "Other" category includes countries that changed monetary policy with or without FXI, and those that did neither; FXI = foreign exchange intervention.

cial conditions tighten. The drawdowns in official reserves have been highly uneven, with greater erosion among below-investment-grade sovereigns. While investment-grade economies have drawn down reserves broadly in line with past stress episodes, below-investment-grade sovereigns have depleted their reserves far more sharply, starting from already weaker adequacy levels (Figure 1.8, panel 2). Lower gold prices have compounded the decline where gold had a larger share in official reserves. Although reserve adequacy remains comfortable in aggregate, supported by reserve rebuilding through stronger trade balances, renewed capital inflows, or bilateral financing arrangements, reserve adequacy across most emerging markets remains below pre-war levels. Furthermore, for weaker emerging markets that are both below-investment-grade and had a reserve adequacy ratio below 100 percent, the median ratio has fallen from 72 percent in the first quarter of 2026 to 63 percent in the second quarter.

The composition and timing of the policy response has varied across regions, with Asia experiencing the greatest pressure on foreign exchange interventions. Foreign exchange interventions were concentrated in Europe and the Middle East in March 2026, rotating toward Asia and Africa in the second and third quarters. Several Asian economies have faced larger capital flow swings given their dependency on imported energy, prompting the use of foreign exchange interventions and in some cases targeted capital flow management measures to ease strains in currency and offshore funding markets. These measures helped contain excessive volatility and near-term funding pressures, although their effectiveness rested on adequate reserves and credible macroeconomic policies. Economies that relied solely on foreign exchange interventions, including many in Asia and Africa, saw little meaningful recovery in exchange rates from their weakest level since end February (Figure 1.9). By contrast, the few economies that complemented intervention with monetary tightening generally experienced stronger exchange rate recoveries. Outcomes were more mixed among economies that relied on other policy tools. Overall, the cross-country experience underscores that foreign exchange intervention outcomes depend importantly on underlying vulnerabilities, including energy dependence, and the broader policy response.

Increased Use of Alternative Financing by Frontier Economies

Financing conditions in frontier economies have improved.[9] Frontier spreads widened by roughly 60 basis points at the onset of the war in the Middle East in late February 2026 but have more than retraced since, with spreads narrowing toward levels last seen in late 2024. Rising US Treasury yields have left all-in hard-currency funding costs little changed since February, but these costs are still down by roughly 200 basis points since early 2024. Market access has also broadened since February, with frontier sovereign issuers accounting for close to one-fifth of the emerging market sovereign supply in the first half of 2026, including several first-time borrowers that have lower sovereign credit ratings.

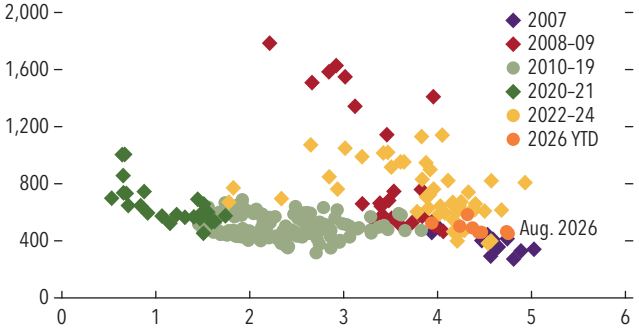
However, unusually tight spreads mask repricing risks. The current backdrop of historically compressed sovereign credit spreads alongside a 10-year US Treasury yield above 4.5 percent is historically unusual and was last observed in 2007 (Figure 1.10, panel 1). Typically, spreads were wider when yields were above 3 percent, suggesting that current credit spread

[9]Frontier economies are defined as sovereigns in the J.P. Morgan Next Generation Markets index, together with low-income sovereigns that have issued or have announced plans to issue international bonds but are not index constituents.

Figure 1.10. Financing Costs and External Debt Accumulation of Frontier Economies

Funding costs remain elevated despite compressed spreads, as US Treasury yields stay high.

1. Financing Costs
(Frontier sovereign spread, basis points, y-axis; 10-year US Treasury yield, percent, x-axis)

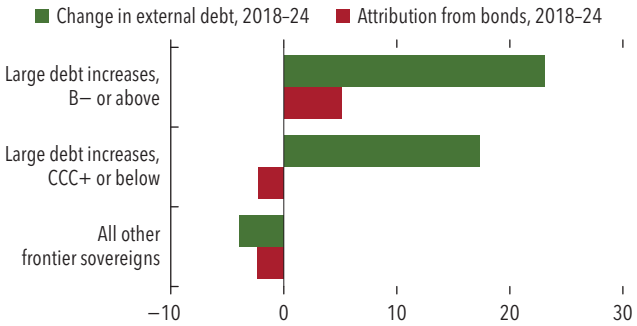


Sources: Bloomberg Finance L.P.; and IMF staff calculations.

Note: Uses monthly observations of the J.P. Morgan Next Generation Markets sovereign index. The US Treasury yield is derived from the all-in yield.

Bonds helped finance the external debt buildup of stronger frontier economies but not the weakest ones.

2. External Debt Changes and the Contribution of Bonds
(Percentage points of GDP)



Sources: World Bank, International Debt Statistics; IMF, April 2026 *World Economic Outlook*; and IMF staff calculations.

Note: Group aggregates are in percent of group GDP. External public debt is publicly guaranteed external debt, including IMF credit, and ends in 2024. Large debt increases are increases above 5 percentage points of GDP during 2018–24. Rating groups use a composite of three agencies' 2024 ratings.

compression enjoys support from favorable global financial conditions and strong investor risk appetite. With Treasury yields likely to remain elevated, the vulnerability of frontier economies is a reversion to higher sovereign credit spreads, as during 2022–25, which could pass through fully into all-in borrowing costs.

Financing of the largest external debt buildups among frontier economies has been outside bond markets, particularly for lower-rated sovereigns. Among the frontier economies with the largest external debt increases, bond markets funded about one-fifth of the debt increase between 2018 and 2024 for those rated B– or higher. For sovereigns rated CCC+ or below with large debt increases, bond exposure declined even as external debt increased (Figure 1.10, panel 2). Instead, these sovereigns relied mainly on official financing.

Some sovereigns have also begun to raise funding using newer structured financing instruments such as sovereign total return swaps. Under these transactions, a sovereign can raise cash by pledging assets—often its own bonds—and transferring the return on those assets to a counterparty. This can create vulnerabilities when borrowing costs rise, as the value of the collateral may fall while the swap position deteriorates at the same time, triggering margin calls or demands for additional collateral precisely when market conditions are stressed and liquidity is scarce. Standard debt statistics usually fail to fully capture these instruments, weakening transparency and investor confidence, as sovereign total return swaps are publicly reported in only a limited number of economies. Continued buildup of these and other opaque transactions could increase the vulnerability of frontier economies to global shocks and hinder future market access. Transparent reporting of these transactions is critical to mitigate vulnerabilities and underpin investor confidence (see Background Analysis 1.4, "Frontier External Debt: Beyond Bond Markets").

Rising Liquidity Mismatches and Concentrated Investments among Institutional Investors

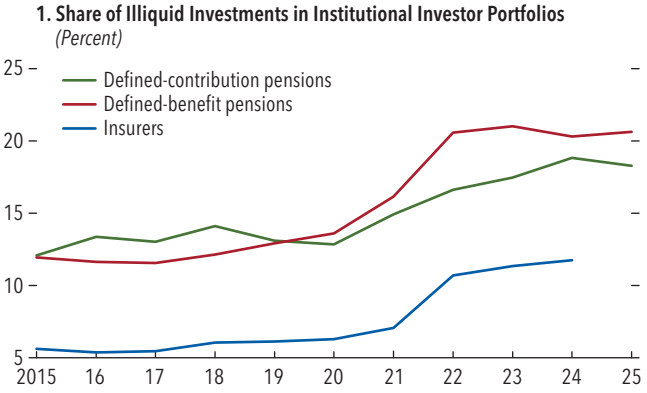
Institutional investors have steadily expanded their holdings of illiquid assets over the past decade. Pension funds and insurers have nearly doubled their share of illiquid investments (Figure 1.11, panel 1). While their long-term liabilities allow them to invest over longer horizons, growing exposure to illiquid assets can create liquidity risks if it is not managed appropriately. During periods of stress, urgent cash needs may force pension funds and insurers to rely on the sale of their most liquid assets.[10] The implications could be

[10]One of the main drivers of the growth in illiquid investments is the increasing allocation to private credit. The investment-grade status of many of these exposures supports favorable capital treatment.

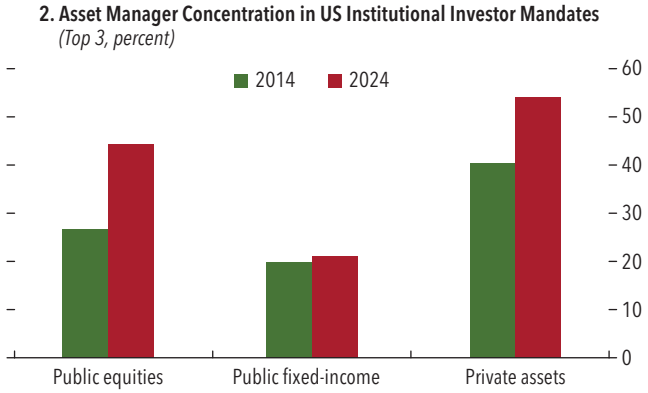
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Figure 1.11. Increasingly Illiquid and Concentrated Exposures of Pension Funds and Insurers

The share of illiquid investments in institutional investor portfolios has steadily expanded ...



... as has the concentration of managers selected to run institutional portfolios.



Sources: *Pensions & Investments*; Standard & Poor; and IMF staff calculations.

Note: The calculations for pension funds estimate the asset-weighted share of alternative investments as a proxy for illiquid investments (subtracting the more liquid hedge fund exposures) for a sample of large defined-benefit plans in the United States and Europe and defined-contribution plans in the United States. The calculations for insurers use the Level 3 exposures of a sample including 50 of the largest insurers globally. Level 3 assets are the most illiquid, often priced with unobservable inputs, including proprietary models.

Sources: *Pensions & Investments*; and IMF staff calculations.

Note: The calculations are based on a sample of US institutional investment mandates from *Pensions & Investments*. Pension funds are the main client in institutional investment mandates, accounting for over half of the advisory assets of investment consultants, followed by sovereign wealth funds, insurers, endowments, and nonprofit organizations.

significant, as pension funds and insurers are among the largest investors in financial markets, holding more than one-quarter of publicly traded corporate bonds in the United States and the euro area. Large-scale sales of liquid assets could therefore exacerbate market stress and transmit shocks well beyond the institutions affected directly.

A potential weak link is the increasing use of derivatives and holdings of private assets. Their use by large pension funds has increased markedly over the past decade, resulting in higher embedded leverage. The "dash for cash" financial turmoil in March 2020, when pension funds and insurers faced large liquidity demands from margin calls on derivative positions, provides a reminder of such risks. Other liquidity shocks may also emerge. For example, growing investments in private assets often come with contingent funding commitments that can require cash on short notice.[11] In addition, insurers may face policy surrenders, whereas defined-contribution pension plans may experience hardship withdrawals or abrupt portfolio reallocations during downturns or when financial conditions tighten.

These vulnerabilities are compounded by growing concentration across the investment chain. A small group of investment consultants plays an increasingly influential role in advising pension funds on asset allocation and manager selection. Further down the chain, fewer asset managers are selected to run institutional portfolios, particularly in private markets (Figure 1.11, panel 2). The three largest managers could now account for more than half of institutional investments in private equity and private credit. Common and concentrated asset management exposures could increase the likelihood that institutions respond to liquidity pressures by adjusting their portfolios in similar ways, amplifying market stress.

Higher Leverage and Contingent Liquidity Risks in Private Credit Direct Lending

Direct lending is becoming increasingly relevant for financial stability. Having outgrown its origins as a niche financing channel, direct lending now accounts for nearly $2 trillion globally in loans.[12] Its extensive cross-border interconnections between

However, a deterioration in credit quality could trigger forced sales, amplifying losses and market stress.

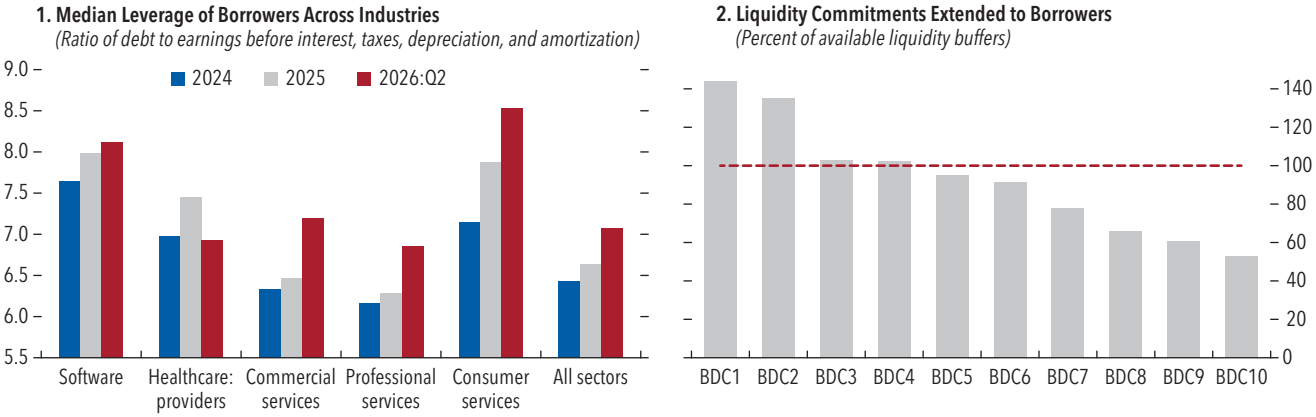
[11]During the global financial crisis, for example, private fund capital calls created severe liquidity strains for some large private university endowments. See Humphreys (2010).

[12]The deployed loans estimate excludes uninvested dry powder and incorporates leverage at the direct lending vehicle level.

Figure 1.12. Higher Leverage and Liquidity Risks in Private Credit Direct Lending

Leverage among direct lending borrowers has increased across most sectors.

The commitments of some direct lending funds and business development companies to borrowers exceed their available cash and borrowing capacity.



Sources: S&P Global Ratings; and IMF staff calculations.

Note: The panel shows the median leverage in the S&P Global Ratings' set of reviewed US direct lending borrowers and S&P's definition of adjusted earnings before interest, taxes, depreciation, and amortization.

Sources: Company disclosures; and IMF staff calculations.

Note: Firms were selected based on their size (largest BDCs) and availability of information. Available liquidity buffers are calculated as cash balances and available undrawn secured facilities minus short-term unsecured debt. BDC = business development company.

banks and nonbanks, combined with growing reliance on contingent funding arrangements and borrowers' leverage, are creating risk transmission channels that have yet to be tested in a sharp tightening of financial conditions.

Recent trends suggest that vulnerabilities are building in some areas, even as some data providers report declining trailing default rates among direct lending borrowers. This is in part because funds have provided flexibility to some borrowers by, for example, amending and extending loans (see the April 2026 *Global Financial Stability Report*). However, borrowers—often medium-sized companies—have taken on additional debt, which is partly used for dividend recapitalizations given pressure on private equity sponsors to return capital to investors. Although these transactions generate liquidity for investors, they leave borrowers more leveraged and less resilient. As a result, the ratio of the median borrower's debt-to-EBITDA (earnings before interest, taxes, depreciation, and amortization) has risen from 2024 through 2026, especially in the software and services industries (Figure 1.12, panel 1). Elevated leverage helps explain the persistently large share of borrowers unable to generate sufficient cash flow to meet debt-servicing obligations, leaving many reliant on sponsor support, lender forbearance, or continued access to external financing to remain viable. Should financial conditions tighten sharply, including through the materialization of the three risks highlighted earlier in this chapter, higher leverage could exacerbate defaults and amplify stress in the sector (see Background Analysis 1.3, "Private Credit Leverage and Contingent Liquidity in Direct Lending").

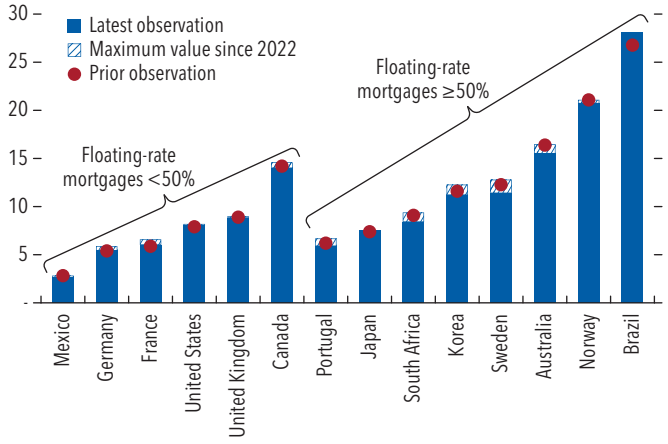
Contingent liquidity risks are also becoming more pronounced. Until recently, concerns about liquidity in direct lending had focused largely on elevated redemptions from semiliquid vehicles. The broader significance of these capital flows is underscored by the growing contribution of semiliquid vehicles to capital formation in direct lending, accounting for more than 50 percent of new fundraising in the US in 2025 prior to the recent redemption wave. Although most of these funds appear to be able to manage investor redemptions,[13] other sources of liquidity demand could add pressure. Direct lending funds—across retail- and institutional-focused vehicles—increasingly provide borrowers with substantial contingent liquidity commitments. For example, among 10 BDCs with $300 billion in total assets, 4—representing about $90 billion in assets—have commitments exceeding their available liquidity buffers (Figure 1.12, panel 2).

[13]Business development companies generally have no regulatory obligation to redeem shares and may suspend or modify repurchase programs, whereas interval funds are generally required to conduct periodic repurchase offers (typically for 5 percent to 25 percent of outstanding shares).

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Figure 1.13. Household Debt: Debt Service Ratios
(Percent)

Household debt servicing burden has improved in jurisdictions with less floating rate mortgages.



Sources: Bank for International Settlements; Organisation for Economic Co-operation and Development; national authorities; and IMF staff calculations.

Note: The debt service ratio is defined as required debt payments (interest plus principal) divided by disposable income. Calculations are made by the Bank for International Settlements for countries aside from Brazil, Mexico, and South Africa. Debt service ratios for Mexico are computed using household income and debt data from the national authority and the Organisation for Economic Co-operation and Development; interest rates are derived from policy rates and may not reflect true interest burdens faced by households. The debt service ratios for Brazil and South Africa are based on data from the Central Bank of Brazil and the South African Reserve Bank, respectively. For BIS-derived or Brazil and South Africa numbers, "latest observation" is the fourth quarter of 2025, and "prior observation" is fourth quarter of 2024. For Mexico, the "latest observation" is for the fourth quarter of 2024 and the "prior observation" is for the fourth quarter of 2023. The share of fixed-rate mortgages is based on the definition of De Stefani and Mano (2025).

In a stress scenario, borrowers could draw heavily on these facilities just as funds' own liquidity resources are eroded by lower collateral values. Such dynamics could transform liquidity pressures into a broader contraction in credit supply, amplifying procyclicality and reinforcing stress across the direct lending ecosystem.

Household Finances Have Improved Somewhat, though Lower-Income Households Could Be Disproportionately Affected by Higher Interest Rates

Household debt burden has stayed moderate even though global interest rates have risen. On the liability side, household debt-service ratios have broadly improved in recent quarters across countries and remain appreciably lower than the peak levels reached after central banks across the world began to hike interest rates in 2022 (Figure 1.13). Countries with more floating-rate mortgages tend to have higher debt-service ratios and are more sensitive to interest rate resets. Meanwhile, household assets have been boosted by a strong equity market and elevated house prices. Globally, households' equity and real estate holdings account for roughly 20 and 40 percent of their assets, respectively, or 1.2 and 2.5 times global GDP.[14]

With a moderate debt burden and high overall asset holdings, households are unlikely to be a source of systemic concern. That said, a correction in housing or asset prices could erode household wealth and curb consumption, with potentially meaningful macroeconomic effects. Lower-income households could be disproportionately affected given their limited liquidity buffers; for example, delinquency rates on consumer debt tied to households, like credit card debt in the United States, have risen.[15] Looking ahead, persistent inflation leading to higher interest rates and weaker real income growth could further raise debt-servicing burdens for low-income households,[16] while their exposure to global equities—though much more modest than that for high-income households—could be vulnerable to a market correction.[17]

What Should Policymakers Do?

Financial markets have demonstrated resilience since the last *Global Financial Stability Report*, but risks and vulnerabilities abound. This section outlines policy recommendations to help mitigate the risks and vulnerabilities analyzed in this chapter and summarized in Table 1.1.

Containing the leverage used to finance the AI ecosystem, where excessive, is a priority. Growing leverage in AI equity positions and high levels of AI-related debt could exacerbate the impact of weaker

[14]Global households also hold 15 percent of assets in pension plans and currencies and deposits each. See McKinsey Global Institute (2025).

[15]Delinquency rates can be found in the Federal Reserve Bank of New York's Consumer Credit Panel. Separately, Mori and Sanchez (2025) divide US zip codes into deciles based on 2019 per capita aggregate gross income and show that the share of credit card debt that is 30 days delinquent is higher in the lowest-income deciles than in the aggregate.

[16]Chapter 1 of the April 2025 *Global Financial Stability Report* contains a sensitivity analysis of global household debt to interest rates and income changes.

[17]In the United States, the euro area, and Japan, the latest available data from the Federal Reserve's Flow of Funds, the European Central Bank's Household Finance and Consumption Survey, and Japan's Family Income and Expenditure Survey, respectively, indicate that investment exposure, including equities, has risen by 1 to 3 percentage points for the bottom 20 percent of households over the past five years.

or less durable investment and profitability. To mitigate the risks of forced deleveraging and volatility amplification when AI equity prices decline, policymakers should increase oversight of the means to obtain leverage—including by retail investors—such as placing restrictions on equity margin financing, limiting the proliferation of leveraged exchange-traded funds, and containing the use of short-term options (see the April 2026 *Global Financial Stability Report*). Furthermore, financial sector supervisors and macroprudential authorities should assess the potential for systemwide losses arising from AI-related exposures, including the risk that highly interconnected and circular financing arrangements amplify distress. Where vulnerabilities could be material, authorities should deploy appropriate tools, including sectoral capital requirements; concentration limits, including in prime brokerage relationships; and capital buffers, to contain the buildup of systemic risk and strengthen financial resilience.

Mitigation of bond market fragilities begins by placing public debt on a sustainable path, but it also requires resilience in market structures, including funding markets. Credible fiscal consolidation is the first line of defense against bond market fragilities, particularly as higher term premiums and growing refinancing needs leave little room for fiscal slippage (see the April 2026 *Fiscal Monitor*). In addition, managers of public debt should reduce rollover risks by establishing a more durable maturity profile for sovereign debt outstanding. Market structure should also be strengthened to prevent a seizing of market liquidity during stress episodes by greater central clearing of both bonds and funding instruments, namely repos. Central bank liquidity facilities should be operationally ready to stem market dysfunction.

Central banks can help mitigate the risk of a sharp rise in sovereign bond yields by delivering on their mandates, preserving their independence, and communicating monetary policy decisions clearly. Communications should focus on explaining the policy reaction function, how incoming data are likely to inform decisions, and the risks surrounding the outlook. Such communication could help anchor medium- and long-term inflation expectations, reduce excessive market sensitivity to individual data releases, and mitigate a source of uncertainty for bond and funding markets. Central bank independence also remains critical to maintaining policy credibility and anchoring inflation expectations.

Addressing cybersecurity risks requires a systemwide operational resilience framework focused on the continuity of critical services. AI adds urgency by accelerating vulnerability discovery, exploitation, and attack, compressing the attack–defense cycle to machine speed. Policy priorities should be tailored to the levels of cyber maturity of the different economies. Advanced economies should strengthen operational resilience, third-party risk oversight, and resilience testing. This includes identifying critical business services, setting impact tolerances for disruptions, mapping operational dependencies, and conducting regular resilience testing. Emerging markets and developing economies may need to prioritize foundational cyber hygiene, incident reporting, crisis coordination, and supervisory capacity before adopting more advanced AI-related oversight frameworks. Low-income countries should focus scarce resources on essential controls and critical infrastructure protection. Across all jurisdictions, supervisors should build specialized cyber expertise, adopt risk-based and proportionate approaches, and ensure robust governance, operational resilience, and human oversight of AI systems.

Although banks remain resilient, an increase in the share of banks that appear weak under a scenario featuring lower growth, higher inflation and interest rates, energy shocks, and weaker AI monetization highlights the need to reinforce safeguards. In jurisdictions where banks' loan books and assets are highly sensitive to energy prices, supervisors should ensure timely and accurate asset classification and adequate provisioning to cover expected credit losses. Not doing so raises overall debt levels in the economy by sustaining firms that struggle to service their debt and may also jeopardize the future earnings and balance sheet health of banks (see Box 1.3 for an illustration of this issue in Asian emerging markets). More broadly, preserving financial stability in an environment of elevated uncertainty requires completing implementation of Basel III and other internationally agreed-upon standards to ensure that banks maintain adequate capital and liquidity buffers. Although a review of regulations to reduce unnecessary complexity may improve efficiency, reforms should not weaken resilience, create opportunities for regulatory arbitrage, or undermine international consistency. Given the growing interconnectedness between banks and NBFIs, supervisors should intensify the monitoring of banks' exposures to NBFIs and assess how stress at lightly regulated institutions could affect bank solvency and liquidity under adverse scenarios.

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The growing size, concentration, and illiquidity of institutional investor portfolios calls for a broader approach to risk monitoring. Authorities should focus on identifying common exposures, leverage, and liquidity mismatches across pension funds and insurers, as well as their links to banks and financial markets, to detect vulnerabilities that could amplify market stress. Increasing the use of solvency and liquidity stress tests for these types of institutions could support this effort. Closing data gaps and strengthening information sharing, both domestically and across borders, would support earlier intervention and more effective prudential policies. Authorities should also ensure that the liquidity of investment products remains aligned with that of the underlying assets, including through appropriate redemption terms and notice periods.

As private credit becomes more interconnected with the broader financial system, authorities should strengthen systemwide monitoring of risks across the entire financing chain, from portfolio companies (borrowers) and special-purpose vehicles to funds and investors. Closing data gaps on leverage, contingent liquidity commitments, and cross-sectoral and cross-border exposures is critical. Enhanced disclosures would support the development of stress testing and surveillance tools to assess how shocks propagate across institutions and markets, helping authorities identify emerging vulnerabilities, better understand risk transmission channels, and mitigate systemic risks before they materialize.

In emerging markets, authorities should rebuild policy buffers, ensuring an overall policy mix consistent with the IMF's Integrated Policy Framework, while strengthening disclosure of alternative financing sources. Rebuilding external buffers where they have eroded is the first line of defense against likely external headwinds; doing so will preserve market access and the capacity to respond to shifts in global risk sentiment. Authorities should calibrate monetary, exchange rate, macroprudential, and capital flow measures to country-specific circumstances and deploy interventions only to address frictions or disorderly market conditions. Medium-term fiscal and debt management frameworks should safeguard debt sustainability and limit refinancing risks. Spending aimed at protecting vulnerable groups from inflation or an energy shock should be temporary and targeted. Given increased recourse to alternative borrowing sources, robust disclosure and comprehensive debt transparency are essential in accurately assessing sovereign balance sheets and ensuring continued investor confidence.

The debt-servicing capabilities and net worth of households have improved in recent years, but a resurgence of inflation and higher interest rates could test that resilience. Authorities should closely monitor household balance sheets and debt-servicing burdens, particularly in jurisdictions where mortgage payments are sensitive to interest rate fluctuations. Appropriate macroprudential measures, such as limits on loan-to-value or debt-service-to-income ratios, can help prevent the buildup of excessive household leverage and strengthen resilience against future shocks.

Box 1.1. Risks and Vulnerabilities Framework in the *Global Financial Stability Report*

This chapter distinguishes between risks and vulnerabilities, following Adrian and others (2019). Their selection draws on IMF staff's daily monitoring of financial markets and institutions, while assessment of their trends is informed by analytical work, including analyses of new data sources.

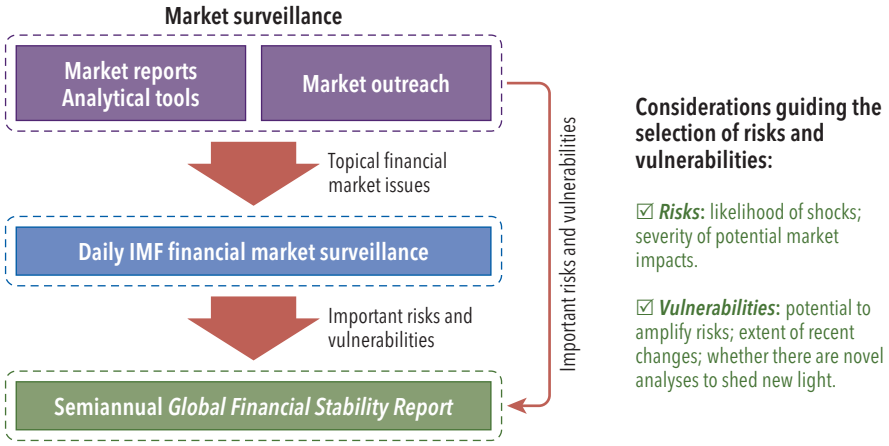
Risks refer to scenarios that are plausible near-term catalysts for market turmoil and a sharp tightening of financial conditions. Rather than focusing solely on adverse shocks, which are inherently difficult to predict, risks combine both the likelihood of triggering shocks and the potential severity of impact on markets. For example, bond market risks could worsen if inflationary energy shocks become more likely. Given the foundational importance of sovereign bonds, the resulting tightening of financial conditions could lead to market turmoil.

Risks by themselves may lead to market turmoil but may not threaten financial stability. Financial instability or systemic risk arises when risks are amplified by financial vulnerabilities to impair the functioning of key financial institutions and markets, disrupting the provision of credit or financial services and causing serious negative effects to the real economy, often necessitating extraordinary policy responses.[1]

Vulnerabilities are structural imbalances in the financial system. They include elevated leverage, liquidity mismatches, concentrated exposures, interconnectedness, and weak external or fiscal positions. They could amplify risks through mechanisms including forced deleveraging, fire sales, funding stress, and contagion. Vulnerabilities determine the extent to which shocks or risks propagate through the financial system and affect the real economy.

The selection of such risks and vulnerabilities is guided by IMF staff's surveillance of financial markets and institutions (Figure 1.1.1), drawing on market reports, analytical tools, and outreach. Candidate risks and vulnerabilities are selected for deeper analysis based on the following considerations: for risks, the likelihood of triggering shocks and severity of potential market impacts; for vulnerabilities, their potential to amplify risks, the extent of recent changes and whether there are novel IMF staff analyses that can shed new light. Once selected, staff assess whether trends in risks and vulnerabilities are "better," "about the same," or "worse," based on the balance of evidence from empirical indicators, balance sheet data, stress tests, and other analytical tools, recognizing that risks and vulnerabilities are inherently forward-looking and their trends cannot be classified purely through mechanical rules. Overall financial stability risks (for example, "elevated" vs. "moderate") are then assessed based on the combined trajectory of risks and vulnerabilities. Where appropriate, this assessment may be benchmarked against growth-at-risk estimates (Adrian and others 2019).

Figure 1.1.1. Selection and Assessment of Risks and Vulnerabilities



Source: IMF staff.

[1]This definition is similar to that of "systemic risk" in the IMF's 2021 policy paper on comprehensive surveillance.

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Box 1.2. European Union Common Borrowing Has Mitigated Sovereign Bond Market Fragilities

In euro area sovereign bond markets, yield differentials between core and southern member states (Greece, Italy, Portugal, and Spain) have narrowed markedly in recent years (Figure 1.2.1, panel 1). This convergence reflects several factors, including stronger fiscal positions in the southern states and European Central Bank measures in response to the macroeconomic shocks that hit Europe (for example, the Pandemic Emergency Purchase Programme and, later, the introduction of the Transmission Protection Instrument; see the April 2026 *Regional Economic Outlook* for Europe). Notably, yield convergence continued even after the European Central Bank began reducing its balance sheet in late 2022. Evidence suggests that European Union funding programs played an important role in this process.[1]

Since the launch of the Next Generation EU, the European Commission has become a relatively large, regular borrower across maturities. By introducing common borrowing and transfers to member states, these programs have strengthened perceptions of fiscal risk sharing and helped reduce concerns about debt sustainability and redenomination risk (Cioffi and others 2019; Blanchard and Ubide 2025; Lane 2026).

Empirically, these initiatives appear to have dampened the effect of systemic shocks on sovereign bond markets. The association of sovereign bond asset-swap spreads to systemic stress—gauged by the European Central Bank's Composite Indicator of Systemic Stress—has become less negative since the introduction of the Next Generation EU (Figure 1.2.1, panel 2).[2] The effect was particularly pronounced in some southern European economies, where joint funding programs also contributed to the compression of sovereign spreads as compensation for contagion and redenomination risks (Pancotto, Gwilym, and Molyneux 2023; Bańkowski and others 2024; Darvas, Welsalu, and Zettelmeyer 2025; Busse, Caselli, and Fotiou 2026). Another set of results (not shown) suggests that shocks that previously triggered a flight into German bunds no longer generate significant selling pressure on southern European sovereign bonds. This evidence suggests that risk-sharing programs, where applicable in currency unions, can supplement fiscal consolidation in mitigating bond market fragilities.

This box was prepared by Francesco de Rossi.

[1]The analysis covers the period from January 2016 until the end of July 2026.

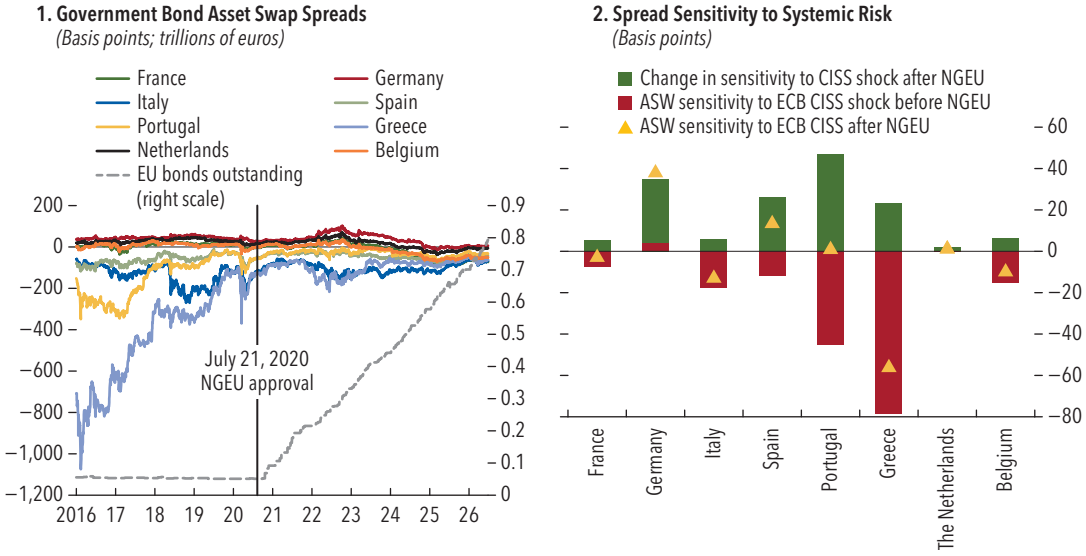
[2]Asset-swap spreads are computed as the difference between the swap rate and bond yields. A negative value reflects a premium demanded by investors to bear sovereign credit risk (including rating migration) associated with sovereign bonds, as well as their liquidity and funding risks.

Box 1.2 *(continued)*

Figure 1.2.1. Common Borrowing and Bond Market Fragilities

Government bond spreads in the euro area have narrowed in recent years.

Government bond spreads' sensitivity to stress has declined significantly since the launch of the NGEU.



Sources: Bloomberg Finance L.P.; S&P Capital IQ; European Central Bank Data Portal; and IMF staff calculations.

Note: Panel 2 shows the change in the short-term sensitivity of ASW to systemic risk, as measured by the CISS of the ECB. The analysis is based on a panel regression of weekly changes in 10-year sovereign ASW spreads on lagged ASW changes; systemic stress (the CISS); and global, country-specific, and ECB policy controls (including Pandemic Emergency Purchase Programme). A dummy following the launch of the NGEU is interacted with CISS to test for a structural break in ECB sensitivity to systemic stress after the introduction of the EU's extraordinary funding programs. ASW = asset-swap spread; CISS = Composite Indicator of Systemic Stress; ECB = European Central Bank; EU = European Union; NGEU = Next Generation European Union.

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Box 1.3. Corporate Zombies Are Thwarting Debt Deleveraging

Private sector debt has remained elevated. While Asia has seen some moderation in credit to nonfinancial corporations, its debt ratio has remained high compared with others. At the end of 2025, credit in Asia averaged 107 percent of GDP, compared with an average of 99 percent for emerging market economies and 93 percent globally,[1] up from 81 percent in 2007 (Figure 1.3.1, panel 1).

This rising share of corporate debt is increasingly concentrated in firms that cannot service it. For example, across 10 Asian economies, zombie firms—those for which earnings have not covered interest expenses for at least three consecutive years[2]—now account for 21.4 percent of corporate debt outstanding in the region, having increased from under 10 percent in 2008. The share of zombie firms is relatively small elsewhere. In Latin America, Europe, and Africa, on average, about one in eight firms were zombies in 2024, and were concentrated in a handful of large borrowers.

Corporate zombies are typically sustained through bank forbearance. Because recognizing losses on distressed borrowers consumes capital, whereas rolling over loans defers losses and preserves reported capital ratios, undercapitalized banks tend to extend their bad loan exposure (Caballero, Hoshi, and Kashyap 2008; Acharya and others 2024; Faria-e-Castro, Paul, and Sánchez 2024). For example, in the Asian economies, banks with Tier 1 capital below the median of their country counterparts have 16 percent of their loans with zombie firms, compared with 12 percent for better capitalized banks.[3] Bank forbearance therefore locks in both weak borrowers and weak banks.

Delaying loss recognition and loan extensions also add to overall debt levels. To quantitatively illustrate this, if the stock of zombie debt in the 10 Asian economies had been subjected to hazard and recovery rates typical of firms with sustained distress (Figure 1.3.1, panel 2), almost 23 percent of their debt would have been written off or restructured as of 2025. This amounts to more than 5 percent of total corporate debt and is likely a source of future earnings and balance sheet weakness for the banks involved.

This box was prepared by Sally Chen and Amanda Liu.

[1]The samples for emerging markets, the global aggregate, and Asia are based on data from the Bank for International Settlements. Estimates of corporate zombies in Asia include China, Hong Kong SAR, India, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan Province of China, and Thailand.

[2]Data from Orbis. Firms exit from zombie status after they cover their interest expenses for three consecutive years.

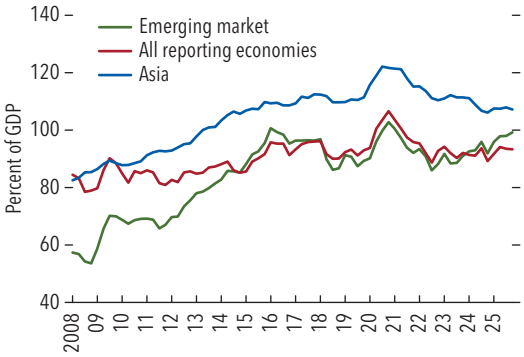
[3]Based on a bank-year panel regression of the share of bank loans extended to zombie firms on lagged Tier 1 capital ratios, controlling for lagged dependent variable, bank characteristics, and bank and year fixed effects.

Box 1.3 *(continued)*

Figure 1.3.1. Corporate Debt, Shares Held by Zombie Firms, and Evergreening

Private sector debt remains elevated.

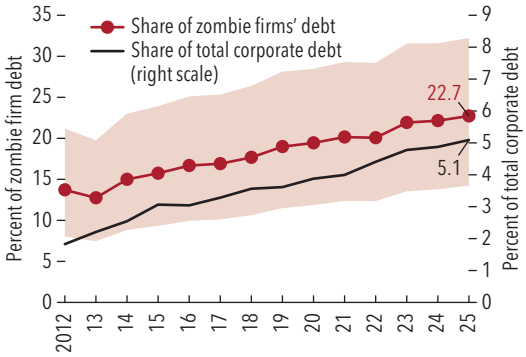
1. Share of Credit to Nonfinancial Corporates
(Percent)



Sources: BIS, Moody's Analytics; Orbis; and IMF staff calculations.

Absent evergreening, a quarter of zombie debt would have been resolved.

2. Estimates of Zombie Debt Resolution in Asia
(Percent)



Sources: BIS, Moody's Analytics; Orbis; and IMF staff calculations.

Note: Estimation of zombie debt that should be written off or restructured assumes an annual default hazard of 9 percent–the exit rate of comparably distressed firms absent evergreening, calibrated by Faria-e-Castro, Paul, and Sánchez (2024)–with creditor recovery of 35 percent upon default based on Kermani and Ma (2023). For a zombie firm in its d^{th} year, the counterfactual of debt resolution is [1 – (1 – 0.09)d] × (1 – 0.35). The shaded band in panel 2 indicates the range of estimates based on alternative default hazards of 5 to 15 percent.

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CHAPTER 2

HEDGE FUNDS AND FINANCIAL STABILITY

Chapter 2 at a Glance

- Hedge funds have become increasingly important participants in global financial markets, with gross assets more than tripling since the previous decade to about $13 trillion in early 2026.
- The growing market footprint of hedge funds can support market liquidity and efficiency in normal times but may amplify price dislocations and liquidity strains during periods of stress.
- This amplification is driven by key vulnerabilities, including leverage, fragile investor funding, and crowded trades in which many hedge funds hold similar positions.
- Equities held by more vulnerable hedge funds experience larger price declines and higher volatility during market stress.
- Leverage amplifies the adverse effects of crowded positions and investor redemptions, including through the widening of spreads when leveraged sovereign bond trades unwind.
- Adverse shocks to hedge funds can spill over to prime brokers, typically large dealer banks, and broader financial markets, with potential implications for macrofinancial stability.
- Hedge fund vulnerabilities remain difficult to monitor because of significant data gaps, particularly regarding leverage, derivatives exposures, counterparty relationships, and cross-border activities.

Policy Recommendations

- Close data gaps and strengthen risk monitoring, including through stress testing and scenario analysis, to better identify vulnerabilities in markets with significant hedge fund participation.
- Address risks from crowded trades and synchronized deleveraging through targeted and well-calibrated activity-based measures, including stronger collateral management practices.
- Where risks are concentrated, deploy entity-based measures, such as risk-based leverage limits, capital or margin add-ons, and limits on concentrated exposures.
- Improve market resilience by strengthening counterparty risk management.
- Maintain credible crisis backstops to contain severe market disruptions and strengthen international coordination to limit regulatory arbitrage.

Introduction

Hedge funds have become increasingly important participants in global financial markets.[1] Although hedge funds account for only about 5 percent of total nonbank financial intermediation, their assets have grown substantially faster than those of most other nonbank financial segments since the global financial crisis (Figure 2.1, panel 1).[2] By early 2026, gross assets of hedge funds reached about $13 trillion, compared with $4 trillion in 2013 (Figure 2.1, panel 2). In addition, hedge funds now play a more prominent role in trading, liquidity provision, and risk transfer across core financial markets, increasing their relevance

The authors of this chapter are Yuhua Cai, Andrea Deghi (co–team lead), Jakree Koosakul, Seungduck Lee, Jialiang Lou, Taneli Mäkinen (co–team lead), Mingmei Xiao, and Mustafa Yenice, under the supervision of Mahvash Qureshi and Felix Suntheim. Itzhak Ben-David served as an external advisor.

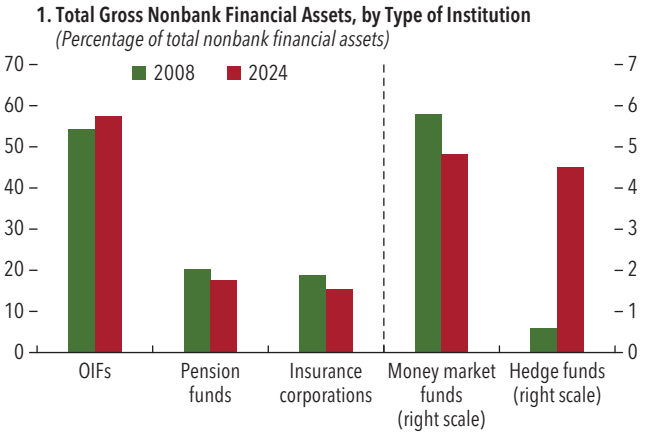
[1]Definitions differ across jurisdictions, but hedge funds are generally private investment vehicles for institutional investors and high-net-worth individuals. Compared with other asset management vehicles, hedge funds typically have greater flexibility to use short selling, derivatives, and leverage and pursue a wide range of investment strategies (see Online Annex 2.1 for a detailed description).

[2]The growth of the hedge fund sector partly reflects the shift after the global financial crisis toward market-based intermediation, as stronger bank regulations have contributed to the migration of some trading activities from banks to hedge funds (Whitehead 2011).

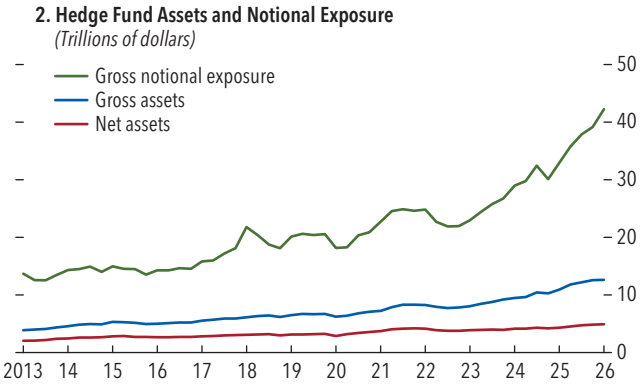
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Figure 2.1. Size of the Hedge Fund Sector

Hedge funds represent a small share of nonbank financial intermediation, but their market footprint has grown substantially ...



... especially in terms of gross notional exposures.



Sources: FSB 2025; Office of Financial Research; and IMF staff calculations.

Note: OIFs refer to investment funds other than hedge funds and money market funds.

in transmitting macrofinancial shocks to the financial system.

The growth of hedge funds has been financed primarily through leverage. Since 2013, the gap between gross and net assets—a measure of borrowing—has risen by nearly $6 trillion for hedge funds (Figure 2.1, panel 2). Many hedge fund strategies also rely extensively on synthetic leverage through derivatives.[3] As a result, the sector's gross notional exposure, including off-balance-sheet derivatives positions, has tripled from $13 trillion in 2013 to more than $40 trillion in early 2026.

The increase in leverage has been fueled by rapid growth in prime brokerage and repurchase (repo) financing, which has expanded by more than $5 trillion since 2013. Whereas repo borrowing has largely funded increased sovereign bond exposures (Figure 2.2, panel 1), prime brokerage financing has supported growth in equity exposures (Figure 2.2, panel 2).

The growing footprint of hedge funds is particularly evident in sovereign bond markets. Hedge funds' sovereign bond exposures have more than doubled since 2022, with about two-thirds of the increase concentrated in US Treasuries. This growth reflects not only higher sovereign bond issuance globally but also a rising share of sovereign debt held by hedge funds. For example, in the US Treasury market, hedge funds are estimated to have increased their share of holdings from around 4 percent in 2022 to 9 percent in 2025, largely through highly leveraged arbitrage strategies (Monin 2026). Consequently, hedge funds now play a more important role in sovereign bond markets, contributing to liquidity provision, price discovery, and absorption of new issuance (Epp and Gao 2025; Mann 2026).

A greater presence of hedge funds can improve market efficiency, liquidity, and risk sharing. Broad mandates, flexible investment strategies, data-driven trading, and access to leverage allow hedge funds to correct mispricing, support price discovery, and absorb order imbalances (Akbas and others 2015; Cao and others 2018), particularly when other intermediaries are constrained (Jylhä, Rinne, and Suominen 2014; Jame 2018).[4] In doing so, they can enhance market efficiency and risk diversification (Kokkonen and Suominen 2015). These benefits, however, often depend on ample funding liquidity and low market volatility, as many arbitrage strategies rely on leverage to exploit small price differentials (Çötelioğlu, Franzoni, and Plazzi 2021).

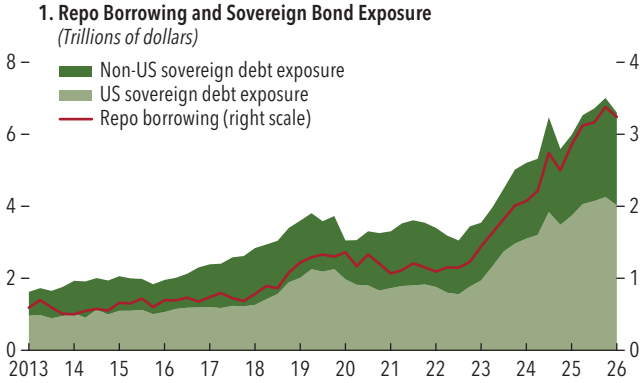
When market conditions deteriorate, hedge funds can shift from stabilizing markets to amplifying stress. The same features that support market functioning

[3]Synthetic leverage refers to market exposure obtained through derivatives rather than through direct borrowing. It is measured using derivatives positions expressed in terms of their equivalent exposure to the underlying assets relative to funds' gross assets.

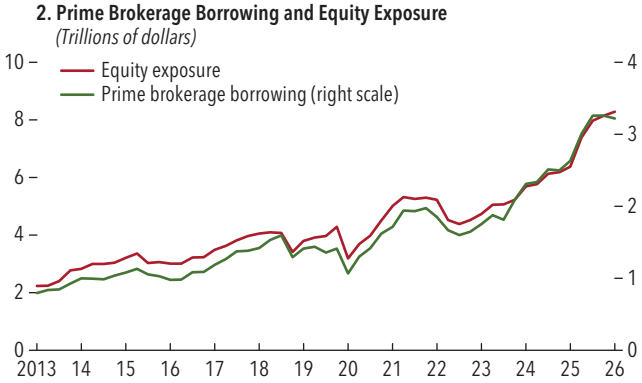
[4]Hedge funds often pioneer the use of new technologies in financial markets, allowing them to extract trading signals from large amounts of data and automate execution (Kaal 2021).

Figure 2.2. Hedge Fund Borrowing and Exposures

Hedge funds' repo borrowing has increased along with government bond exposures ...



... whereas prime brokerage borrowing has grown in tandem with equity exposures.



Sources: Office of Financial Research; and IMF staff calculations.

Note: Panels 1 and 2 show long notional exposure to sovereign debt and equity, respectively. Repo = repurchase agreement.

in normal times can lead hedge funds to retrench substantially when market volatility rises or funding conditions tighten (Ben-David, Franzoni, and Moussawi 2012; FSB 2023; BIS 2024). For example, margin calls, which require borrowers to post additional collateral when asset values fall, may trigger the unwinding of leveraged positions, while concentrated or crowded positions in specific markets can reverse abruptly as hedge funds adjust their portfolios.[5] Investor redemptions may force further asset sales, intensifying selling pressures and impairing market liquidity. These amplification mechanisms may be more pronounced than in other investment funds since hedge funds typically employ higher leverage and face fewer constraints on portfolio positions and risk levels. However, they may be similar to those in proprietary trading firms, which often employ comparable trading strategies and can adjust risk exposures rapidly in response to market conditions (Bergman and others 2026).[6] The market impact of hedge funds can therefore be sizable even when their asset holdings are relatively small; this was evident during the March 2020 "dash for cash," when hedge fund deleveraging and larger portfolio adjustments than those of mutual funds (Figure 2.3) contributed to market stress (Schrimpf, Shin, and Sushko 2020).

The vulnerabilities and risks associated with hedge funds vary across strategies but can spill over across asset classes and financial institutions. For example, macro and relative-value strategies often rely on significant leverage, making them susceptible to margin calls and forced deleveraging when funding conditions tighten. Equity funds are more exposed to changes in equity valuations and market liquidity, whereas managed futures strategies may be more sensitive to abrupt reversals in market trends.[7] The unwinding of leveraged or concentrated positions can transmit stress beyond the initially affected market, as funds are forced to sell other assets to raise cash. Global trading activity, cross-border funding arrangements, collateral linkages, and offshore investment vehicles can further amplify these spillovers by reinforcing an adverse feedback loop between deleveraging, asset sales, and tighter financial conditions.[8]

The growing footprint and systemic relevance of hedge funds have increased the importance of effec-

[5]A case in point is the July 2026 stress episode at Situational Awareness, then a major hedge fund managing a multibillion-dollar portfolio, when losses on highly leveraged and concentrated AI-related equity positions triggered margin calls and forced deleveraging. The fund's publicly listed portfolio was subsequently acquired by another market participant, facilitating an orderly unwind and helping to mitigate the immediate market impact of the forced liquidation (With Intelligence 2026).

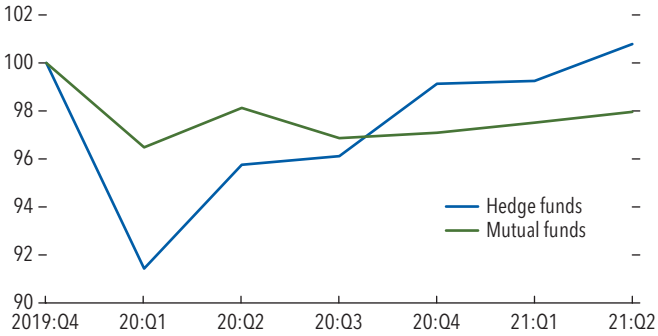
[6]The financial stability concerns posed by proprietary trading firms may therefore be similar to those of hedge funds. This chapter focuses on hedge funds and does not examine proprietary trading firms because of data availability issues.

[7]Managed futures funds can also be significantly leveraged, particularly through derivatives.

[8]Collateral linkages refer to interconnections created through the use and reuse of collateral in funding markets. Offshore investment vehicles are entities domiciled in foreign jurisdictions that facilitate cross-border investment and funding.

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Figure 2.3. Global Equity Holdings of Hedge Funds and Mutual Funds during the March 2020 Market Turmoil
(Index)



Sources: FactSet; and IMF staff calculations.

Note: Global equity holdings are adjusted for valuation changes, indexed to 100 in the quarter preceding the shock. Q = quarter.

tive monitoring and oversight. Historically, hedge funds operated with fewer disclosure requirements and investment restrictions than most other nonbank financial intermediaries (Cumming, Johan, and Wood 2021). Reforms following the global financial crisis have improved transparency through adviser registration, regulatory filings, and more systematic reporting of private fund activity (Brown and others 2008; FSB 2023). Nevertheless, hedge funds remain inherently opaque, making comprehensive risk assessment difficult because of significant heterogeneity across funds, rapidly shifting exposures, and leverage embedded in derivatives (Ang, Gorovyy, and van Inwegen 2011; FSB 2024). Offshore structures and uneven data coverage further complicate the measurement of aggregate exposures, counterparty concentration, and cross-border spillovers, potentially obscuring the buildup and transmission of systemic risks (Aragon, Liang, and Park 2014).

In this context, this chapter analyzes the evolution of the hedge fund sector and its implications for market functioning and financial stability. It begins by presenting a simple conceptual framework that illustrates how hedge funds can transmit and amplify shocks through markets and intermediaries, with potential consequences for macrofinancial stability. The chapter then examines the evolution of the hedge fund sector over time, including changes in its size, concentration across investment strategies, and leverage. The chapter next assesses the role of hedge funds in equity and bond markets, focusing on how their behavior affects market liquidity and efficiency during both calm and stressed conditions and comparing it with that of other nonbank financial intermediaries like mutual funds.[9] The analysis then turns to assessing the role of vulnerabilities, including leverage, investor redemptions, and crowded positions, in influencing hedge fund trading behavior and market impact. Finally, the chapter evaluates the systemwide financial stability implications of hedge fund stress, including spillovers to other financial intermediaries and broader market conditions, and concludes by outlining policy options to strengthen monitoring, transparency, and risk mitigation.

To examine these issues, the chapter combines information from multiple data sources to develop a comprehensive picture of the hedge fund sector. The analysis draws on granular data for more than 25,000 unique hedge funds domiciled in 78 advanced and emerging market economies from 1990 to 2026. It integrates several commercial hedge fund databases covering information on fund size, investment strategies, leverage, redemption terms, and counterparty relationships, including links to prime brokers.[10] These data are complemented by quarterly security-level equity and bond holdings data, capturing both sovereign and corporate issuers. Collectively, these sources provide a uniquely comprehensive view of hedge fund activities and exposures, facilitating a systematic assessment of key vulnerabilities, transmission channels, and broader financial stability implications.[11]

Hedge Funds and the Transmission of Financial Shocks: A Conceptual Framework

The growing presence of hedge funds in financial markets makes them potentially important conduits

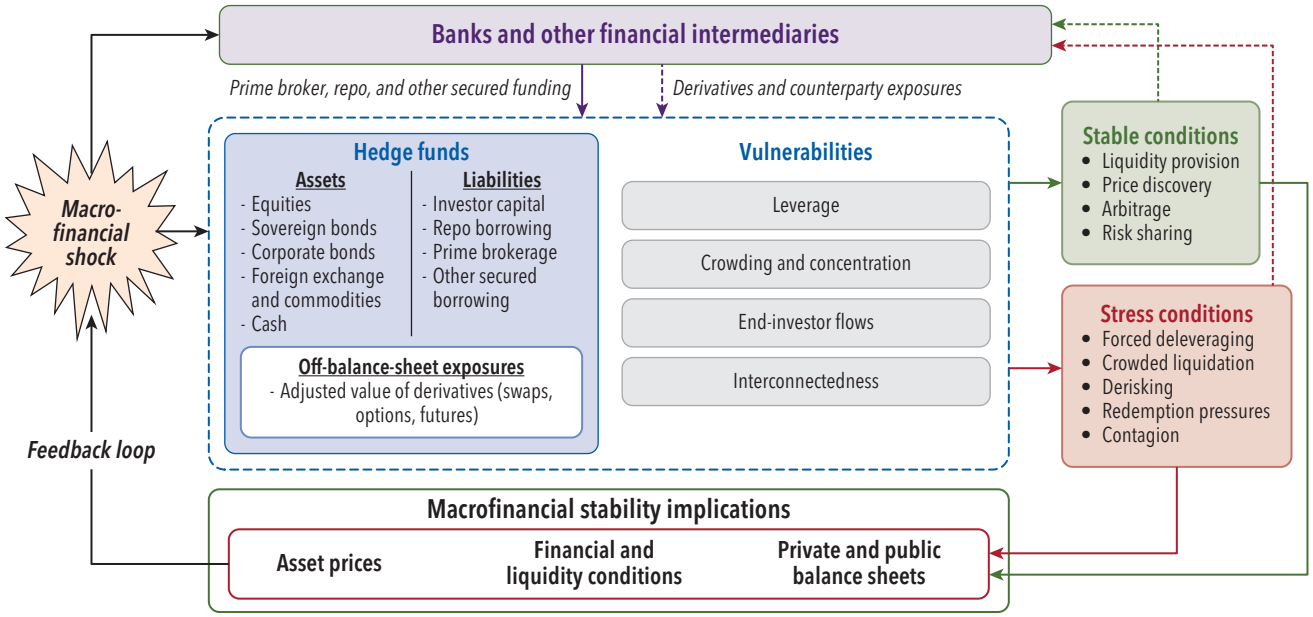
[9]The impact of hedge funds can vary across financial markets, reflecting differences in their activities, leverage, and market footprint. This chapter focuses on equity and bond markets; Box 2.1 examines their role in foreign exchange markets.

[10]Data coverage is broad and includes offshore financial centers. Although the United States accounts for the largest share of reported funds and advisers, many funds are domiciled offshore (Barth and others 2025). Important data gaps remain, however, including incomplete information on leverage, derivatives exposures, and prime broker relationships and weaker coverage of bond holdings than of equities. Further details on the data are provided in Online Annex 2.2.

[11]Beyond the comprehensive data, the chapter makes three key contributions to the literature: It examines how hedge funds affect market liquidity and efficiency relative to mutual funds, analyzes how different hedge fund vulnerabilities can amplify macrofinancial shocks, and identifies channels through which hedge fund stress can spill over to other financial intermediaries.

Figure 2.4. Shock Transmission and Amplification through the Hedge Fund Sector

Hedge fund vulnerabilities can amplify the effects of adverse macrofinancial shocks on financial markets and intermediaries.



Source: IMF staff illustration.

Note: Investor capital represents the net assets of the fund. Hedge fund investors typically include institutional investors and high-net-worth individuals. Repo = repurchase agreement.

for the transmission of global macrofinancial shocks to financing conditions. Although hedge funds hold a modest share of outstanding equity and debt securities, they play a central role in arbitrage and information-driven trading, which allows them to influence both the speed and magnitude of asset price adjustments. For example, hedge funds can accelerate the incorporation of news about technological developments into equity prices through short selling, derivatives trading, and other flexible trading strategies that enable them to adjust positions more rapidly than many traditional asset managers.

Vulnerabilities of hedge funds influence the transmission of shocks. The dual role of hedge funds in financial markets, discussed earlier as supporting efficiency and liquidity in calm times but potentially exacerbating stress when conditions deteriorate, is closely linked to their vulnerabilities—notably, concentrated and crowded positions, correlated end-investor flows, and leverage.

Concentrated and crowded exposures increase the sensitivity of portfolios to adverse price movements and raise the risk of synchronized unwinding. Concentrated positions reflect large exposures to specific assets, whereas crowded positions arise when similar exposures are shared across investors. Hedge funds often concentrate investments in securities with attractive risk-adjusted expected returns, and when such exposures become widespread across funds, prices can become more sensitive to their trading activity. During periods of market stress, crowded positions can unwind rapidly, leading to price declines that exceed what fundamentals alone would suggest (Boyson, Stahel, and Stulz 2010; Cai and others 2019; Brown, Howard, and Lundblad 2022). Consequently, securities heavily held by hedge funds may be vulnerable not only to issuer-specific risks but also to shocks from hedge fund deleveraging and herding, amplifying stress across markets and institutions (Figure 2.4).

Correlated end-investor redemptions can further amplify selling pressures during market stress. The impact of hedge fund sales on asset prices depends on the concentration of holdings as well as on the degree of synchronization in portfolio adjustments across funds. Securities held by a small number of hedge funds experiencing significant redemptions are particularly vulnerable to price dislocations arising from forced sales. When redemption pressures are correlated

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across investors, funds are more likely to sell simultaneously, exacerbating price declines and liquidity strains.[12]

Deleveraging can force hedge funds to reduce exposures and withdraw liquidity when market conditions are strained. Hedge funds rely heavily on secured financing and derivatives-based leverage, both of which are highly sensitive to market conditions through financing terms and margin requirements. As a result, hedge fund leverage is strongly procyclical (Kerry, Lewrick, and Schmieder 2026). This procyclicality can transform hedge funds from liquidity providers in calm times into demanders of liquidity during market stress (Jylhä, Rinne, and Suominen 2014), exacerbating selling pressures, asset price dislocations, and market illiquidity (Ben-David and others 2013; Brunnermeier and Oehmke 2014; Schrimpf, Shin, and Sushko 2020; FSB 2023).

Interactions among leverage, crowding, and redemption pressures can create powerful feedback loops that intensify market stress and price dislocations. For example, margin calls can trigger the unwinding of crowded positions, resulting in price declines that can generate additional margin calls and further deleveraging. Similarly, correlated investor redemptions can force leveraged funds to reduce exposures simultaneously, especially when they target specific leverage ratios. The ensuing selling pressure may increase market volatility, with binding internal risk limits prompting further portfolio adjustments.

The extent of shock transmission from hedge funds to broader financial conditions depends on the market footprint and interconnectedness of the sector. Hedge funds with a significant presence across core financial markets can serve as important conduits through which shocks propagate across markets and borders (see Box 2.1 for evidence from the foreign exchange market). These effects are amplified by hedge funds' close links with other financial intermediaries, particularly prime brokers. When hedge funds are forced to deleverage, prime brokers may incur losses on their hedge fund exposures. Moreover, the resulting asset sales can strain the balance sheets of prime brokers and other dealers absorbing these flows, potentially limiting their intermediation capacity because of regulatory and risk-management constraints (Duffie 2020). The resulting balance sheet pressures may, in turn, tighten financing conditions, further reinforcing hedge fund deleveraging and asset liquidations (Barth and Zarra 2026). As liquidity provision weakens, stress can spread across asset markets and jurisdictions, amplifying the initial shock, tightening financing conditions more broadly, and posing risks to macrofinancial stability.

Characteristics and Evolution of the Hedge Fund Sector

The growth of the hedge fund sector has varied considerably across investment strategies. Gross assets have expanded most rapidly among credit-focused funds, which invest primarily in debt instruments, followed by managed futures and multistrategy funds (Online Annex Figure 2.2.2, panel 1). More recently, growth has been particularly pronounced among relative-value and multistrategy funds, consistent with strong investor demand for diversified sources of return and strategies that can exploit a wider range of market opportunities. Equity funds have also expanded notably, likely reflecting the strong performance of global equity markets, particularly technology-related sectors, and positive investor inflows into these funds (Online Annex Figure 2.2.2, panel 3).[13]

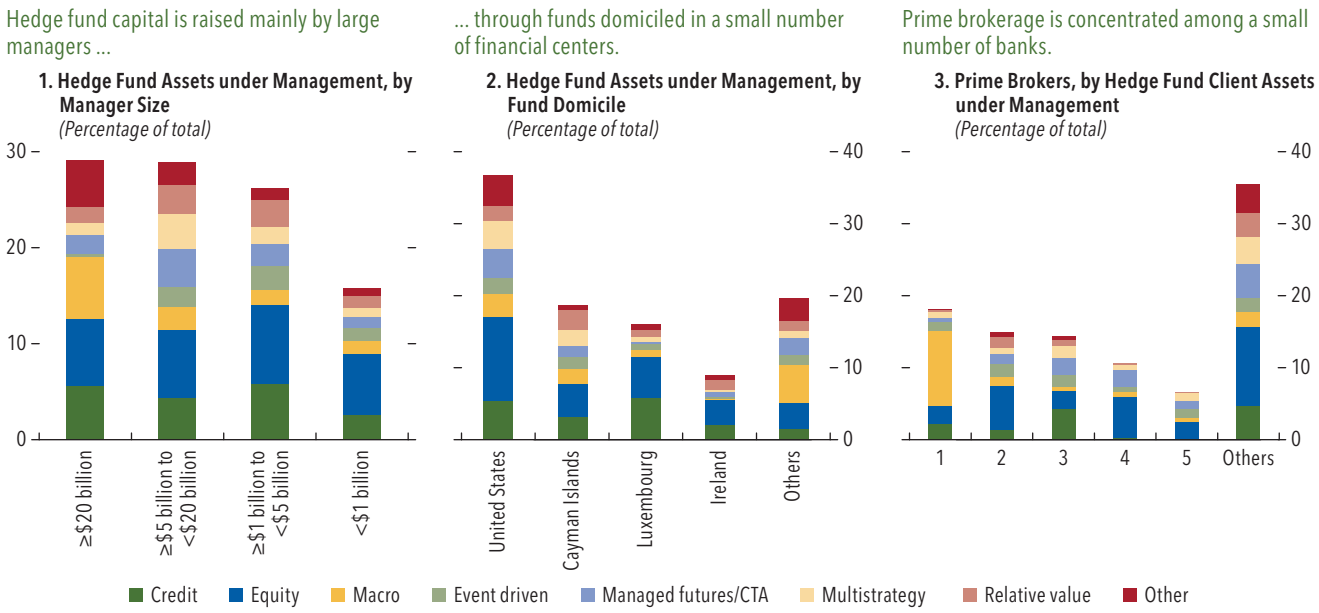
The hedge fund sector is highly concentrated, with a small number of large managers accounting for a sizable share of assets under management, market exposure, and borrowing. The largest 16 managers oversee over $20 billion in investor capital each and account for about one-third of total net assets (Figure 2.5, panel 1). Among the 300 or so firms managing more than $1 billion in net assets, which account for about 85 percent of the sector's capital, macro and managed futures strategies are more prevalent than they are among smaller firms. Concentration is even higher when measured by gross exposures, with the largest 10 managers accounting for one-third of total exposures (OFR 2026). Combined with the higher financial leverage of larger firms, this suggests that balance sheet and synthetic leverage through derivatives are also concentrated among a relatively small group of managers.

Hedge funds are domiciled in a small number of financial centers and raise most of their capital through offshore structures. Funds in the United

[12]Redemption arrangements with end investors—such as notice periods, redemption fees, and gates—can limit outflows during periods of market stress and can be key determinants of stress amplification.

[13]Compared with market-capitalization weights, hedge funds may be somewhat overweight in "hyperscaler" stocks, making them potentially more exposed to valuation changes in these firms (see also Chapter 1 for a discussion).

Figure 2.5. Hedge Fund Concentration, by Size, Domicile, and Prime Brokerage



Sources: Hedge Fund Research; Lipper Trading Advisor Selection System; With Intelligence; and IMF staff calculations.

Note: Panels 1 through 3 report hedge fund assets under management as of December 2025, disaggregated by investment strategy. In panel 3, the numbers refer to the largest five prime brokers. For funds reporting multiple prime brokers, assets under management are allocated equally across the reported prime brokers. See Online Annex 2.2 for additional details. CTA = commodity trading advisor.

States, the Cayman Islands, Luxembourg, and Ireland collectively hold over 80 percent of the sector's assets under management (Figure 2.5, panel 2). Other major managers are domiciled in Brazil, Hong Kong SAR, Singapore, and the United Kingdom. Fund managers raise approximately 70 percent of their investor capital through offshore structures, which broadens access to a global investor base but can complicate risk monitoring and supervisory oversight, particularly when disclosure requirements vary across jurisdictions.[14]

Leverage is concentrated in a few strategies and is obtained primarily from the largest dealer banks. Relative-value and macro strategy funds exhibit the highest financial leverage and account for most of the increase in leverage since 2023 (Online Annex Figure 2.2.2, panel 2). Leverage of relative-value funds has been more variable over time, suggesting greater susceptibility to deleveraging, particularly during periods of stress. Hedge funds typically obtain leverage from a handful of prime brokers, mostly large global banks, with the five largest providers serving an estimated two-thirds of funds by assets under management (Figure 2.5, panel 3). Prime broker exposures vary considerably across investment strategies, creating channels through which shocks can be transmitted between hedge funds and dealer banks.

Hedge fund portfolios are becoming increasingly similar. The overlap in equity holdings across hedge funds—measured by the similarity of portfolio weights—has risen over time, especially among the largest funds (Figure 2.6, panel 1). This trend has accelerated since 2022, alongside rising concentration in advanced economy equity markets, driven by the rapid growth of large information technology firms (HFR 2026). Although increasing similarity in portfolios is not unique to the hedge fund sector, greater commonality in positions can raise the risk of synchronized asset sales, thereby amplifying price pressures and market volatility during periods of stress.

Hedge funds' end investors are highly sensitive to performance. Although hedge funds tend to rely more on longer-term institutional investors than mutual funds (Kruttli, Monin, and Watugala 2017), investor flows remain strongly linked to past returns (Figure 2.6, panel 2). The relationship is especially pronounced following large losses, consistent with investors redeeming from underperforming managers. More generally, the strong flow-performance relation

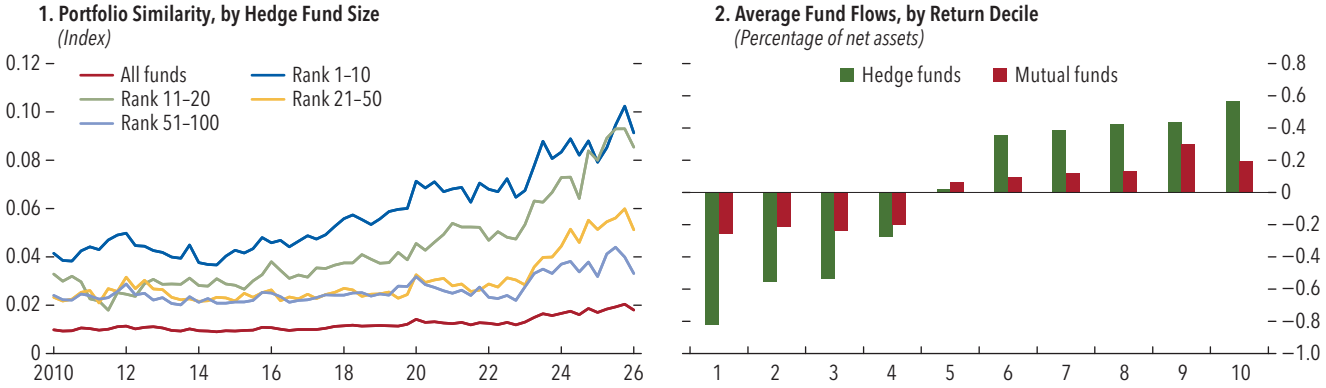
[14]Offshore capital is raised mainly through feeder and parallel funds. Feeder funds channel investor capital into a common master portfolio, whereas parallel funds hold similar portfolios in separate legal vehicles tailored to different investor groups.

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Figure 2.6. Hedge Fund Portfolio Similarity and Flow-Performance Relationship

Hedge fund equity portfolios are becoming increasingly similar, especially among the largest funds.

End investors in hedge funds are more sensitive to performance than end investors in mutual funds are.



Sources: Hedge Fund Research; Lipper; Lipper Trading Advisor Selection System; With Intelligence; and IMF staff calculations.

Note: Panel 1 shows the degree of overlap in hedge fund securities holdings, measured using cosine similarity, ranging from 0 (no overlap) to 1 (full overlap). The subgroups refer to hedge funds ranked by their assets under management. Panel 2 shows average monthly fund flows relative to lagged monthly assets, by previous-month return decile. Flows are expressed as deviations from the full-sample mean for each fund type. Return deciles are formed separately by fund type, with 1 indicating the lowest decile. The differences between hedge funds and mutual funds are larger when using a common returns scale. Returns and flows are winsorized at the 0.5th and 99.5th percentiles.

suggests that investors closely monitor performance when evaluating managers, given the difficulty in assessing expected returns based solely on fund mandates and strategies.

Redemption restrictions are widely used across hedge funds, though their intensity varies. Hedge funds typically limit investor withdrawals through lockup periods that restrict the redemption of newly invested capital, advance notice requirements, and specified redemption frequencies (Online Annex Figure 2.3.7, panel 1).[15] Redemptions can also be subject to fees and, in some cases, gates that temporarily limit the amount of capital investors can withdraw. Notably, redemption terms vary considerably across funds—smaller managers tend to impose more restrictive terms, whereas larger, more leveraged funds offer investors greater liquidity. Although redemption terms may also reflect investor base composition and portfolio liquidity, this may leave leveraged funds more vulnerable to investor outflows during periods of stress.

Market Impact of Hedge Fund Trading

Hedge funds tend to trade against price movements in calm times but become less contrarian when market volatility rises. An analysis of individual equity holdings, following Grinblatt and others (2020), suggests that hedge funds generally increase positions in equities whose prices are falling and reduce positions in those whose prices are rising (Figure 2.7, panel 1). This contrarian tendency, however, weakens when markets are under stress, suggesting that hedge funds absorb order imbalances and provide risk-bearing capital in normal times but are less likely to play this stabilizing role when volatility is elevated and liquidity conditions deteriorate.[16]

The stabilizing role of hedge funds varies considerably by fund size.[17] Whereas the largest funds are equally contrarian under both tranquil and stressed market conditions, smaller funds exhibit contrarian trading primarily during calm times. When volatility rises, the trading behavior of the smallest hedge funds resembles that of mutual funds: buying stocks whose prices are rising and selling those whose prices are falling (Online Annex Figure 2.3.1, panel 1). These findings are consistent with smaller funds facing funding

[15]Typical lockup periods range from two to six months, redemption frequencies are generally set at monthly or quarterly intervals, and notice periods average just over 30 days.

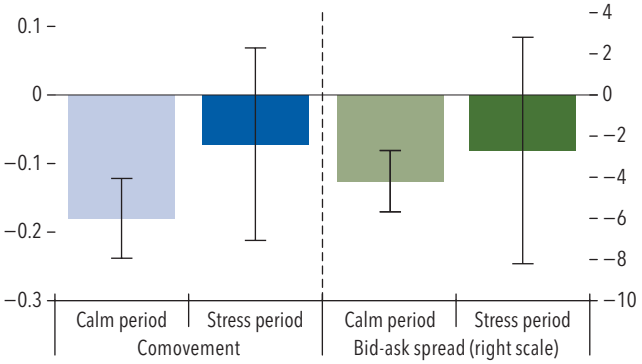
[16]The difference between momentum trading during periods of stress and calm is statistically significant at the 10 percent level. Analysis for corporate and sovereign bonds also provides some evidence of hedge funds becoming less contrarian in periods of stress (Online Annex Figure 2.3.1, panel 3).

[17]The market impact of hedge funds may also vary across investment strategies, but such differences are difficult to examine within equity markets because long-short equity funds dominate hedge fund equity holdings.

Figure 2.7. Hedge Fund Momentum, Ownership, and Equity Market Conditions

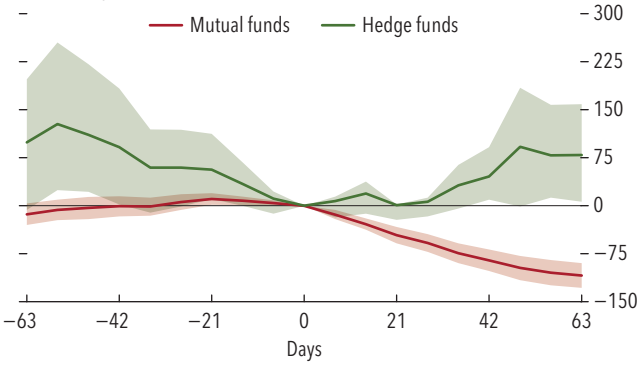
In calm times, hedge funds trade against price movements, and their equity purchases improve market liquidity.

1. Comovement of Hedge Fund Purchases with Stock Returns and Bid-Ask Spreads
(Index; basis points)



Equities bought by hedge funds subsequently overperform, whereas those acquired by mutual funds underperform.

2. Cumulative Abnormal Returns around an Increase in Hedge Fund and Mutual Fund Ownership
(Basis points)



Sources: FactSet; and IMF staff calculations.

Note: Panel 1 reports (1) the average quarterly comovement between hedge fund net purchases and stock returns (blue bars); and (2) the estimated effect of a 10-percentage-point increase in hedge fund ownership (90th percentile of the ownership changes) on next-quarter bid-ask spreads (green bars). Regressions are unweighted. Stress periods are defined as quarters in which the Chicago Board Options Exchange Volatility Index is in its top decile. Panel 2 plots the estimated cumulative abnormal returns (CARs) associated with a 10-percentage-point increase in hedge or mutual fund ownership at different horizons. CARs are based on Fama-French five-factor abnormal returns accumulated over trading-day horizons; negative (positive) horizons indicate returns before (after) the increase in ownership. Error bars and shaded areas indicate 90 percent confidence intervals. See Online Annex 2.3 for additional details.

or risk-management constraints during market stress, which may limit their ability to provide liquidity.

Securities with greater hedge fund ownership tend to be more liquid, although this effect is not significant during periods of market stress. In calm markets, equities purchased by hedge funds subsequently experience a narrowing of their bid-ask spreads (Figure 2.7, panel 1), consistent with evidence that hedge funds can improve market liquidity (Jylhä, Rinne, and Suominen 2014).[18] However, this relationship is not significant under stress, potentially reflecting tighter funding conditions and reduced risk-bearing capacity.

Hedge fund trading is linked to information acquisition, valuation-based investing, and arbitrage activity. Using the event-study methodology of Coval and Stafford (2007), cumulative abnormal equity returns are analyzed around increases in hedge fund ownership. The returns rise gradually, show little subsequent reversal, and tend to occur after periods of relative price weakness (Figure 2.7, panel 2), consistent with hedge funds identifying undervalued stocks or accumulating positions following market dislocations.[19] By contrast, increases in mutual fund ownership are associated with lower subsequent abnormal returns and exhibit little evidence of a pre-trend.

Role of Hedge Fund Vulnerabilities

Hedge fund vulnerabilities can amplify the effects of global risk shocks. In times of stress, hedge funds with larger exposures to crowded trades, correlated investor redemption pressures, and higher leverage tend to exacerbate rather than stabilize price movements. These effects are particularly pronounced when multiple vulnerabilities are present simultaneously:

1. *Equities held by funds with crowded positions are more vulnerable to synchronized liquidations*, as losses on crowded trades can trigger deleveraging and broader portfolio sales. Consequently, stocks with a higher risk of such synchronized selling exhibit significantly higher volatility and deeper drawdowns (that

[18]The narrowing in bid-ask spreads in calm times, driven mainly by high-portfolio-turnover funds (Online Annex Figure 2.3.3, panel 2), may also reflect greater informational efficiency, as hedge fund trading promotes price discovery and incorporation of information into prices (Figure 2.7, panel 2).

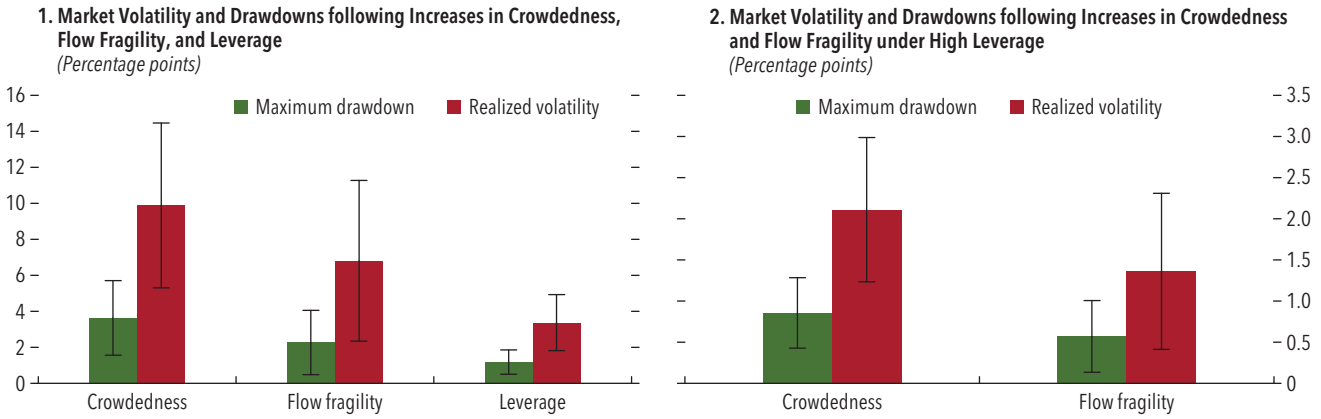
[19]Earlier studies find that hedge funds help correct equity mispricing, whereas mutual funds may reinforce it (Akbas and others 2015; Cao and others 2018). Overall, Figure 2.7 points to information- or arbitrage-driven trading as well as liquidity provision when hedge funds buy after price declines. Information-driven trading is concentrated among larger funds (Online Annex Figure 2.3.2).

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Figure 2.8. Relationship between Hedge Fund Vulnerabilities, Equity Returns, and Volatility during Market Stress

Downside risks are higher for equities exposed to crowded trades, correlated redemption pressures, and elevated hedge fund leverage.

Higher leverage amplifies the effect of crowdedness and investor base fragility on equity returns and volatility.



Sources: FactSet; Hedge Fund Research; Lipper Trading Advisor Selection System; With Intelligence; and IMF staff calculations.

Note: The figure shows the association of crowdedness, end-investor flow fragility, and leverage with next-quarter outcomes during market stress, defined as periods in which the Chicago Board Options Exchange Volatility Index is in its top decile. Crowdedness measures a stock's exposure to synchronized hedge fund liquidations as captured by the ownership share of hedge funds with large holdings relative to average daily trading volumes. Flow fragility measures a stock's vulnerability to correlated hedge fund selling pressure, combining ownership shares with the estimated comovement of hedge fund flows. Panel 2 shows the association of pre-stress crowdedness and flow fragility with next-quarter outcomes during stress when leverage is above its within-quarter median. Regressions are unweighted. Error bars denote 90 percent confidence intervals. Online Annex 2.3 provides additional technical details.

is, peak-to-trough losses) during periods of market stress (Figure 2.8, panel 1).[20] The most crowded stocks exhibit about 10 percentage points higher volatility and 4 percentage points larger drawdowns than the least-crowded stocks. These effects are also economically meaningful, with an average stress-period realized volatility of daily returns of 37 percent and maximum stress-period drawdowns of 17 percent. The effects are somewhat stronger for US equities and weaker for emerging market stocks, consistent with hedge funds being able to unwind crowded positions more rapidly in deeper, more liquid markets.

2. *Equities more exposed to correlated redemption pressures face greater downside risk*. As noted previously, concentrated ownership and highly correlated end-investor flows can amplify selling pressures due to redemptions and increase price volatility (Greenwood and Thesmar 2011). Consistent with this mechanism, stocks with the least-stable hedge fund investor base exhibit 7 percentage points higher volatility and 2 percentage points deeper drawdowns than comparable stocks with less-correlated redemption pressures.[21]
3. *Equities held by more leveraged hedge funds experience larger price declines and higher volatility during market stress episodes*. As leveraged positions are more likely to be unwound when market conditions deteriorate, stocks with greater exposure to hedge fund leverage face stronger selling pressure and downside risk, consistent with the evidence. However, the effects are, on average, smaller than those associated with crowdedness and investor base fragility, suggesting that in equity markets, leverage on its own may play a more limited role in amplifying selling pressure during stress episodes.[22] Box 2.2 shows that leverage can have a significant effect in the US Treasury market, where leveraged basis-trade positions support market functioning in calm times but can amplify dislocations when funding conditions deteriorate.

[20]A security holder's exposure to crowded trades is measured by extending the approach of Brown, Howard, and Lundblad (2022). See Online Annex 2.3 for details.

[21]Redemption terms can significantly influence investor outflows during market stress. Redemptions tend to be about seven times smaller for funds with lockup periods of at least one year and four times smaller for funds with redemption frequencies longer than one month than for funds with more flexible terms (Online Annex 2.3).

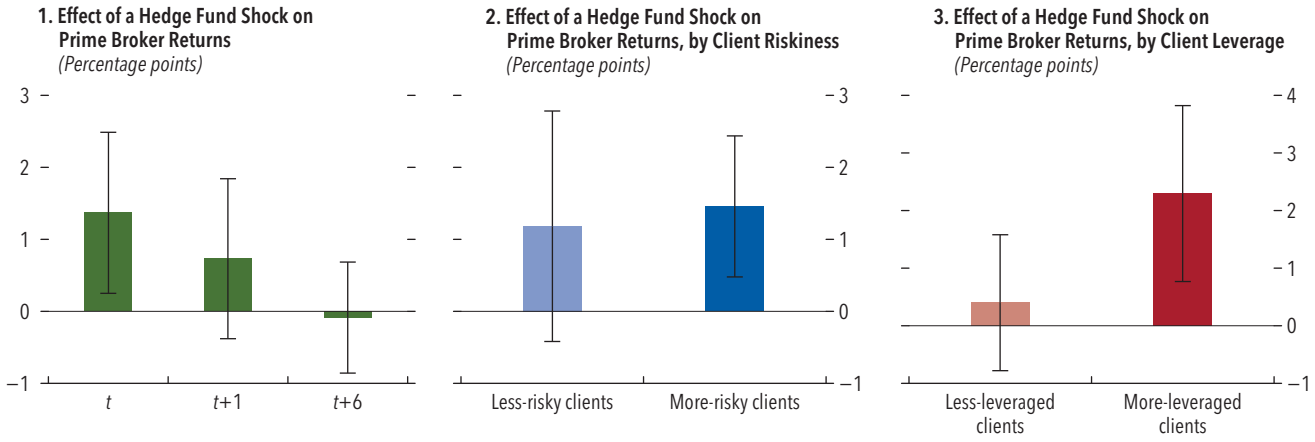
[22]The amplification effects are stronger for securities exposed to the vulnerabilities of smaller funds, which are more likely to be constrained during market stress and thereby exert greater price pressures (Online Annex Figure 2.3.6).

Figure 2.9. Effects of Hedge Fund Stress on Prime Broker Returns

Hedge fund stress spills over to prime brokers ...

... particularly to those with riskier hedge fund clients ...

... as well as more leveraged client bases.



Sources: Hedge Fund Research; Lipper Trading Advisor Selection System; With Intelligence; and IMF staff calculations.

Note: Effect of a one-standard-deviation shock to hedge fund returns on prime broker returns. See Online Annex 2.3 for technical details. Error bars show 90 percent confidence intervals. Panels 2 and 3 split brokers by median average variance of fund returns and fund leverage, respectively.

4. *Leverage amplifies the effects of crowdedness and investor base fragility*. Equities simultaneously exposed to hedge fund leverage and crowded positions experience significantly larger increases in volatility and deeper drawdowns during periods of market stress (Figure 2.8, panel 2). Leverage similarly intensifies the effect of investor base fragility, suggesting that redemption pressures can force hedge funds to liquidate leveraged positions, reinforcing downward price pressures and triggering further redemptions.

Taken together, the findings on hedge fund trading behavior, market impact, and vulnerabilities suggest that the funds play a dual role in securities markets. In tranquil times, hedge funds tend to improve price discovery and market liquidity. During periods of stress, however, hedge fund vulnerabilities can amplify price dynamics, contributing to higher volatility. The resilience of hedge fund balance sheets and funding arrangements is therefore critical in determining whether they dampen or amplify shocks.

Macrofinancial Effects of Hedge Fund Stress

Hedge funds can adversely affect financial stability by transmitting stress to their counterparties and propagating shocks across markets. This section examines two channels through which these risks can materialize: (1) spillovers from hedge funds to prime brokers and (2) the amplification of global shocks to domestic financing conditions.

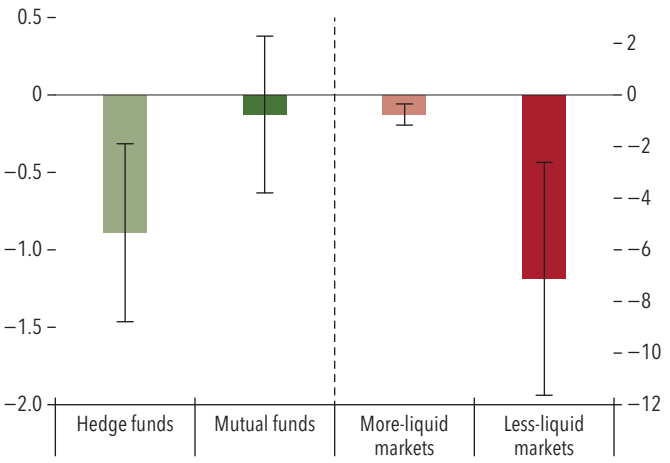
Prime brokers are exposed to shocks affecting their hedge fund clients. A one-standard-deviation increase (decline) in hedge fund returns, equivalent to around 2 percentage points, raises (reduces) prime broker returns by 1.4 percentage points during the month of the shock (Figure 2.9, panel 1).[23] Because declines in bank equity valuations increase leverage, all else equal, adverse shocks to hedge fund clients may induce prime brokers to reduce lending and risk taking, potentially transmitting stress to the broader financial system (Adrian and Shin 2010). However, the spillover effect dissipates over subsequent months, suggesting that it is relatively short-lived.

These spillovers are significant for prime brokers with riskier and more leveraged hedge fund clients. Prime brokers with riskier clients, as measured by the volatility of their returns, are affected statistically significantly by a hedge fund return shock of a given magnitude (Figure 2.9, panel 2), consistent with greater exposure to lower-quality collateral. Spillovers are significantly larger for prime brokers with more leveraged clients, indicating that the effect likely

[23]The analysis isolates shocks to hedge fund returns that are unrelated to marketwide movements using the instrumental variables approach of Gabaix and Koijen (2024) and aggregates them to the prime broker level using assets-under-management weights.

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Figure 2.10. Hedge Fund Equity Market Presence and Stock Returns during Market Stress
(Percentage points)



Sources: FactSet; and IMF staff calculations.

Note: Effect of a one-standard-deviation change in hedge funds' ownership share on equity returns when the Chicago Board Options Exchange Volatility Index is in its top decile. Error bars denote 90 percent confidence intervals. Red bars show the effect of hedge fund ownership for liquid (illiquid) markets, defined as those for which the Amihud illiquidity measure is below (above) its median. See Online Annex 2.3 for additional details.

operates through funding provided by prime brokers rather than indirectly through common exposure to stressed markets (Figure 2.9, panel 3).

Equity markets with a larger hedge fund footprint are strongly affected by global macrofinancial shocks. In countries with a greater hedge fund presence in publicly traded equities, global risk shocks have a larger effect on domestic stock markets (Figure 2.10). A one-standard-deviation increase in aggregate hedge fund ownership (1.3 percentage points) amplifies the effect of a global risk shock on quarterly domestic equity returns by about 1 percentage point, which is sizable relative to the average 7 percent decline following such a shock. The amplification is substantially more pronounced in less-liquid markets, where hedge fund asset liquidations are likely to create strong price pressures. These effects are not observed for mutual fund ownership, suggesting that hedge funds transmit shocks and respond more forcefully to global risk conditions.

Conclusions and Policy Recommendations

Hedge funds have become increasingly important participants in global financial markets. During calm market conditions, hedge funds support market functioning by providing liquidity, facilitating risk sharing, and correcting price dislocations. However, during periods of stress, their leverage, crowded positions, and correlated investor redemptions can interact to trigger synchronized deleveraging and asset sales, reducing market liquidity, tightening funding conditions, and amplifying shocks. Given hedge funds' extensive links to prime brokers, derivatives counterparties, repo markets, and other financial intermediaries, stress in the sector can spill across markets, impairing market functioning, increasing asset price volatility, and tightening financial conditions more broadly.

As the sector continues to grow, safeguarding macrofinancial stability requires close attention to hedge fund vulnerabilities. The findings of this chapter underscore the need for a comprehensive policy approach that combines improved data collection and risk monitoring, targeted prudential measures, and market-structure reforms to strengthen resilience. By identifying key hedge fund vulnerabilities and the conditions under which they can amplify shocks, the chapter helps inform targeted policy responses and systemwide surveillance.

Data, Transparency, and Risk Monitoring

Significant data gaps continue to limit the ability of policymakers to assess vulnerabilities and interconnections involving hedge funds. Efforts should prioritize improving information on leverage, exposures to derivatives, securities financing transactions, prime broker relationships, and investor redemption arrangements. Closing these gaps would support a more comprehensive assessment of risks and their transmission channels. Given the global nature of the hedge fund industry and the prominent role of offshore fund domiciles, stronger cross-border reporting frameworks and information-sharing arrangements are essential to improve risk attribution and monitoring.

Systemwide surveillance and stress-testing frameworks should be strengthened to better assess the resilience of markets with significant hedge fund participation. Stress tests and scenario analyses could incorporate hedge funds' linkages with other financial intermediaries, as well as their cross-asset positions, to assess how leverage, margin calls, funding pressures, and asset liquidations affect market liquidity and asset prices (see, for example, IMF 2025) and generate adverse feedback loops that amplify and propagate

shocks across financial markets. Such exercises can help identify vulnerabilities, transmission channels, and amplification mechanisms before they materialize.

Risk-Based Prudential Toolkit

Policy measures should be calibrated to the nature and source of underlying vulnerabilities, consistent with international efforts to strengthen the resilience of nonbank financial intermediaries. Where risks arise primarily from the potential for synchronized deleveraging across a wide range of hedge funds—for example, in response to margin calls or correlated investor redemptions—activity-based measures may be appropriate. These could include minimum margin and haircut requirements in securities financing transactions and derivatives markets, stronger collateral management practices, and measures to ensure preparedness for margin calls during periods of market stress. Their design should account for uneven application across jurisdictions and counterparties as well as potential adverse effects on market liquidity (FSB 2025).

Where vulnerabilities are concentrated in specific firms or exposures, entity- and concentration-based tools may be warranted. Securities regulators overseeing hedge funds and fund managers may consider measures such as risk-based leverage limits, enhanced reporting of large positions, capital or margin add-ons, and large-exposure limits. Carefully calibrated, such measures can reduce vulnerabilities while preserving the beneficial role that hedge funds play in financial markets.[24]

Market Resilience and Crisis Preparedness

Supervisors should ensure that prime brokers maintain robust counterparty risk management, given their central role in providing leverage and financing to hedge funds. Enhanced risk assessment, monitoring of concentrated exposures, and prudent collateral practices can help limit contagion between hedge funds and the banking sector (BCBS 2024).

Central banks should maintain credible, targeted, and operationally ready backstops to address episodes of severe dysfunction in core financial markets. To limit moral hazard, such measures should aim to preserve market functioning rather than support the solvency of individual institutions and should complement, rather than substitute for, ex ante resilience at prime brokers and other key intermediaries.[25] Because hedge funds operate across borders, effective international cooperation is needed to promote consistent implementation of policy measures, reduce regulatory gaps, and limit opportunities for regulatory arbitrage across jurisdictions.

[24]Because hedge funds are typically not prudentially regulated (FSB 2023), such tools are available in few jurisdictions and often operate indirectly through fund managers or counterparty requirements. The effectiveness of the tools may be constrained by the use of synthetic leverage, cross-border activity, limits on information sharing, and potential effects on market liquidity. Where funds, managers, and counterparties span jurisdictions, measures applied at the point of financing may be more practical (FSB 2025).

[25]Backstops could include discretionary marketwide operations informed by predefined, data-driven indicators of market dysfunction (April 2023 *Global Financial Stability Report*). Collateralized lending and securities financing operations can ease funding pressures, while market-functioning asset purchases can relieve the balance sheet constraints of dealers (Duffie 2020; Box 2.2). To preserve incentives for prudent risk management, eligibility, collateral, and pricing should be set ex ante and designed to limit use to periods of acute dysfunction.

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Box 2.1. Hedge Fund Activity and the Foreign Exchange Market

Hedge funds are active participants in foreign exchange markets, accounting for about 8 percent of global foreign exchange turnover in April 2025 (BIS 2025). One common foreign exchange strategy is the carry trade: borrowing in low-yielding currencies to invest in higher-yielding currencies or assets. Although carry trades are often profitable in low-volatility periods, they can reverse sharply following unexpected policy changes or shifts in risk sentiment. This box examines how leveraged hedge fund activity can amplify such reversals, using the Swiss franc floor removal in January 2015 and the yen carry trade unwind in August 2024 as case studies.[1]

The analysis begins by assessing whether hedge funds had become increasingly exposed to carry trade risks ahead of the unwinds. To do so, it estimates the sensitivity of hedge fund returns across strategies to a benchmark carry trade, capturing how closely hedge fund performance tracks carry trade returns.[2] The estimates show that exposures increased notably before both events and declined sharply thereafter (Figure 2.1.1, panels 1 and 2).

Positioning data also point to crowded funding-currency shorts (Online Annex Figure 2.3.9, panel 1). Noncommercial yen shorts rose during the yen depreciation of 2022–24, reaching a record 3.5 standard deviations above their historical average before unwinding abruptly. Swiss franc shorts were also elevated ahead of removal of the floor.[3] A returns-based crowdedness indicator peaked ahead of both episodes, suggesting that the risk reflected broad hedge fund exposure to the same funding-currency factor rather than a few concentrated positions. Following the yen carry trade unwind, volatility spilled over to equity markets as multistrategy funds, especially those domiciled offshore, reduced both carry trade and Japanese equity exposures (Online Annex Figure 2.3.9, panel 2).[4]

Leveraged and crowded positioning raises the risk of sharp funding-currency reversals, with potentially broader market spillovers. A one-standard-deviation increase in leveraged short positions is associated with significantly worse lower-tail outcomes up to one quarter, with cumulative effects reaching 2 percentage points for funding currencies and related equity indices (Figure 2.1.1, panel 3). The effect is highly nonlinear: When crowdedness is elevated, the same buildup is associated with a 9-percentage-point decline in the 10th percentile of the Nikkei, compared with 1.5 percentage points otherwise (Figure 2.1.1, panel 4). This suggests a crowded-trade tail-risk mechanism in which synchronized unwinds amplify shocks across funding and investment currencies (Online Annex Figure 2.3.10, panel 2) as well as other asset markets.

The findings highlight the importance of monitoring leveraged and crowded carry trade exposures, particularly among funds domiciled offshore, where exposures tend to be concentrated and transparency is limited. Granular data on over-the-counter derivatives, prime broker financing, and cross-asset exposures would help identify vulnerabilities before they unwind. The evidence also underscores the need to assess the procyclicality of margining practices and volatility-sensitive risk models, which can amplify shocks through synchronized deleveraging across asset classes (FSB 2024; BCBS, CPMI, and IOSCO 2025).

This box was prepared by Andrea Deghi.

[1]On January 15, 2015, the Swiss National Bank abandoned the franc floor, triggering an intraday franc appreciation of 16 percent against the US dollar and a sharp Swiss equity sell-off. In early August 2024, narrowing dollar-yen differentials triggered a yen carry trade unwind with margin calls and volatility-driven deleveraging amplifying market stress (Aquilina and others 2024).

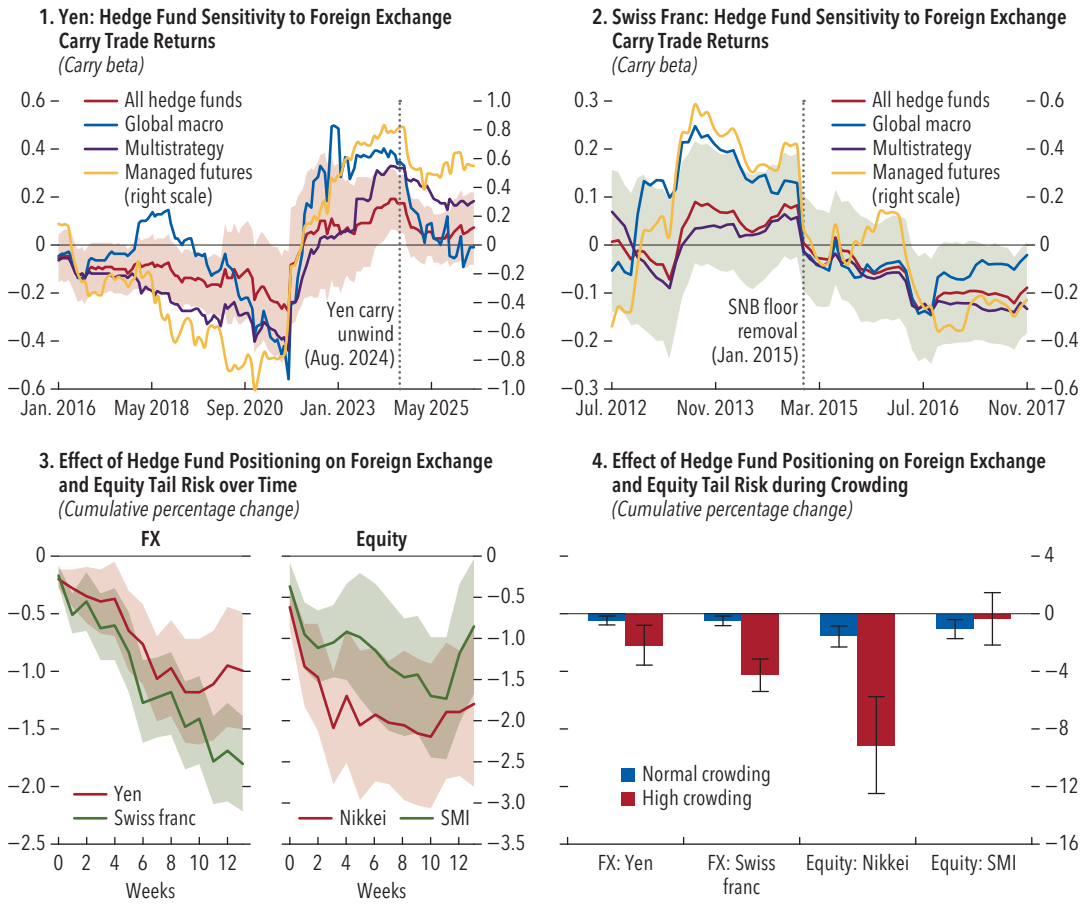
[2]A higher sensitivity (carry beta) means hedge fund returns co-move more closely with a benchmark carry trade; funds tend to gain when a carry trade performs but are more exposed when funding currencies appreciate and the trade unwinds.

[3]Because data on direct hedge fund foreign exchange carry positions are not available, the box uses the Commodity Futures Trading Commission positions of leveraged funds as a proxy (Galati, Heath, and McGuire 2007). Following Pojarliev and Levich (2011) and BIS (2024), the crowdedness indicator is constructed by estimating 36-month rolling carry sensitivities (betas) for hedge fund strategy indices, controlling for broad market risk, and measuring the net share of strategies with significantly positive versus negative betas.

[4]BIS (2024) notes that before the August 2024 episode, multistrategy hedge funds had leverage of about 4:1 on traditional measures and 14:1 including synthetic leverage through derivatives.

Box 2.1 *(continued)*

Figure 2.1.1. Hedge Funds in Foreign Exchange Markets: Carry Trades and Spillover Risks



Sources: Bloomberg Finance L.P.; Commodity Futures Trading Commission; EUROPACE AG/Haver Analytics; Hedge Fund Research; Kenneth French Data Library; and IMF staff calculations.

Note: Panels 1 and 2 show rolling 36-month carry betas of hedge fund strategy-index excess returns to a benchmark foreign exchange carry factor, controlling for the market factor, around the August 2024 yen unwind and the January 2015 Swiss franc shock. Panel 3 shows the cumulative effect of a one-standard-deviation increase in gross short positions on the 10th percentile of future foreign exchange and equity returns over the projection horizon. Foreign exchange outcomes are quoted as funding-currency units per US dollar (lower values indicate an appreciation of the funding currency). Panel 4 shows the one-month-ahead effect of leveraged positioning conditional on hedge fund crowding, with high (normal) periods reflecting when the crowdedness indicator is above (below) its historical upper tercile. Shaded areas in panels 1 through 3 indicate 90 percent confidence bands. FX = foreign exchange; SMI = Swiss Market Index; SNB = Swiss National Bank. See Online Annex 2.3 for further details.

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Box 2.2. Implications of US Treasury Cash-Futures Basis Trades of Hedge Funds

Hedge funds have become increasingly important participants in the US Treasury market, driven by the growth of leveraged relative-value strategies. Their share of outstanding Treasury securities rose from about 4 percent in 2022 to 9 percent in 2025 (Monin 2026). A significant portion of this activity is associated with Treasury cash-futures basis trading, in which hedge funds buy Treasury securities financed in repurchase markets while selling Treasury futures to profit from small pricing discrepancies expected to converge over time (Glicoes and others 2024; Barth and Kahn 2025).

Although basis trades can improve Treasury market functioning by narrowing pricing gaps between cash and futures markets, they depend on large leveraged positions and uninterrupted access to funding. Shocks to volatility, margins, or funding conditions can force rapid deleveraging, amplifying stress through asset sales, reduced liquidity, and tighter financing conditions. These pressures may also spill over to other asset classes as hedge funds adjust their portfolios.[1] The March 2020 Treasury market turmoil highlighted these vulnerabilities, which continue to feature prominently in policy discussions as leveraged relative-value strategies have become increasingly important in Treasury market intermediation (CFTC 2024; Kashyap and others 2025; Kahn and McCormick 2026).

Understanding the scale and evolution of hedge fund basis-trade exposures is important in assessing these vulnerabilities. The basis-trade footprint for hedge funds is assessed using the relationship between hedge fund returns and Treasury net-basis volatility.[2] The estimated footprint has varied substantially over time, accounting for a meaningful share of hedge fund return variation at times (Figure 2.2.1, panel 1). It has grown during periods associated with elevated basis-trade activity, became insignificant following the March 2020 Treasury market turmoil, and strengthened again after 2022. The pattern broadly mirrors documented developments in Treasury cash-futures basis trading (Glicoes and others 2024). More recently, the footprint has moderated, consistent with the decline in leveraged funds' short Treasury futures positions reported by the Office of Financial Research Hedge Fund Monitor.[3]

The analysis also suggests that basis-trade activity is concentrated in relative-value and macro strategies, consistent with evidence on large basis traders (Barth and Kahn 2025). Exposure appears greater among more leveraged funds, consistent with the reliance of basis trades on repurchase financing and leverage to scale positions (Figure 2.2.1, panel 2). Within relative-value strategies, exposures were particularly pronounced among offshore-domiciled and larger funds during the buildup before the COVID-19 pandemic (Online Annex 2.3).

The growth and concentration of basis-trade exposures suggest that hedge fund positioning may have important implications for market functioning. This is indeed the case—regression analysis shows that hedge fund positioning can help absorb cash-futures dislocations in normal conditions but can amplify them under stress. A one-standard-deviation increase in leveraged positioning leaves the median basis unchanged but raises its 90th percentile by 1.5 basis points over eight weeks while helping reduce dislocations when the basis is already converging (Figure 2.2.2, panel 1). The effect is even larger when the Federal Reserve balance sheet is smaller relative to the debt stock, suggesting that quantitative tightening can amplify the market impact of hedge fund positioning (Figure 2.2.2, panel 2).

The effects of hedge fund positioning also depend on dealer intermediation capacity. When dealer capacity is ample, greater positioning helps absorb Treasury supply and reduces basis widening. When capacity is constrained, the effect reverses, amplifying market dislocations (Figure 2.2.2, panel 3). This suggests that basis traders can improve market functioning in normal times but become an amplification channel when funding conditions tighten and dealers' balance sheet capacity is limited (Kashyap and others 2025).

This box was prepared by Andrea Deghi and Mingmei Xiao.

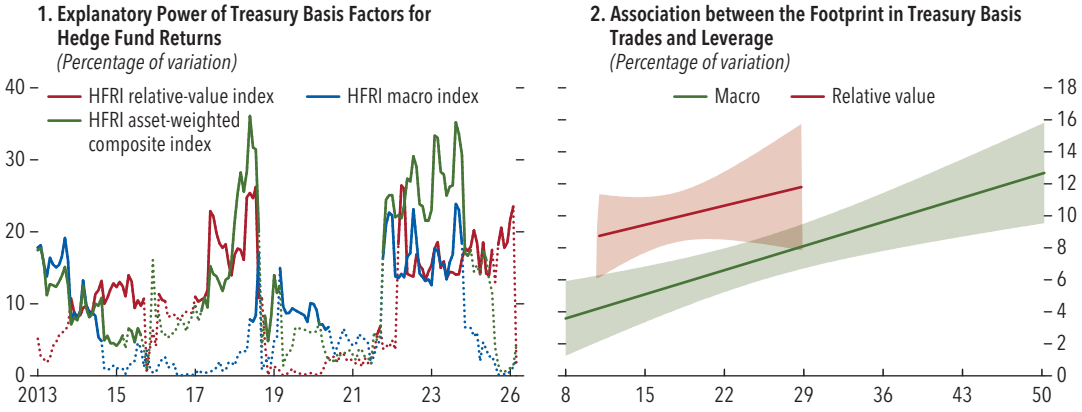
[1]The amplification mechanism does not require hedge funds to lead the sell-off. If tighter funding conditions or dealers' balance sheet constraints force leveraged arbitrageurs to retrench, their reduced capacity to absorb supply can widen the basis and erode market liquidity, amplifying market stress from other sources.

[2]The basis-trade footprint is estimated from rolling regressions of hedge fund strategy returns on the realized volatility of Bloomberg Finance L.P.'s 10-year Treasury net basis, controlling for broader market risk factors. Basis volatility is used instead of the basis because it captures both the risks and opportunities in basis trading, including margin-related pressures and changes in trading opportunities, while preserving high-frequency variation in basis-market conditions. Figure 2.2.1 reports the share of residual hedge fund return variation explained by basis volatility.

[3]Office of Financial Research (OFR), Hedge Fund Monitor; CFTC Traders in Financial Futures (TFF) report, updated July 2026.

Box 2.2 *(continued)*

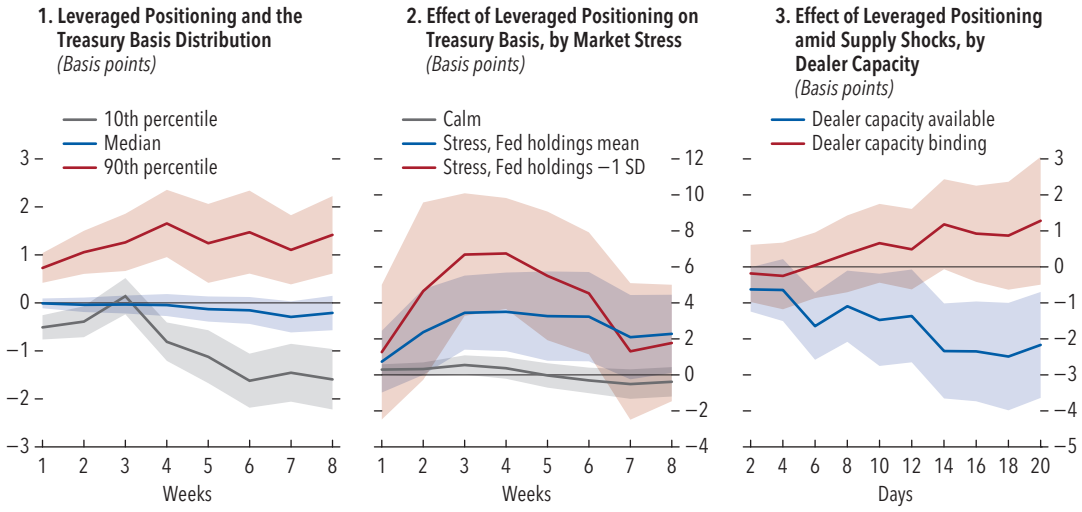
Figure 2.2.1. Treasury Basis and Hedge Fund Exposures



Sources: Bloomberg Finance L.P.; Hedge Fund Research; Office of Financial Research; and IMF staff calculations.

Note: Panel 1 reports 36-month rolling partial R^2 estimates, defined as the share of residual hedge fund return variation explained by contemporaneous and lagged Treasury net-basis volatility, after controlling for relevant factors. Treasury net-basis volatility is the monthly realized volatility of Bloomberg's 10-year Treasury futures net basis computed from daily changes in the same-contract net basis. Solid (dotted) lines denote periods when net-basis volatility factors are jointly significant (not significant) at the 10 percent level. Panel 2 relates quarterly Office of Financial Research leverage measures to the estimated basis-volatility footprint for these strategies. The shaded areas indicate 90 percent confidence intervals around fitted relationships. HFRI = Hedge Fund Research Index. Online Annex 2.3 provides further details.

Figure 2.2.2. Effect of Hedge Fund Positioning on Treasury Basis



Sources: Bloomberg Finance L.P.; Commodity Futures Trading Commission; Federal Reserve Board; TreasuryDirect; Financial Accounts; FR 2004; and IMF staff calculations.

Note: Panel 1 shows the cumulative response of the 10-year Treasury basis to a one-standard-deviation increase in leveraged positioning at the 10th, 50th, and 90th percentiles. Panel 2 shows the cumulative change in the Treasury basis to a one-standard-deviation increase in positioning under stress (calm) periods, defined as those in which the Chicago Board Options Exchange Volatility Index is above (below) its 90th percentile. Results for stress periods are compared when the Federal Reserve Treasury holdings, as a share of marketable Treasury debt, are at their average level (blue line) and one standard deviation below average (red line). Panel 3 shows the effect of a one-standard-deviation increase in positioning on the Treasury basis following Treasury auction shocks, conditional on dealer capacity. Auction surprises are defined as the DV01-weighted change in offering size against the previous auction of the same tenor and reopening status. See Online Annex 2.3 for additional details. Fed = Federal Reserve; SD = standard deviation.

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CHAPTER 3

SCALING TOKENIZATION: NEW EFFICIENCIES, NEW VULNERABILITIES

Chapter 3 at a Glance

- Tokenization—the representation of financial assets and liabilities on distributed programmable ledgers—has the potential to transform financial markets. By placing functions traditionally performed by separate intermediaries onto a distributed ledger, tokenization can reduce reconciliation needs, increase transparency, and enable greater automation.
- The tokenization ecosystem is subject to strong network effects: both benefits and risks increase when more assets, participants, and settlement instruments are brought onto the ledgers.
- The tokenized asset market remains small and fragmented. Future growth depends, among other factors, on how four key, interdependent constraints are addressed: legal certainty, regulatory clarity, interoperability, and availability of settlement assets.
- This chapter documents novel empirical evidence on some emerging benefits and risks. Analysis of tokenized equity markets shows evidence of 24/7 trading, fractional ownership, and preliminary indications that on-chain prices contain relevant information for traditional markets. However, mainly because of their small size, tokenized equity markets are so far less liquid, more volatile, and more fragmented than traditional ones. Given the incipient nature of the market, empirical findings should be interpreted with caution.
- Tokenization can elevate risks related to technology and infrastructure while creating new channels that amplify traditional vulnerabilities, including liquidity, interconnectedness, and leverage.
- For now, systemic risks remain limited. The key financial stability question is whether tokenized market infrastructure, legal foundations, liquidity arrangements, and risk controls are adequate if tokenization were to achieve broader adoption.

Policy Implications

- To enable efficient and safe market development, policymakers should adopt a technology-neutral approach that removes unnecessary constraints to tokenization while safeguarding financial stability.
- To remove unnecessary constraints to tokenization,
  - ensure that legislation provides legal certainty for tokenized assets;
  - provide regulatory clarity through the consistent implementation of the principle of "same activity, same risk, same regulatory outcome," and create policy sandboxes to inform regulatory drafting;
  - promote interoperability across networks while safeguarding resilience; and
  - ensure that tokenized securities are settled in safe and widely accepted forms of money.
- To safeguard financial stability as tokenization scales,
  - intensify monitoring and mitigation of operational, governance, and infrastructure risks;
  - assess and manage the liquidity implications of atomic settlement, collateral reuse, and procyclical deleveraging;
  - design circuit breakers and liquidity safeguards for tokenized trading environments; and
  - strengthen monitoring of linkages between tokenized and traditional financial markets.

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Introduction

Tokenization—the representation of assets and liabilities on distributed programmable ledgers—has the potential to transform financial markets. Traditionally, financial markets operate through multiple intermediaries and separate ledgers. Tokenization allows financial claims to be issued, transferred, serviced, and settled through shared digital infrastructure. As a result, tokenization can consolidate many steps along the asset life cycle, potentially reducing friction, improving transparency, and enabling greater automation.

Tokenization builds on the broader digitalization of finance. Digitalization makes financial assets and processes electronic. Tokenization offers further possibilities by allowing assets, payments, and contractual rules to interact on a shared data set through distributed ledgers. For example, broader digitalization allows programmability, whereas tokenization offers native programmability through smart contracts,[1] which can also lead to composability—the ability to combine and embed assets across protocols. By reducing the need for multiple intermediaries to operate their own separate ledgers, tokenization can improve automation and other financial processes. Potential benefits include lower transaction costs, faster settlement, new market designs, and more efficient market functioning, although not all these benefits are contingent on tokenized infrastructure (Adrian 2026; Cabedo and others 2026).

However, the potential benefits of tokenization depend critically on network effects, market design, and interoperability. Duffie (2020), for example, argues that integrated ledgers and common standards can dramatically improve the speed and efficiency of payments. Recent empirical studies provide early evidence that tokenized bonds may have lower issuance costs, tighter bid-ask spreads, and lower yields than comparable conventional bonds, suggesting tangible efficiency gains (Leung and others 2023; Aldasoro and others 2025; Born and others 2026).

At the same time, tokenization could build up financial vulnerabilities as it scales. Policymakers have warned that greater tokenization could amplify financial shocks by increasing interconnectedness, leverage, and liquidity risks (Carapella and others 2023; Bank of England 2024; FSB 2024; Born and others 2026). While these studies generally conclude that tokenization remains small and mostly experimental, posing limited systemic risk thus far, its future significance is less certain. The balance between potential benefits and risks depends on how tokenization will evolve, scale, and interact with the traditional financial markets (that is, TradFi).

This chapter has two main objectives: (1) to discuss the potential benefits of tokenization and the constraints to its development and (2) to assess its implications for financial stability. The analysis covers both tokenized real-world assets (RWAs) and on-chain native assets[2] while excluding stablecoins, except when they are used for settlement. Rather than focusing on a specific asset class, the chapter examines the broader tokenization ecosystem, including tokenized bonds, money market funds, equities, repurchase agreements (repos), and related market infrastructure, building on a growing body of research.[3] Given the still-limited size of tokenized markets, the chapter places less emphasis on current risks and more on how the features of tokenization could reshape financial markets as it scales, how vulnerabilities may evolve, and how policy frameworks can help prevent these risks from becoming embedded in the financial system.

The authors of this chapter are Parma Bains, Pamela Cardozo, Andrew Ferrante, Manisha Patel, Jose De Luna Martinez, Kleopatra Nikolaou, Aki Yokoyama, and Xuege Zhang. The team was co-led by Mindaugas Leika and Gonzalo Fernandez Dionis under the supervision of Caio Ferreira. Chapter 3 also benefited from comments and suggestions from Darrell Duffie, External Advisor; and Yaiza Cabedo.

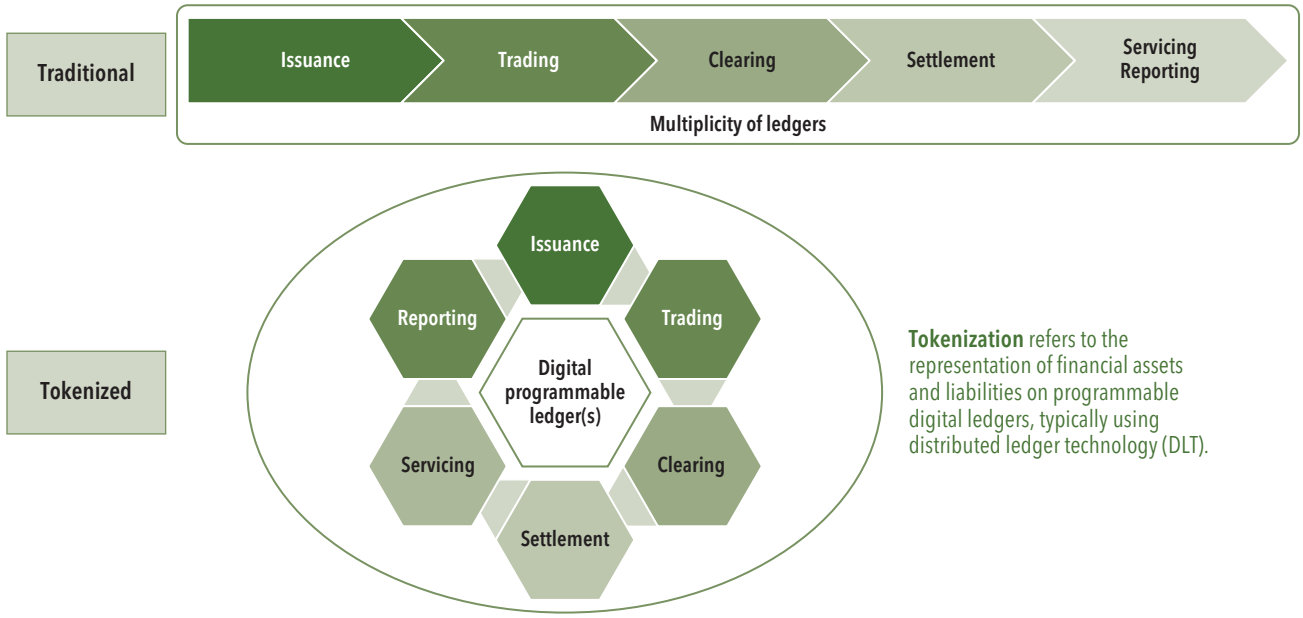
[1]A smart contract is a self-executing computer program stored on a blockchain that automatically carries out predefined rules and actions when specified conditions are met. It enables parties to execute agreements without relying on a central intermediary.

[2]"On-chain native assets" here refers to real-world assets and liabilities (bonds, equities, money market funds, and so on) that have been created directly and only through distributed ledger technology (DLT). Protocol tokens and crypto assets such as Bitcoin and Ether are excluded from this definition. Acknowledging that real-world assets could be issued directly onto DLTs ("native issuance") or otherwise immobilized and then represented onto DLT ("tokenized"), the terms are sometimes grouped simply as "tokenized assets."

[3]Bains (2025), BIS-CPMI (2024), IMF (2024), Agur and others (2025), and Adrian and others (2026) review defining concepts of blockchains, tokenization, and changes to market functioning and architecture arrangements. FSB (2024) and Adrian (2026) explore emerging areas of financial stability vulnerabilities. IOSCO (2025) evaluates the implications for regulators, including market integrity and investor protection issues. Cabedo and others (2026) review the changing role for financial market infrastructures. Patel and others (2026) consider the role of settlement assets for tokenized capital markets and options for central bank policymakers.

Figure 3.1. How Tokenization Reshapes the Asset Life Cycle*

Tokenization can bring together functions that are traditionally performed by separate intermediaries across the asset life cycle onto a distributed ledger.



Source: IMF staff compilation.

*Reporting is not tied to the sequence since it could happen along many stages.

Changes in Financial Market Infrastructures and Processes

Traditional financial markets, for example, for equities and bonds, operate through a network of specialized intermediaries, each maintaining a ledger and performing a distinct function along the asset life cycle. Trading, clearing, settlement, custody, servicing, and collateral management are typically conducted across separate institutions and recordkeeping systems (Figure 3.1). As a result, transactions often require information related to ownership or trades to move sequentially between multiple parties, and each step involves reconciling, verifying, and updating separate ledgers. Although this fragmented structure can create operational complexity, delays, and costs, it also reflects legal, regulatory, and risk-management arrangements that have evolved to support market integrity and financial stability (Cabedo and others 2026).

Traditional finance benefits from strong network effects through a few dominant central securities depositories, central clearing counterparties, Society for Worldwide Interbank Financial Telecommunication (SWIFT), major exchanges, and custodians. Tokenization attempts to recreate many of these functions on distributed ledgers. In tokenized environments, financial assets are represented as digital tokens on distributed ledgers, which allow participants to interact through a common transaction environment governed by predefined rules. More activities can be executed directly on shared infrastructure, potentially reducing reconciliation needs, increasing transparency, and enabling greater automation (Box 3.1). This results in some integration or automation of traditional functions, which could potentially ease frictions, lower costs, and improve efficiency (Agur and others 2025). The system is subject to strong network effects: Benefits and risks increase when more assets, participants, and settlement instruments are brought into the platform and as markets converge on common standards and settlement arrangements rather than fragment into many isolated platforms.

Tokenization can affect each stage of the asset life cycle (Cabedo and others 2026).

- During issuance, assets and financial products are represented as tokens on a one-to-one or fractional basis. Assets and financial products could even be combined and represented as new products (for example, tokenized money market funds). Native

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assets are created directly and only through distributed ledger technology (DLT), whereas existing financial assets could be represented on DLT in different ways.[4]
- During trading, programmable transfer rules can automate aspects of transaction execution, including eligibility criteria, transfer restrictions, and compliance requirements.
- Within clearing and settlement, smart contracts could automate certain clearing arrangements and may improve the coordination between securities and money for settlement, potentially facilitating delivery versus payment transactions with greater certainty and atomicity.
- Reporting functions could move to a real-time basis, potentially improving transparency of asset holdings and transactions and facilitating reconciliation of corporate actions.

Current Adoption in Financial Markets

The public market for tokenized RWAs, excluding repos, has grown rapidly, reaching about $65 billion[5] (Figure 3.2, panel 1). The overall market is even larger when factoring in the value of private tokenized markets, which include at least $8 billion in tokenized bonds.[6] The 30-day average daily volume of tokenized repos reached $303 billion (Figure 3.2, panel 3). Tokenization markets are also segmented by investor type: tokenized equities are dominated by retail investors, whereas bonds, money market funds, and repos are predominantly institutional markets.

The prominence of tokenized repos reflects that collateral management and collateral mobility are among the most compelling early-use cases for tokenization. By digitizing and automating collateral-related workflows, tokenized repo platforms can reduce operational frictions and improve the movement and deployment of collateral across transactions. Tokenized repo can also add greater flexibility and precision to the timing of the transaction, potentially supporting liquidity management. However, despite accounting for a large share of current tokenized market activity, tokenized repo volumes remain small relative to traditional repo markets, and transactions are still largely concentrated among affiliated entities (Duffie 2026; Patel and others, 2026; Box 3.2).

The market is expanding fast, albeit from a small base (Figure 3.2, panels 1 and 2). Tokenized fixed income, spanning corporate credit, asset-backed credit, and money market fund holdings, accounts for the bulk of tokenized assets outside repos, at about $48 billion. Within this category, tokenized credit accounted for $30.4 billion, with asset-backed credit accounting for the largest share, followed by smaller corporate and diversified credit segments. Tokenized money market funds, at about $17.5 billion, are held primarily as yield-bearing, cash-like collateral and are generally created and redeemed with the issuer rather than traded. Tokenized equity markets remain limited, with an estimated market size of $2.3 billion.[7] Issuance is highly concentrated: two platforms, Ondo Finance and Backed Finance, together account for more than 70 percent of tokenized equity value, with products aimed at investors that reside outside the United States.[8]

At present, tokenization activity is also concentrated geographically. Most value originates from issuers in the United States, followed by issuers with undisclosed domiciles and a long tail of smaller financial centers, including Liechtenstein and the British Virgin Islands (Figure 3.2, panel 4). The large share of issuers with

[4]For example, existing assets may be immobilized in traditional accounts and held in custody off-chain while represented as a token onto DLT on a 1-1 or fractional basis. Legal rights can vary depending on the issuance mode. Garrido (2023) covers concepts of how legal rights can be attached to tokens.

Patel and others (2026) highlight the heterogeneity in issuance models for such nonnative tokens across asset classes, ranging from custodial models (which confer full legal rights to the underlying assets) to synthetic exposures (which concern only an asset's price). Regulatory guidance, such as from the US Securities and Exchange Commission (SEC), has sought to clarify how different issuance models may be reconciled with securities law (SEC 2026).

[5]As of July 2026. Private tokenized markets, repos, and stablecoins are not included in this figure.

[6]Private tokenized markets also include J.P. Morgan's Kinexys, Citi Token Services, HSBC Orion, Euroclear DLT, and others whose comprehensive data are limited.

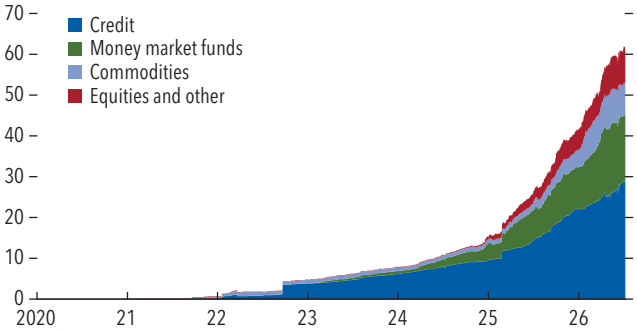
[7]Tokenized equities take one of three forms, distinguished by the rights they convey. Native tokens are issued directly on-chain as the share itself, with holders retaining full economic and governance rights (for example, Figure and Exodus). Custodial tokens represent a beneficial claim on a share held in custody, with dividends and corporate actions passing through to the holder. Synthetic or special purpose vehicle-based tokens represent a claim on a structured vehicle that holds the underlying shares, giving economic exposure without direct legal ownership. The two largest issuers, Ondo Finance and xStocks (the latter issued by Backed Finance), use synthetic models.

[8]Ondo Finance and Backed Finance (xStocks) are among the largest tokenization platforms globally and major issuers of tokenized real-world assets (RWAs), particularly US Treasuries, stocks, and exchange-traded funds.

Figure 3.2. Tokenized Asset Market Size, Composition, and Integration with Core Funding Markets

Tokenized real-world assets have grown rapidly, reaching about $65 billion ...

1. Total Tokenized Asset Value
(Billions of dollars)

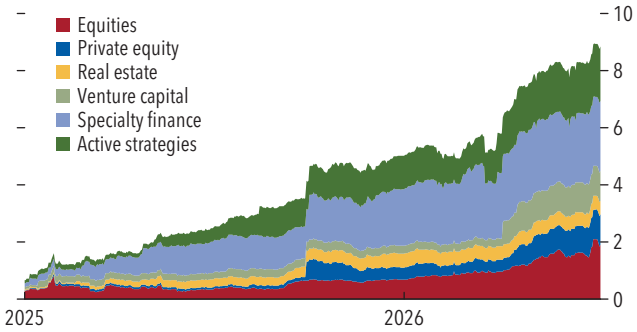


Sources: RWA.xyz; and IMF staff calculations.

Note: Total is $65.10 billion. Asset value is measured as token supply multiplied by issuer-reported unit valuation. Size of the market as a percent of outstanding US Treasuries and the S&P 500 market capitalization is 0.20 percent and 0.12 percent, respectively. Data as of July 31, 2026.

... while equities, real estate, and other asset classes are smaller, although growing steadily.

2. Tokenized Asset Value Excluding Credit, MMFs, and Commodities
(Billions of dollars)

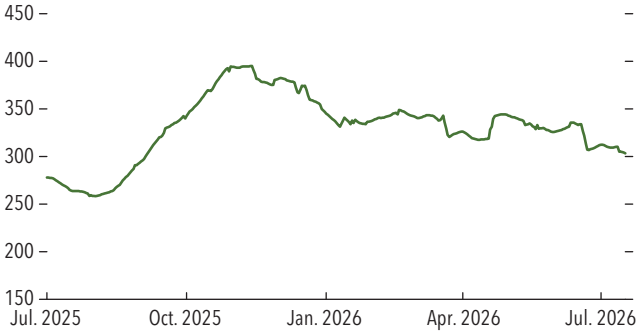


Sources: RWA.xyz; and IMF staff calculations.

Note: Total is $9.47 billion. Asset value is measured as token supply multiplied by issuer-reported unit valuation. Per RWA.xyz definitions: Specialty finance is a niche asset- or contract-backed debt; private equity is nonpublic equity; venture capital is tokenized venture fund interests; and active strategies are managed discretionary or systemic mandates. Assets added to the data providers' catalog within 30 days of the reporting date are excluded to avoid backfill bias. Data as of July 31, 2026. MMFs = money market funds.

Tokenized repo has scaled rapidly, reflecting growing use of tokenization for collateral management.

3. Tokenized Repurchase Agreement Volumes
(Billions of dollars)

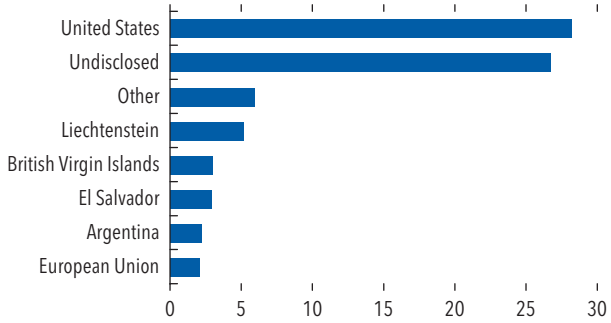


Sources: RWA.xyz; and IMF staff calculations.

Note: Data are a 30-day moving average. Value reflects repo activity rather than outstanding tokenized asset value. Data as of July 31, 2026.

Issuer jurisdictions are concentrated in the United States and in undisclosed domiciles.

4. Tokenized Value, by Issuer Jurisdiction
(Billions of dollars)



Sources: RWA.xyz; and IMF staff calculations.

Note: Data as of July 31, 2026.

undisclosed domiciles highlights persistent gaps in transparency regarding the origin and jurisdiction of tokenized assets and may mask regulatory arbitrage, the bypassing of access restrictions (for example, sanctions), or being synthetic derivatives (World Federation of Exchanges 2025).

A growing number of institutions are either issuing new bonds directly on-chain or tokenizing existing bonds on distributed ledgers. Most activity is concentrated in advanced economies, although several emerging market and developing economies have also begun tokenizing debt securities. Issuances are concentrated around shorter maturities, with most transactions maturing within five years (Figure 3.3, panel 1).

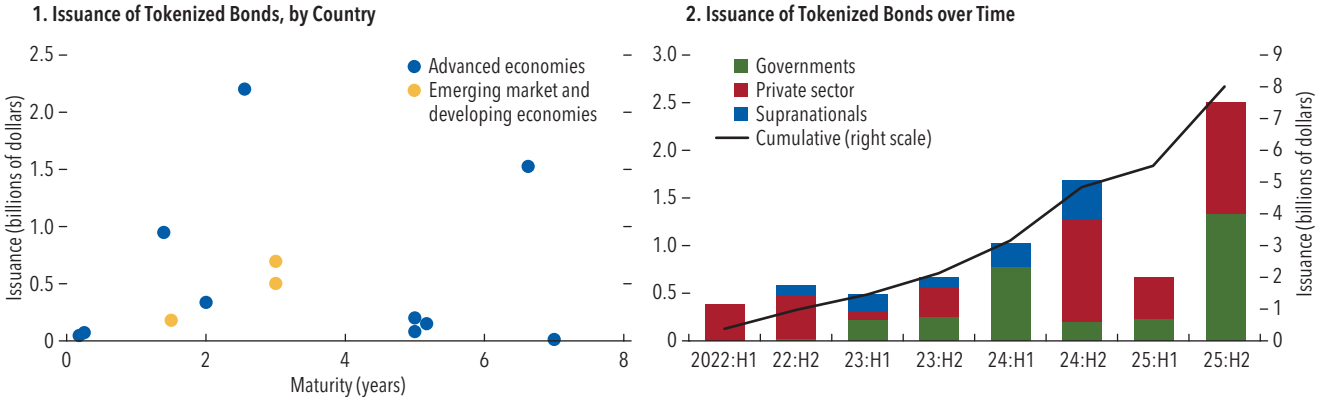
The motivations for issuing tokenized bonds vary across jurisdictions. Some jurisdictions seek to strengthen their position as a regional financial center and to improve market efficiency (for example, Hong Kong SAR), while others prioritize financial inclusion (for example, the Philippines). Since 2022, cumulative

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Figure 3.3. Tokenization of Debt Securities

Tokenized bond issuance spans advanced economies and emerging markets but remains concentrated at shorter maturities.

Issuance has scaled since 2022, with governments and the private sector driving the trend.



Sources: De Luna Martinez and Zhang (forthcoming); and IMF staff calculations.

Sources: De Luna Martinez and Zhang (forthcoming); and IMF staff calculations.

issuance has scaled steadily to about $8 billion, driven primarily by government and private sector issuers (Figure 3.3, panel 2). So far, however, the number of issuers and the range of maturities remain limited (Box 3.3).

As in traditional finance, where concentration is largely institutionalized through regulated financial market infrastructures (FMIs) such as central securities depositories, central counterparties, payment systems, and foreign exchange settlement systems, tokenized market infrastructure is organized around leading chains, platforms, custodians, oracles, and bridges. Most activity occurs on a handful of key blockchain networks and platforms (Figure 3.4, panels 1 and 2) and relies on off-chain data such as prices, corporate actions, and collateral information, with data provision by a single provider. At the same time, this concentration coexists with fragmentation across a long tail of secondary providers as activity is spread across dozens of smaller networks and platforms that remain weakly interoperable at most.

Key Constraints to the Growth of Tokenized Markets

The growth of asset tokenization is currently constrained by four key, interdependent factors: legal certainty, regulatory clarity, interoperability, and safe, sound, and scalable settlement (Figure 3.5).

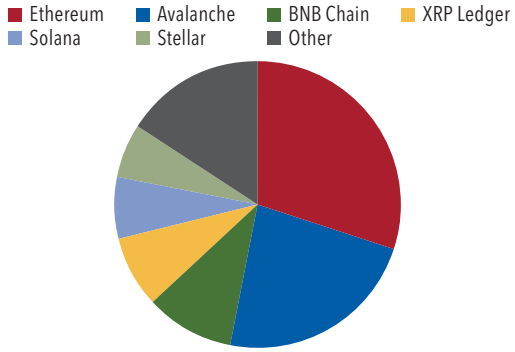
Legal certainty is a prerequisite for scale, as market participants need confidence that tokenized assets confer enforceable rights and obligations. The legal framework must establish clear rights over both the token and the underlying asset it represents, define the legal relationship between the two, and clarify whether transfers recorded on distributed ledgers constitute legally effective transfers of ownership and settlement finality—and at what point. The framework must also address the legal recognition and enforceability of smart contracts, distributed records, and ledger entries as well as the responsibilities of custodians and other service providers. Additional risks arise in cases of insolvency, enforcement, fraud, and cyber incidents (see Online Annex 3.3, which provides examples of specific operational and infrastructure risks). In cross-border transactions, differences in property laws and conflict-of-law rules may create uncertainty over ownership, jurisdiction, and the enforceability of claims. Without legal certainty across these dimensions, adoption, especially by institutional investors, is likely to remain limited.

Regulatory uncertainty remains a key market concern, especially for institutional adoption. Global standard-setters apply the principle of "same activity, same risk, same regulatory outcome," using a technology-neutral, look-through approach that maps existing securities, banking, and payments rules onto tokenized products. Frictions with existing regulation arise mainly at the back end of the asset life cycle—clearing, settlement, and reporting—and around DLT-specific features, where existing frameworks are less readily applicable (see the policy recommendations section on

Figure 3.4. Layers of Concentration in Tokenized Market Infrastructure

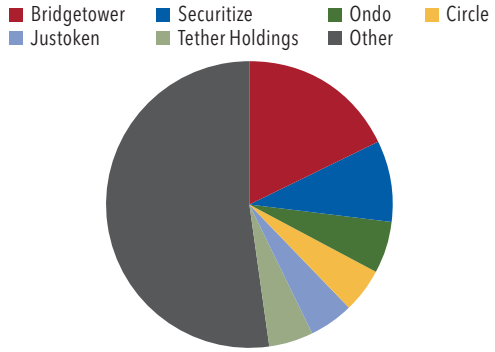
Tokenized assets are concentrated across a handful of leading blockchain networks ...

1. Tokenized Value, by Blockchain Network
(Share of total)



... while platforms, which include issuers, managers, and protocol operators, are similarly concentrated.

2. Tokenized Value, by Blockchain Platform
(Share of total)



Sources: RWA.xyz; and IMF staff calculations.

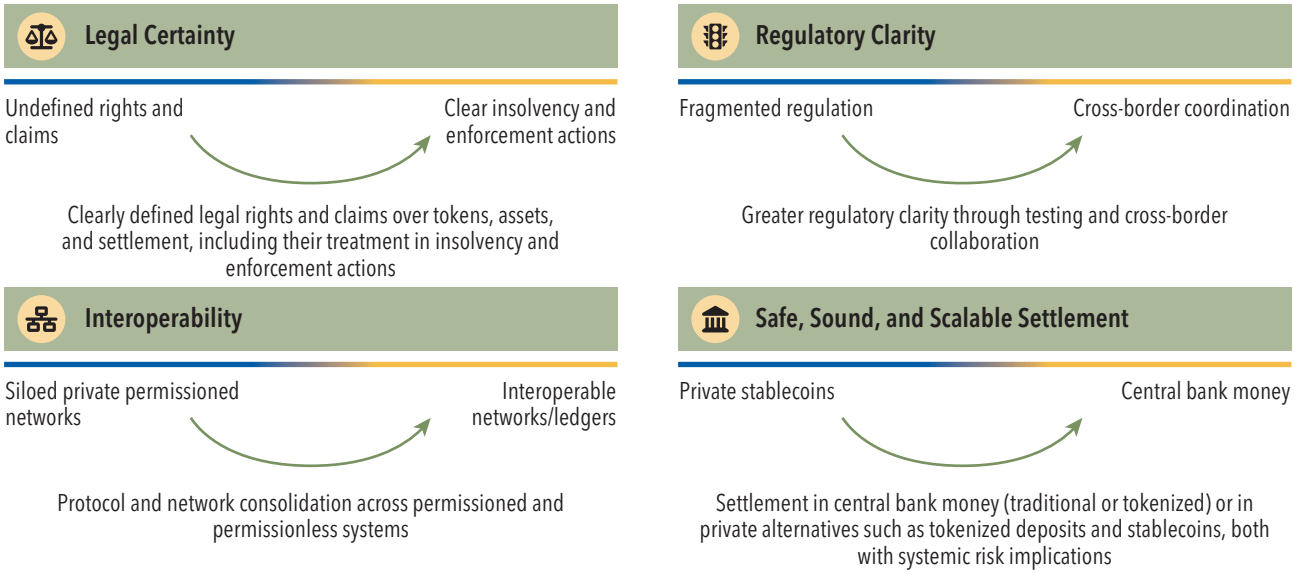
Note: Figures exclude tokenized repurchase agreements and stablecoins. The Figure Technologies HELOC token is also excluded to prevent a single asset from driving the results. Circle and Tether remain in the platform rankings even though the reported values exclude stablecoins. Including stablecoins would make Tether account for more than half of platform asset value and Circle for less than one quarter. A blockchain network refers to the protocol-based ledger technology; a blockchain platform refers to a specific provider offering services on top of one or several blockchain networks.

regulatory clarity). Authorities are using test-and-learn environments (such as policy sandboxes)[9] to determine potential gaps in existing rules for tokenized assets, but inconsistent rules across economies could create unnecessary complexity unless regulatory approaches are more coordinated globally.

The benefits of tokenization depend on how well different platforms and systems can work together (interoperability) and scale up. Current activity remains concentrated in fragmented networks, which

[9]These should not be confused with regulatory sandboxes. Rather than testing products against existing regulation, policy sandboxes test regulation itself as part of the drafting process.

Figure 3.5. Key Constraints to Tokenized Market Adoption



Source: IMF staff compilation.

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can trap liquidity and reduce secondary market depth, limiting participation by larger investors. Progress is constrained by a coordination problem (Agur and Copestake 2025) whereby low liquidity discourages participation by the very investors who could help deepen markets. Scaling therefore depends on greater interoperability across networks and protocols, common standards across instruments, and support for interoperable settlement assets.

Tokenized markets require safe, sound, and scalable settlement arrangements.[10] Tokenized trading without a trusted cash leg may increase the risks involved in settlement processes, limiting the potential for delivery versus payment, end-to-end programmability, and the full crystallization of tokenization's benefits (see the next section).[11] Emerging private settlement assets further introduce credit and liquidity risk into settlement processes unless such risks are properly mitigated, both by issuers and FMIs. Enabling settlement in safe and widely accepted forms of money could attract a broader set of investors by providing clarity on the stability of their on- and off-ramp transactions. In addition, the choice of settlement asset has important implications for financial stability, shaping the degree of interconnectedness with other asset classes, such as sovereign bonds, and institutions, such as banks and money market funds.

Current, Emerging, and Potential Benefits

To assess the potential benefits of tokenization, it is useful to distinguish among benefits that have already materialized across stages of the asset life cycle, those that are currently emerging, and those that remain largely potential. Figure 3.6 maps these potential gains across the five stages of the asset life cycle—issuance, trading, clearing, settlement, and servicing and reporting—and organizes them according to their degree of maturity.

Importantly, several of these benefits are not exclusive to tokenization and are increasingly achieved through other technologies and market reforms. Capital markets have long been digital, although they operate across fragmented infrastructure and institutional databases. Many jurisdictions have compressed settlement cycles, with same-day settlement available in some markets. For example, India introduced optional same-day settlement for a subset of its equities markets using conventional technology rather than distributed ledgers and tokenization.[12] Both the United Kingdom and the United States plan to extend market opening hours to certain products in equities markets, moving toward nearly continuous operating hours. Programmability can also be implemented on more conventional technology, where it is used to automate processes across the asset life cycle, including the conditional execution of payments, collateral management, and compliance processes. Real-time or nearly real-time monitoring and reporting can be implemented in capital markets using conventional technology, including application programming interfaces. This allows market participants and financial sector authorities to receive automated data feeds and supervisory information without relying on distributed ledgers. Many claimed benefits of tokenization are the benefits of digitalization. However, tokenized markets can apply competitive pressure to transform traditional infrastructure and architecture. Tokenization can also deliver new benefits by combining assets, payments, and programmability on the same or shared platforms.

Current benefits are concentrated in efficiency and transparency gains that build directly on the core properties of distributed ledgers. Recent empirical studies provide early evidence that tokenized bonds may lead to lower issuance costs. For example, Leung and others (2023) find that underwriting fees of tokenized bonds were lower than those of traditional bonds across a sample of bonds in Hong Kong SAR. In clearing and servicing, back-office operations can be streamlined through a shared, auditable record

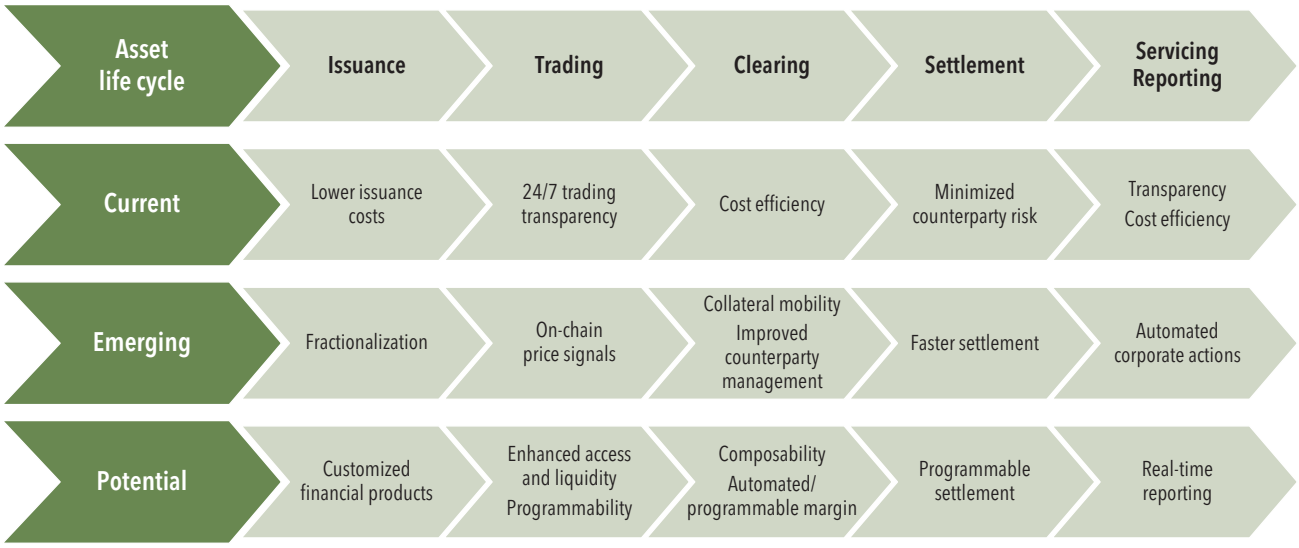
[10]Safety, soundness, and scalability are defined as desirable features for settlement assets and FMIs conducting wholesale financial market transactions. Safety refers to the risk profile of assets; soundness refers to an FMI's conduct and operations, and scalability refers to the ability for FMIs to support transactions at scale. The Principles for Financial Market Infrastructures (CPSS-IOSCO 2012) highlight core principles to support the conduct and operations of systemically important FMIs.

[11]Ensuring settlement of the cash leg in tokenized capital market transactions is a topic of increasing focus (see Duffie [2026] and GFMA [2026]). IMF works covering aspects of payment and settlement in tokenized market include Patel and others (2026), Adrian and others (2026), and Cabedo and others (2026). Reducing settlement risks is one factor in supporting financial stability.

[12]More recently, India advanced its financial market infrastructure by launching a pilot programme for tokenized corporate bonds, integrating Distributed Ledger Technology (DLT) with the RBI's Central Bank Digital Currency (CBDC).

Figure 3.6. Current, Emerging, and Potential Benefits from Tokenization

Current benefits of tokenization remain centered around cost savings.



Source: IMF staff compilation.

that improves transparency and lowers reconciliation costs. In settlement, delivery versus payment on common ledgers minimizes counterparty-principal risk by construction. These benefits are primarily operational—as reductions in cost, time, and reconciliation frictions—and probably will not fully materialize until tokenization scales up, at which point network effects will begin to dominate.

Emerging benefits reflect the next layer of functionality being unlocked as tokenization scales and market infrastructure adapts. On the primary side, fractionalization[13] is broadening the investor base for traditionally illiquid instruments (such as commercial real estate), while continuous on-chain trading can generate observable market signals that improve pricing. In post-trade activities, programmability is enhancing collateral mobility across venues and strengthening counterparty risk management. It is also shortening settlement cycles materially, while the increasing execution of corporate actions—coupons, dividends, and redemptions—through smart contracts is reducing manual processing risks (Cabedo and others 2026).

Potential benefits depend on the growth of tokenized financial assets. At the issuance stage, programmable logic could enable tailored financial products designed around specific investor mandates or contingent payoffs. Broader market access and programmability could deepen liquidity, while automated margining, programmable settlement, and real-time regulatory reporting could shift oversight from periodic reconciliation toward more continuous supervision and monitoring.

Empirical Assessment of Benefits from Tokenized Equity Markets

An empirical analysis of the five most liquid tokenized US equities was performed across two issuers and compared with their corresponding underlying equity traded on traditional markets.[14] The sample covers 11 trading venues across centralized and decentralized networks,[15] representing approximately $345 million

[13]Fractionalization allows high-priced equities to be divided into smaller units, lowering the entry threshold for investors who might be unable to afford whole shares.

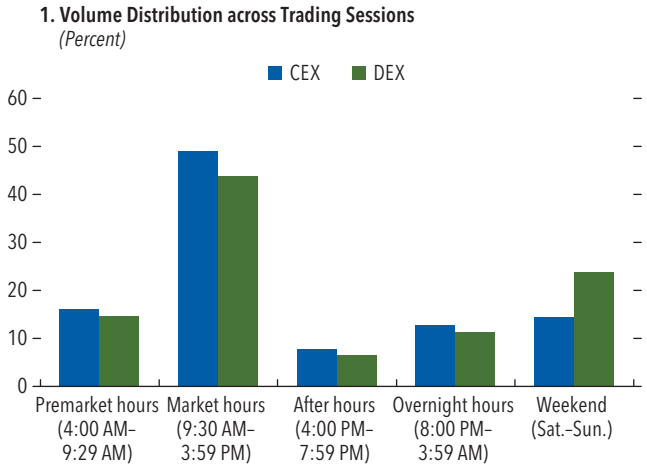
[14]Our sample includes tokenized equities for the S&P 500, Nasdaq, Tesla, Google, and NVIDIA that were issued by Ondo and xStocks.

[15]Both venues trade the same blockchain-based tokens. Centralized exchanges hold tokens for identified customers and settle trades on their own books. Decentralized exchanges settle each trade on the blockchain, meaning users keep custody, access requires only a wallet, and holders are identified by address rather than name. Tokens can also move directly between wallets without any venue.

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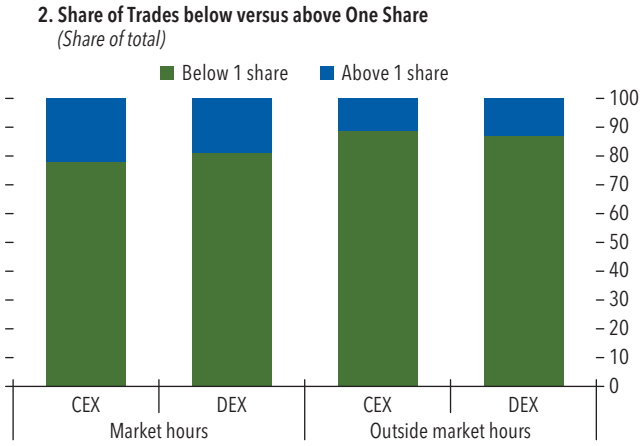
Figure 3.7. Tokenized Equities Reveal Multiple Benefits

More than 50 percent of trading occurs outside regular market hours.



Sources: Allium; CoinDesk; and IMF staff calculations.
Note: CEX = centralized exchanges; DEX = decentralized exchanges.

Current tokenized trading confirms demand for fractionalization.



Sources: Allium; CoinDesk; and IMF staff calculations.
Note: CEX = centralized exchanges; DEX = decentralized exchanges.

in reported market value,[16] or about 15 percent of the $2.3 billion tokenized equity market. The data set covers 365 trading days and more than 2 million observations of price and volume fluctuations during five-minute intervals. Through this analysis, several of the benefits set out in Figure 3.6—current (24/7 trading) and emerging (fractionalization and on-chain price signals)—already have initial empirical support.

Although the analysis provides early evidence on the benefits and risks of tokenization, findings should be interpreted with caution, given the incipient nature of the market.[17] Therefore, market structure and operations can change significantly if tokenization scales. As discussed in the section "Potential Scenarios for the Evolution of Tokenized Markets," a range of plausible market structures could emerge as tokenization evolves. These different end states would shape the balance of risks and benefits associated with tokenization, implying that current market dynamics may not be representative of the sector's eventual steady state.[18]

Market participants benefit from continuous trading as more than 50 percent of activity in tokenized equities occurs outside regular US market hours (Figure 3.7, panel 1). Unlike traditional equity markets, which operate within fixed exchange hours, tokenized equities trade on-chain around the clock, allowing investors to transact at any time and across time zones. The volume outside standard hours suggests that 24/7 availability is not merely a technical feature but a source of demand—particularly among investors in regions operating outside US trading hours and those seeking to react immediately to news and price movements when conventional venues are closed.

The market also displays a pronounced tilt toward small transactions, with about 80 percent of tokenized equity trades executed in sizes below one share, suggesting strong demand for fractionalization. The prevalence of subshare trades indicates that the current user base is dominated by smaller retail-oriented participants rather than institutional investors transacting in large blocks (Figure 3.7, panel 2).

Tokenized equity prices also carry information relevant for traditional assets. Drawing on the sample of five liquid tokenized US equities, the analysis regresses each underlying equity's cumulative return over the first five minutes of the US trading session on the overnight return of its tokenized counterpart—that is, the return accumulated on-chain while traditional markets are closed—to estimate a pass-through coefficient (Figure 3.8). A coefficient of 1 implies the underlying equity has fully absorbed the overnight on-chain information five minutes after

[16]As of July 31, 2026.

[17]The analysis, using data compiled by RWA.xyz, comprises about 930,000 investors, with the holder count representing unique on-chain addresses holding a nonzero token balance as of July 31, 2026.

[18]For a more detailed analysis of tokenized equity markets, see Cong and others (2025).

the open; values below 1 indicate partial absorption, while values above 1 indicate overshooting. The estimates range from 87 percent to 99 percent, suggesting that traditional and tokenized markets respond to similar information sets.

Financial Stability Implications from Asset Tokenization

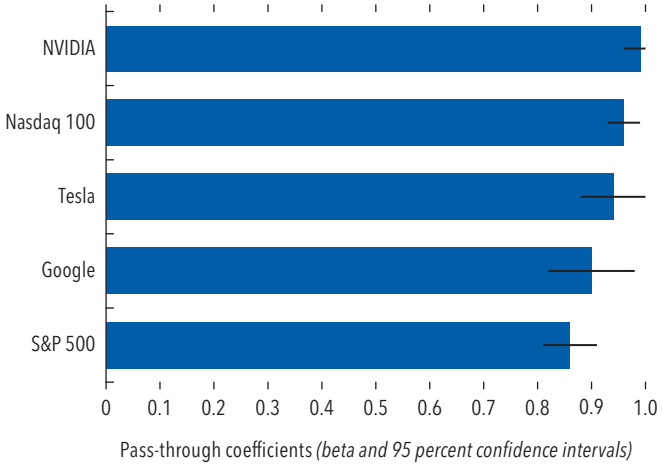
Tokenization may not fundamentally alter the nature of financial stability risks, but it can reshape the channels through which vulnerabilities accumulate and shocks are transmitted. The distinctive features and design choices of tokenization can increase the prominence of risks related to technology and infrastructure. At the same time, they can create new channels through which traditional risks such as liquidity, interconnectedness, and leverage are amplified and transmitted across markets. (See Online Annexes 3.2 and 3.3 for technical and specific risk details.)[19]

To contextualize how tokenization features influence financial stability outcomes, the key structural features linking tokenized assets to broad categories of risks can be placed within a framework. Unlike existing approaches that connect risk categories primarily by asset class, our framework links key tokenization features and market-design choices to the mechanisms through which risks emerge, are amplified, mitigated, and transmitted across the asset life cycle. For each core feature, the framework identifies a primary channel through which risks are generated directly and secondary channels through which existing risks are amplified or transmitted across markets and infrastructures (Table 3.1; Online Annex 3.2).[20] The discussion of risks is organized according to their prominence and directness rather than their overall importance, which may evolve as tokenization progresses. For example, while operational risks and the transmission of shocks to the traditional financial system through direct exposures are the most prominent concerns today, as tokenized markets scale up, smart contracts, composability, and reliance on shared governance arrangements could create new amplification channels that increase financial sector leverage and liquidity risks and new critical infrastructure nodes, adding a new dimension to operational risks.

A key insight is that tokenization can increase the systemic relevance of operational and infrastructure-related risks. Operational and governance risks gain prominence because of their association with distributed technologies, smart contracts, oracles, and code-based execution (see Online Annex 3.3). Market structure and infrastructure risks linked to validators, interoperability arrangements, cloud providers, and tokenization platforms also become more important. Operational and governance risks (blue and brown entries in Table 3.1) are prevalent direct sources of risk, accounting for most direct channels in the matrix. For example, permissionless access models, decentralized governance arrangements, and reliance on external oracles can heighten operational and governance risks by making coordination more complex, diffusing accountability, and introducing dependencies on external data providers (Table 3.1, codes I3–I5).[21] These risks are concentrated largely in the earlier stages of the asset life

Figure 3.8. Price Signals in Tokenized Equities

Traditional assets absorb more than 87 percent of the overnight change in tokenized equity prices.



Sources: Allium; CoinDesk; and IMF staff calculations.

Note: The chart shows the pass-through coefficient from a regression of the underlying equity's five-minute return on the overnight tokenized-equity return average of Ondo and xStocks equivalent tokens. See Online Annex 3.1.

[19]Beyond the discussion in the matrix, an emerging challenge may be the role of private settlement assets. Stablecoins, subject to their backing, could face further challenge if large-scale redemptions affect their reserve backing (see Patel and others [2026] and Cabedo and others [2026] for a discussion).

[20]Online Appendix Table 3.2.2 develops the framework further and provides detailed explanations of the rationale of the matrix.

[21]Permissioned networks are networks in which only known actors with specific rights can validate existing records and add new ones, whereas permissionless networks are networks in which anyone can participate in validating existing records and adding new ones (Bains 2025). Permissioning can happen at the infrastructure, platform, or asset level.

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Table 3.1. Prevalence and Directness of Risks in Tokenized Markets

The framework's most direct sources of risk are related to technology, whereas traditional risks tend to be amplifiers.

Code	Core Features	Definition or Attribute	Increase Risk			Reduce Risk
Core Tokenization Features		**Definition**	**Direct**	**Amplification**		**Mitigation**
C1	DLT-based recordkeeping and transfer	Ownership and transfers are recorded on a shared distributed ledger rather than through traditional centralized registries.	Outages and failures	Single-point failures		Reconciliation
C2	Programmability	Rules governing issuance, transfer, settlement, collateral use, and corporate actions can be embedded and automatically executed.	Automation	Contagion	Leverage	Processing
C3	Composability	Assets and applications can interact programmatically with other protocols, allowing assets to be combined, reused, or embedded in broader financial transactions.	Contagion	Leverage	Operational	Coordination frictions
C4	Atomicity	Linked transactions can be executed simultaneously, eliminating principal risk by ensuring that all legs settle together or not at all.	Operational	Liquidity		Contagion
Issuance Design		**Attribute**				
I1	Nature of claim	Direct claim on underlying asset	Fire sale	Contagion		Contagion
		Claim on issuer-intermediary	Contagion	Liquidity		
I2	Off-chain dependence	Reliance on off-chain assets or processes	Links to traditional fin. system	Reconciliation		DLT dependence
		Fully on-chain	Concentration	Operational		Operational
I3	Access model	Permissionless	Cyber and governance	Coordination		Single-point failures
		Permissioned	Single-point failures	Liquidity		Contagion
I4	Governance structure	Decentralized governance	Accountability	Coordination		
		Centralized governance	Concentration	Governance		Incident response
I5	Oracle dependence	Yes	Manipulation	Contagion		
Trading Structure		**Attribute**				
T1	Trading venue concentration	Single dominant venue	Single-point failures	Contagion		Liquidity
		Multiple venues	Operational	Fragmentation		Single-point failures
T2	Interoperability	Interoperable networks	Contagion	Infrastructure dependency		Friction
		Siloed network	Silos	Liquidity		Contagion
T3	Trading hours	Continuous (24/7)		Liquidity	Leverage	Funding shocks
T4	Investor access	Institutional only				
		Retail accessible		Liquidity	Contagion	
Settlement and Clearing		**Attribute**				
S1	Settlement finality	On-chain finality		Settlement speed	DLT reliance	Reconciliation
		Reliance on legal or off-chain finality	Reconciliation			Contagion
S2	Clearing structure	Bilateral clearing/settlement	Contagion	Liquidity		Single-point failures
		Central clearing (or CCP-like model)	Single-point failures	Liquidity		Liquidity
Financial Functions (cross-cycle)		**Definition**				
F1	Collateral mobility and reuse in tokenized finance	Tokenization enables collateral to move and be redeployed more easily across platforms, transactions, and financial applications.	Leverage	Contagion		Liquidity
F2	Programmable collateral and margining	Collateral management, margining, haircuts, and liquidation processes can be governed and automatically executed through programmable rules.	Leverage	Liquidity		Liquidity

Source: IMF staff.

Note: The table summarizes the channels through which tokenization features and market-design choices can affect financial stability. Entries under "Direct" identify the primary risk category generated by a feature or design choice, while entries under "Amplification" identify risks that may be intensified or transmitted through the feature. Entries under "Mitigation" identify channels through which the feature may reduce risk or strengthen market resilience. Colors correspond to the five financial stability risk categories defined in Table A3.2.1 in Online Annex 3.2; liquidity (red), interconnectedness and contagion (orange), leverage and procyclical deleveraging (purple), operational, technology, and governance risk (blue), and infrastructure and market risk (brown). The classifications are based on the analytical framework presented in Online Annex 3.2, which describes the methodology, rationale, and assignment of risks across the tokenized asset life cycle. CCP = central clearing counterparty; DLT = distributed ledger technology.

cycle, where technology, governance, and market-design choices are established.

Traditional risks—such as fire sales and liquidity runs, contagion through heightened interconnectedness, and leverage—can arise through new transmission and amplification mechanisms in tokenized markets. For example, greater collateral mobility with tokenized repo can facilitate the use of collateral across platforms, supporting larger leverage positions and potentially amplifying deleveraging pressures during stress (Table 3.1, code F1). In decentralized finance derivatives markets, tokenized money market funds or other tokenized assets could, in the future, be programmed to serve as margin collateral and reused across multiple transactions, creating collateral chains across interconnected platforms (Table 3.1, codes C3, F1, and F2).

Similarly, liquidity and contagion risks can propagate through new transmission channels in tokenized markets. Examples include automated programmable collateral management further accelerating margin calls and asset liquidations compared with traditional arrangements, intensifying liquidity strains during stress (Table 3.1, codes C2 and F2). Likewise, real-time settlement, 24/7 trading, and automated liquidation mechanisms may increase redemption pressures in tokenized investment vehicles like tokenized money market funds, accelerating liquidity stress and transmitting shocks to both tokenized and traditional markets through the underlying assets they hold (Table 3.1, codes C2, C4, I1, and T3). Contagion may also spread through interoperable platforms, composable applications, and automated collateral-management arrangements that facilitate the rapid transmission of shocks across markets and infrastructures (Table 3.1, codes T2, C3, and F1).

The examples presented illustrate that traditional financial stability risks often operate less as an originating source of vulnerabilities and more as a mechanism through which shocks are propagated and amplified across markets. Moreover, all three traditional risks appear to emerge more strongly further along the asset life cycle, as tokenized assets become integrated into trading, settlement, funding, and collateral-management activities in which leverage can build, liquidity pressures can materialize, and shocks can propagate across interconnected markets.[22]

Another key insight from the framework is that the financial stability implications of tokenization are shaped by trade-offs between risk mitigation and risk amplification. Table 3.1 illustrates how individual tokenization features can cut both ways as they reduce some vulnerabilities while giving rise to others. Programmability, for example, can lower operational risk and legal uncertainty by automating issuance, settlement, and corporate actions, but the same automation can amplify procyclicality and contagion while introducing new vulnerabilities stemming from smart contract design flaws or cyber incidents (Table 3.1, code C2). Composability can improve coordination and capital efficiency, yet it also propagates contagion and leverage across interconnected applications and expands the operational attack surface (Table 3.1, code C3). Atomicity reduces counterparty and principal risk by ensuring that all transfers occur near-simultaneously, but in doing so it heightens dependency on the underlying infrastructure and removes temporal buffers that in traditional transactions help absorb operational disruptions and liquidity shocks (Table 3.1, code C4 and S2; Box 3.2). Overall, by reducing the friction, buffers, and intermediation arrangements that traditionally help absorb shocks, these features can also alter how vulnerabilities accumulate and shocks are transmitted across markets and infrastructures.

The analysis also suggests that risks may emerge through new channels, potentially affecting financial market authorities' ability to conduct effective supervision. Although the use of public networks may improve transparency, in practice, market participants may prefer private networks or the use of privacy technologies to ensure proprietary and client transactions are no more transparent than they are today. Tokenization is not inherently a risk for anti-money laundering/combating the financing of terrorism. Yet, the registration or servicing of tokenized assets through offshore jurisdictions, as evidenced in the case of equities, can increase such vulnerabilities when it creates regulatory, supervisory, or transparency gaps (FATF 2026). Supervisors may need to expand their monitoring across new trading venues and asset classes as well

[22]Contagion becomes more prominent in the trading, settlement, and clearing layers, in which interoperability arrangements, settlement dependencies, and liquidity pressures can propagate stress across market participants and infrastructures. Liquidity risk becomes the leading traditional risk in the trading layer, reflecting how venue structure, fragmentation, and continuous trading reshape market depth and price dynamics. Leverage risk is concentrated in the collateral-management and margining functions that span the asset life cycle, in which tokenized collateral can support leverage and amplify deleveraging pressures through collateral mobility, reuse, and automated margining arrangements (Table 3.1, codes F1 and F2).

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as understand new market infrastructure and protocols (like smart contracts) and their effect on market integrity rules, which may challenge resources and expertise. This challenge is compounded by the need to identify whether existing tools (such as circuit breakers) are effective, reconciling data on-ledgers and off-ledgers, and potentially dealing with entities domiciled outside their jurisdiction.

Empirical Evidence of Fragmentation and Volatility in Tokenized Markets

Tokenized equity markets are considerably less liquid than traditional markets, especially on decentralized exchanges (Figure 3.9, panel 1), also because of the absence of trading by institutional investors. Using the same data on venues, tokens, and time period as in the "Empirical Assessment of Benefits from Tokenized Equity Markets" section, it is evident that certain risks also have empirical support: heightened volatility, illiquidity, and price dispersion. Using the Amihud measure—defined as the median absolute five-minute price change per $1 billion of daily volume, with higher values denoting greater illiquidity—traditional markets are the most liquid, centralized exchanges are materially less so, and decentralized exchanges are the least liquid by a wide margin. This pattern suggests that a given volume of trading currently has a much larger effect on prices in tokenized venues, reflecting shallower liquidity and limited market-making activity.

Tokenized equities exhibit significantly higher volatility than equivalent equities traded in traditional markets. Realized volatility is approximately 1.5 times higher (Figure 3.9, panel 2). Volatility rises from traditional markets to centralized exchanges and is highest on decentralized exchanges. Part of this gap reflects that tokenized venues are less liquid and trade continuously, so their volatility captures price movements during lower-volume overnight and weekend periods.

Despite higher volatility and lower liquidity, tokenized equities generally remain closely aligned with prices in traditional markets. Panel 3 in Figure 3.9 plots the kernel density of the five-minute price spread against traditional markets during US market hours when a contemporaneous traditional price is available. For both centralized and decentralized exchanges, distributions of price differences show peaks close to zero, indicating that, on average, tokenized prices track their underlying equities closely. However, the decentralized exchange distribution is visibly flatter and wider than the centralized exchange distribution, suggesting larger and more frequent deviations in decentralized venues, consistent with their weaker liquidity.

Price alignment between tokenized and traditional markets is strongly linked to trading activity, with higher-volume venues tracking traditional prices more closely. Plotting each venue's median absolute five-minute deviation from traditional prices against its median daily volume per token—both on log scales, with bubble size proportional to average trades—reveals a clear downward-sloping relationship (Figure 3.9, panel 4). Venues with higher trading volumes tend to track traditional market prices more closely, whereas low-volume venues have substantially larger pricing errors.

Potential Scenarios for the Evolution of Tokenized Markets

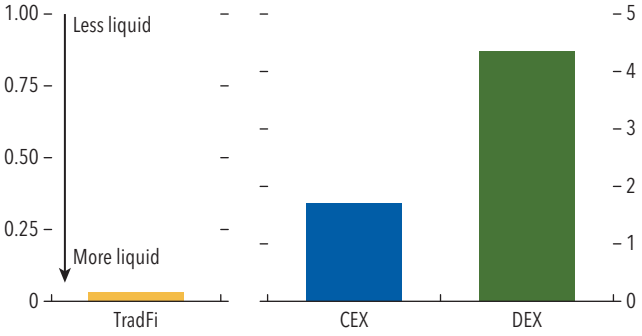
The pace and direction of adopting tokenization ultimately depend less on the underlying technology than on incentives facing market participants. Legal and regulatory frameworks and safe settlement assets are key drivers of adoption (Adrian 2026). Figure 3.10 illustrates the potential progression from today's fragmented ecosystem toward a more integrated tokenized financial system. Network effects can make the adoption of tokenization nonlinear: early adoption may be slow because the benefits of participation are limited when few participants are on the network, but once a critical mass is reached, adoption can accelerate rapidly.

Today, tokenization remains largely confined to specific use cases that can achieve immediate efficiency gains without the need for broad market coordination. Activities such as tokenized repos, collateral management, tokenized money market funds, and selected sovereign bond issuances are mostly concentrated on private permissioned platforms. Platforms are largely siloed and operated by individual institutions or consortiums, whereas trading and settlement continue to rely heavily on traditional infrastructure. Legal certainty is often missing across jurisdictions, and regulatory treatment differs substantially across markets, creating doubts about ownership rights, custody, insolvency treatment, and cross-border enforceability. This fragmented equilibrium also partially reflects that incumbents have limited incentives to support open interoperability, because proprietary infrastructures allow them to maintain control over clients, deposits, and market access (Agur and Copestake 2025). In this environment, systemic risks remain limited because

Figure 3.9. Tokenized Equity Markets: More Volatile, Less Liquid, but Closely Priced

Tokenized equity markets are far less liquid, especially on decentralized exchanges ...

1. Amihud Illiquidity Measure
(Price impact per unit of volume, Lower = more liquid; TradFi, left scale; CEX/DEX, right scale)

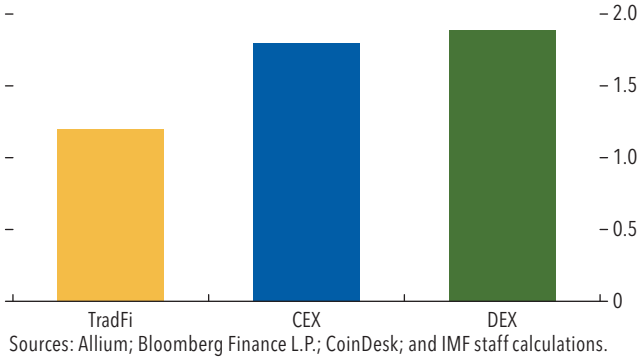


Sources: Allium; Bloomberg Finance L.P.; CoinDesk; and IMF staff calculations.

Note: Amihud illiquidity is the median absolute five-minute price change divided by median daily volume, scaled per $1 trillion for traditional markets (market hours) and per $1 billion for centralized and decentralized exchanges (24/7). All measures use volume-weighted venue prices within five-minute bins, are winsorized at the 1st/99th percentile, require more than one trade per decentralized exchange bin, and report medians. CEX = centralized exchanges; DEX = decentralized exchanges; TradFi = traditional finance (exchanges).

... and 1.5 times more volatile than traditional markets ...

2. Realized Volatility
(Percent)

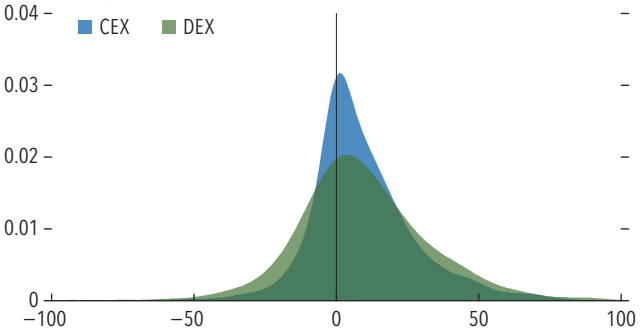


Sources: Allium; Bloomberg Finance L.P.; CoinDesk; and IMF staff calculations.

Note: Realized volatility is the median across token-days of the square root of the sum of squared five-minute log returns (Andersen-Bollerslev-Diebold-Labys), in percentage per day; traditional markets cover US market hours, while centralized and decentralized exchanges cover all hours (24/7). All measures use volume-weighted average prices within five-minute bins, are winsorized at the 1st/99th percentile, require more than one trade per decentralized exchange bin, and report medians. CEX = centralized exchanges; DEX = decentralized exchanges; TradFi = traditional finance (exchanges).

... but still remain closely priced relative to traditional markets.

3. Spread Distribution: Tokenized versus Traditional
(Density)

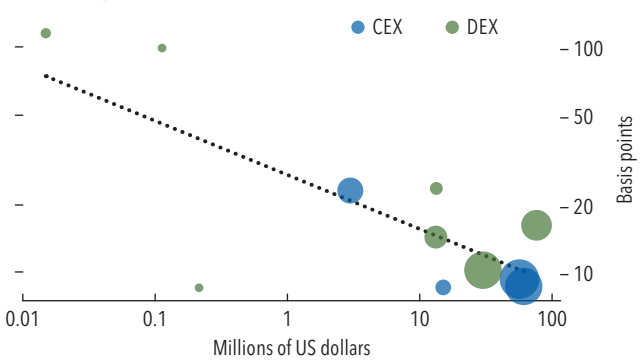


Sources: Allium; Bloomberg Finance L.P.; CoinDesk; and IMF staff calculations.

Note: Distribution of the five-minute price spread versus traditional markets, spread = 10,000 × (log volume-weighted average price − log Bloomberg price); US market hours for all venues since a contemporaneous traditional price is required; curves are kernel density estimates. All measures use volume-weighted average prices within five-minute bins, are winsorized at the 1st/99th percentile, require more than one trade per decentralized exchange bin, and report medians. CEX = centralized exchanges; DEX = decentralized exchanges.

Higher-volume exchange venues track traditional prices more closely.

4. Price Deviation, by Venue Volume
(Basis points; millions of dollars)



Sources: Allium; Bloomberg Finance L.P.; CoinDesk; and IMF staff calculations.

Note: Price deviation is each venue's median absolute five-minute deviation from traditional prices (y-axis, log scale) versus median daily volume per token (x-axis, log scale); the bubble sizes represent the average trades per token; the trendline is a log-log fit across all venues. All measures use volume-weighted average prices within five-minute bins, are winsorized at the 1st/99th percentile, require more than one trade per decentralized exchange bin, and report medians. CEX = centralized exchanges; DEX = decentralized exchanges.

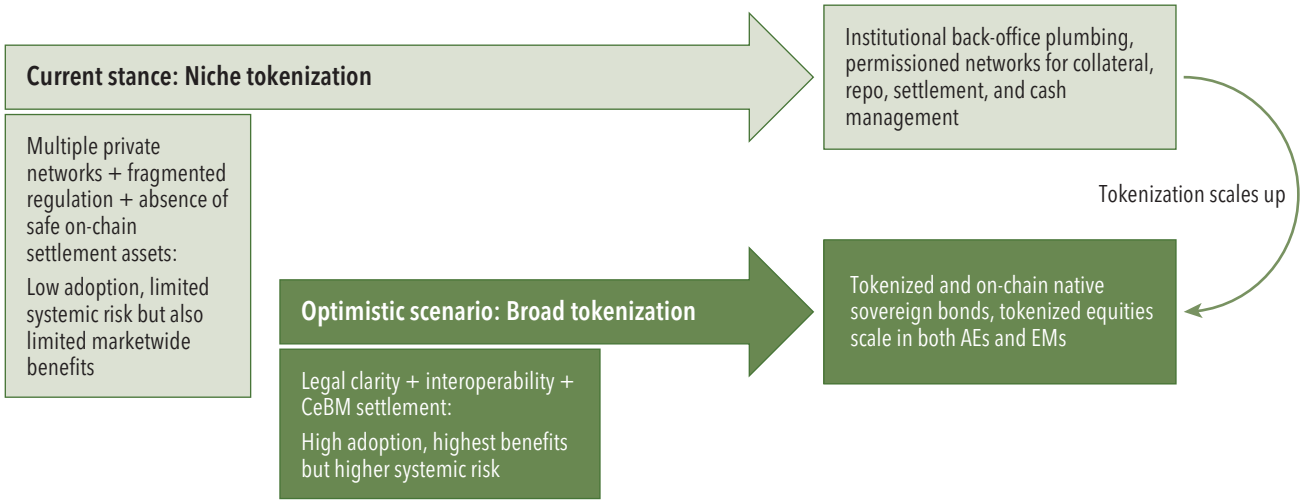
adoption is small, but the broader efficiency gains associated with tokenization—including composability, liquidity aggregation, and integrated settlement—also fail to materialize.

The current trajectory points to limited scaling and adoption. Continued fragmented regulation, limited interoperability, and uncertainty regarding the suitability of available settlement assets could prevent markets from reaching the scale necessary to generate meaningful network effects. Under this scenario, a fragmented equilibrium would deliver localized efficiencies. Tokenization would remain concentrated in specific use cases, pilot projects, and isolated issuance programs. Secondary markets would remain illiquid,

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Figure 3.10. Paths for Adopting Tokenization in Financial Markets

How fast tokenization grows depends on how multiple constraints are resolved, with low adoption (current stance) because of multiple private networks, fragmented regulation, and absence of safe settlement assets.



Source: IMF staff compilation.

Note: AEs = advanced economies; CeBM = central bank money; EMs = emerging markets.

investor participation would narrow, and many of the purported benefits would not materialize. Tokenization would therefore continue to have modest economic significance.

A potential medium-term scenario is the adoption of tokenization to improve the financial market's technical infrastructure. Under this scenario, tokenization becomes increasingly embedded in repo markets, collateral management, securities servicing, and cash management, while remaining largely invisible to end investors. Permissioned networks operated by banks, custodians, exchanges, and FMIs dominate activity. Much of the recent growth in tokenized repo activity and private permissioned networks points toward this trajectory, which could offer meaningful operational benefits. Institutions can reduce reconciliation costs, mobilize collateral more efficiently, shorten settlement timelines, and automate selected post-trade functions. This model does not require fully harmonized regulation or universal interoperability to generate benefits. Instead, gains arise from optimizing existing market structures. As Aldasoro and others (2023) note, in large, high-turnover markets such as government bonds, even small per-trade efficiency gains from tokenization can translate into substantial aggregate benefits when trading is automated on a common platform.

Broad tokenization adoption may emerge if current constraints are addressed. Under this scenario, tokenized markets can evolve beyond isolated institutional applications and become an integrated layer for issuance, trading, settlement, and servicing across multiple asset classes. Tokenized sovereign bonds, equities, deposits, money market instruments, and other financial assets would coexist on interconnected networks governed by common standards. Arrangements that allow settlement in central bank money would provide a highly trusted and stable settlement option. Such a scenario would allow tokenization to generate and amplify network benefits. Liquidity could move seamlessly across platforms, collateral could be mobilized in real time, and secondary markets could deepen substantially. Interoperability would reduce the current fragmentation of investors and trading order flow, while legal frameworks would support cross-border trading and issuance. Emerging markets could also benefit disproportionately because tokenization could lower some issuance costs, broaden investor access, and facilitate participation in global capital markets. This scenario would also have significant implications for financial stability as many of the same features that generate the largest efficiency gains from broad tokenization can also create new vulnerabilities and amplify existing transmission channels.

The broad tokenization scenario highlights that further growth of tokenized finance also depends on coordination across institutions and jurisdictions. The benefits and risks of tokenization increase nonlinearly with adoption because liquidity, interoperability, and standardization reinforce each other. Individual institutions may not have enough incentive to bear the initial cost of creating open standards or interoperable infrastructures if competitors can benefit. While coordination problems may be resolved in time by markets themselves, public policy may help expedite an optimal outcome.

Policy Recommendations

Tokenization is one of several innovations that could help address inefficiencies in financial markets. To support safe and efficient market development, policymakers should adopt a technology-neutral approach that allows different technologies to compete on their merits. Removing unnecessary constraints to tokenization while safeguarding financial stability is the first step toward enabling tokenized markets to develop. This implies assuring legal certainty and improving regulatory clarity, focusing on potential operational, governance, and infrastructure risks and upgrading supervisory capacity.

In emerging markets, although tokenization could support and complement efforts to deepen and develop capital markets, fundamental reforms remain paramount. Tokenization may allow some emerging market and developing economies to "leapfrog" legacy market infrastructure but not the broader process of capital market development itself. Where incumbent systems are less entrenched, newer arrangements, such as on-chain native bond issuance, can be adopted without replicating the infrastructure architecture of mature markets. Infrastructure, however, is only one pillar of capital market development, and the costs of adoption warrant careful consideration. Building tokenized infrastructure, adapting legal frameworks, and developing supervisory capacity require substantial fixed investments, whereas efficiency gains tend to increase with transaction volumes. In low-turnover markets, whether the potential gains will outweigh the costs remains uncertain. Authorities should advance the foundational elements of capital market development, including a broad investor base, benchmark pricing, secondary market liquidity, and robust legal and supervisory safeguards in parallel with technology adoption. Otherwise, tokenization may add operational, cyber, and governance risks to shallow markets that lack legacy infrastructure and established institutional arrangements to fall back on.

Promote Technology Neutrality by Removing Unnecessary Constraints

Legal Certainty

To promote technology neutrality, national authorities should first review their legal frameworks and ensure that laws provide legal certainty for tokenized assets. The law needs to establish clear rights and claims over tokens and define the legal relationship between tokenized assets and their real-world equivalents. It should also address key issues across the tokenized asset life cycle, including issuance, transfer, redemption, insolvency treatment, and enforcement actions, as well as jurisdictional and conflict-of-law rules in cross-border transactions. In doing so, authorities should clarify the rights conveyed by tokenized assets, including whether they confer direct rights over the underlying asset or claims against the issuer (Garrido 2023).[23]

Regulatory Clarity

Second, financial sector authorities should provide regulatory clarity. In the short term, existing securities, banking, and payments regulations can and should be applied to tokenized markets. Consistent with the principle of "same activity, same risk, same regulatory outcome," international standard setters generally adopt a technology-neutral approach focused on the underlying asset, activity, and risks rather than the technology used. As a result, tokenized securities should generally be subject to securities regulation, tokenized deposits to banking regulation, and tokenized payment arrangements to payments regulation. Similarly, requirements governing issuance, disclosure, transparency, market conduct, corporate governance, best execution, market surveillance, and consumer protection should continue to apply in tokenized markets. This approach helps prevent regulatory arbitrage while allowing innovation to develop within established legal and regulatory frameworks.

[23]Some jurisdictions are providing legal certainty for both tokenized representations of real-world assets and natively issued on-chain assets.

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In the medium term, some functions and prudential metrics may require additional regulatory clarity and targeted adjustments. Custody is one area where greater adaptation may be needed, although the starting point should remain client asset rules. Although fundamental regulatory principles on asset segregation and safekeeping should continue to apply, additional considerations are necessary for private key custody, including the use of different types of wallets (hot, cold, warm).[24] Furthermore, some prudential metrics, including leverage ratio limits, are generally constructed from point-in-time or end-of-day snapshots rather than continuous intraday monitoring. As a result, intraday transactions that are open and unwind within the same business day, before a reporting snapshot is taken, may not be fully reflected in reported balance sheet metrics, even if real funding and counterparty exposure existed for part of the day. Supervisors should assess whether existing reporting frameworks adequately capture intraday exposures associated with tokenized funding and securities markets (see also Singh 2026).

Over the longer term, if tokenization scales, recordkeeping, clearing, and settlement will require greater regulatory review. The use of public permissionless networks for tokenized assets can challenge regulatory assumptions, particularly in areas of finality. For example, the Principles for Financial Market Infrastructures (PFMIs) require clear and final settlement for designated FMIs (CPSS-IOSCO 2012), whereas many public permissionless networks can provide only probabilistic technical finality that converges to economic and legal finality over time. Although recent technical developments have increased confidence in settlement finality from a technical perspective,[25] legal and regulatory uncertainty remains in many jurisdictions. Where distributed ledgers perform recordkeeping functions, existing regulation can create friction with the efficiencies offered by tokenization. For example, some jurisdictions require securities to be recorded and maintained through central securities depositories. Such requirements may need to be adapted when equivalent functions are carried out on distributed ledgers. Likewise, smart contracts challenge clearing frameworks designed around intermediaries such as central counterparties. In addition, atomicity may require regulators to reconsider assumptions about clearing, the treatment of netting arrangements, and the allocation of risk-management responsibilities.

Financial sector authorities with resources and expertise can use policy sandboxes to identify regulatory constraints and assess whether existing rules need to be adapted.[26] By providing flexibility within a controlled environment, these frameworks can help regulators better understand how tokenization interacts with regulation and should be considered in the drafting process for new legislation or regulation. Sandboxes can also help authorities distinguish between rules that remain appropriate and those that create unnecessary barriers to innovation. To be effective, such initiatives should have clear objectives, realistic timelines, and a transparent process for translating lessons from testing into regulatory or legislative reforms (also see Bains and Wu 2023). Not all financial sector authorities could, or should, build policy sandboxes, especially those in low-income countries with limited resources. In these instances, regulatory adjustments can be informed by pilots and experiments being conducted in more advanced or larger emerging markets.

Although national initiatives provide regulatory clarity to help ensure technology neutrality, greater international coordination is needed to prevent national approaches from diverging. Cross-border cooperation is necessary to reduce risk of global regulatory arbitrage and further fragmentation of tokenized markets. If tokenized markets grow, international organizations and standard-setting bodies should play a role in coordinating and providing such clarity in line with their mandates.

Interoperability

Policymakers should ensure there are no unnecessary inhibitors to developing interoperability across networks while safeguarding resilience. Financial sector authorities can, in collaboration with other relevant authorities and market participants, help prevent the emergence of fragmented tokenization silos if they support the development of common standards for asset representation and messaging along with resilient

[24]Hot wallets are connected to the internet and convenient for frequent transactions but open to greater cyberattacks. Cold wallets store private keys offline and are commonly used for long-term or larger storage. Recently developed warm wallets allow only brief connections to the internet while having additional controls in place.

[25]For example, the use of checkpoints as part of the Ethereum Network's finalization process or known validator sets and the use of Tower Byzantine Fault Tolerance in Solana. See also Bains (2025).

[26]Examples include the United Kingdom's Digital Securities Sandbox, and the European Union's DLT Pilot Regime.

and scalable settlement arrangements that allow assets and money to be transferred across platforms with little risk. These measures could ease the fragmentation and coordination frictions that currently trap liquidity and deter larger investors. However, bridges and other interoperability arrangements can introduce operational vulnerabilities, including by widening the surface for cyberattacks. Efforts to promote interoperability should therefore be accompanied by robust standards and risk-management frameworks for bridges, oracles, message layers, and other cross-network connections. This would ensure that efficiency gains do not come at the expense of cyber and operational resilience.

Safe, Sound, and Scalable Settlement

Authorities should ensure that tokenized securities are settled through strong FMIs and in safe and widely accepted forms of money. All securities settlement systems are systemic and must comply with the risk-management expectations set out in the PFMIs: securities are settled using central bank money in wholesale capital markets where practical and available. Without an interoperable form of central bank money, private settlement assets—tokenized deposits or stablecoins—could become the preferred settlement instruments for capital market transactions. The use of private settlement assets introduces credit and liquidity risks associated with their issuer. In tokenized capital markets, stress affecting one counterparty may be transmitted more rapidly to an FMI if the FMI lacks adequate risk-management controls. An FMI may also face heightened concentration risk where, for example, one private settlement asset becomes the preferred settlement asset on a platform, increasing the FMI's exposure to its issuer. Policymakers should therefore consider how to best support the development of settlement assets, underpinned by central bank money that is either interoperable with existing forms of central bank money or issued directly on-chain (tokenized reserves).[27,28] They should also ensure that any private settlement infrastructures conducting settlement with commercial bank money mitigate risks carefully, aligning with the PFMIs and prudential standards.[29] This would safeguard settlement finality and resilience without forcing tokenized assets to defer to legacy settlement methods, which may erode the efficiency gains from on-chain settlement.

Safeguard Financial Stability

Operational, Governance, and Infrastructure Risks

To protect financial stability, public authorities should intensify monitoring and mitigation of operational, governance, and infrastructure risks. As tokenized markets grow, these risks are likely to become increasingly important. To address them, authorities should do the following:

- *Adapt supervision to the operational and cyber risks of distributed networks*. Supervisors should assess how the design of DLT networks, including their degree of decentralization and reliance on interoperability solutions such as bridges and oracles, affect operational and cyber resilience. Authorities should also develop a systemwide map of DLT networks and the interoperability arrangements that connect them to identify concentration risks, critical dependencies, and potential channels of contagion.
- *Establish robust third-party risk and outsourcing frameworks*. As tokenization increases reliance on external technology providers, smart contracts, and distributed networks, authorities should ensure that regulated entities remain accountable for managing operational and cyber risks in line with PFMI expectations. Key safeguards include business continuity arrangements, smart contract audits, and resilient on- and off-chain data management. More direct oversight may be warranted where a small number of networks become dominant.
- *Safeguard recordkeeping integrity and settlement infrastructure resilience*. Financial sector authorities should require robust reconciliation between on- and off-chain records, clear legal recognition of the authoritative record of ownership, and resilience standards consistent with the PFMIs for settlement infrastructure. These safeguards can help prevent ownership disputes, operational disruptions, and concentration risks as recordkeeping and settlement functions migrate onto distributed ledgers. If tokenized mar-

[27]As tokenized market infrastructure scales, jurisdictions may also examine whether certain FMIs may eventually require access not only to central bank money for settlement but also to central bank liquidity facilities under stressed conditions.

[28]Several central banks are actively exploring these issues. For example, the ECB's Project PONTES seeks to enable the settlement of DLT-based transactions in central bank money while promoting interoperability between distributed ledger platforms and existing market infrastructures.

[29]See Patel and others (2026) for a further discussion on the role of central bank money in tokenized settlement.

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kets were to grow, bank resolution authorities might consider adapting their frameworks to address the transfer of tokenized assets during resolution.

Supervisory Capacity

Supervisors need the skills, tools, and resources to oversee tokenized markets safely and effectively. This will require building capacity in areas such as custody, smart contracts, intraday liquidity, third-party dependencies, privacy technologies, and tokenized exposure reporting. Supervisors must also identify new channels of market abuse. Given resource constraints, domestic and cross-border supervisory cooperation will be increasingly important. The use of blockchain analytics providers could also be one tool in a broader toolkit to assist in market monitoring.

Authorities should also ensure that anti-money laundering/combating the financing of terrorism frameworks remain effective in tokenized environments, including with respect to effective customer due diligence measures, beneficial ownership transparency, and cross-border supervision.

Liquidity Runs and Fire Sale Risk

Assess and manage the liquidity implications of atomic settlement. While atomicity reduces counterparty risk, it can increase intraday liquidity needs by requiring prefunding and eliminating timing gaps that traditionally help absorb liquidity shocks. Financial sector authorities should ensure that frameworks to manage liquidity risk, including intraday liquidity monitoring and supervisory requirements, keep pace with the adoption of atomic and near-instant settlement arrangements. Financial institutions should maintain sufficient liquidity buffers to meet prefunding obligations under stress without resorting to fire sales. Authorities should also strengthen intraday and out-of-hours liquidity monitoring and stress testing, incorporating tokenization-specific disruptions such as smart contract failures and trading suspensions to better manage emerging risks.

Interconnectedness, Contagion, and Deleveraging Risk

Develop circuit breakers and liquidity safeguards for 24/7 tokenized trading environments. While round-the-clock trading is not unique to tokenized markets, tokenized infrastructure can support continuous trading and near-instant execution natively. Absent appropriate safeguards, continuous trading and instant, automated liquidations could amplify price volatility and fire sales during stress. Authorities should examine whether existing tools, including circuit breakers, trading halts, liquidity fences, redemption gates and fees, and continuous margining remain effective in always-on DLT infrastructure and consider adapting them where needed. Existing crisis-management arrangements may also need to be enhanced to better enable continuous monitoring, expanded operational readiness, and intervention tools adapted to always-on financial markets.

Strengthen monitoring of linkages between tokenized and wider financial markets. Because redemption pressures in tokenized vehicles (for example, tokenized money market funds) can transmit to the underlying assets they hold, liquidity stress can propagate between tokenized and traditional markets. Financial sector authorities should monitor interconnections between tokenized and traditional markets, including the use of settlement assets for tokenized asset transactions, so that stress originating in tokenized markets does not spill over undetected into core funding and securities markets.

Monitor collateral reuse and procyclical deleveraging. Greater collateral reuse—including through tokenized money market funds or other tokenized assets posted as margin and reused across platforms—can lengthen collateral chains and amplify deleveraging pressures during stress. Financial sector authorities should monitor collateral velocity and reuse, consider limits or haircuts on the reuse of tokenized collateral, and ensure that automated margining does not trigger simultaneous, self-reinforcing liquidations across interconnected protocols.

Box 3.1. Does Tokenization Change Market Structure?

Tokenization could structurally change financial infrastructure and the organization of financial services but may not eliminate the need for intermediaries. Traditional markets rely on intermediaries such as custodians, central securities depositories, and central counterparties to coordinate activity across fragmented infrastructures and maintain trust in the transaction process. While distributed ledgers and smart contracts may automate some operational functions, many activities may continue to require governance, legal accountability, risk management, and regulatory oversight (Cabedo and others 2026). In this box, intermediation refers primarily to how trading, clearing, settlement, custody, and related services are organized and delivered rather than to the underlying economic functions of intermediaries such as liquidity provision or market-making.

Still, tokenization could change the organization of market structure substantially. Today, many FMIs and service providers are vertically integrated, operating both the infrastructures (platforms) on which transactions occur and the assets and services performed on that infrastructure. Tokenization could allow some functions to be provided more independently on shared platforms, encouraging competition (Budau and Tourpe 2024; Adrian and others 2026). For example, a central clearing counterparty (CCP) today typically operates the infrastructure through which parties are authorized and new contracts novated and cleared while also performing the associated risk-management functions. In tokenized markets, a CCP could focus on contract novation and risk management, with these services delivered on a shared market infrastructure rather than a platform operated by the CCP itself.

Tokenization could reshape the structure of intermediation across the asset life cycle, although it remains uncertain which market model will ultimately prevail. One possibility is a single shared platform where all parties transact (IMF 2024). Such an arrangement could reduce the number of intermediaries involved and maximize the benefits of tokenization by enhancing the scope for programmability and reducing operational friction and transaction failures. However, a shared platform would also create concentration risks and would require participants to agree on common governance arrangements and operating protocols.

A more likely outcome in the medium term may be the emergence of multiple ledgers and networks serving different markets and assets (IMF 2024). In such an environment, market participants could still benefit from the shared state within individual networks and platforms. However, while participants and assets within one network and platform may easily trade with each other, distributed ledger technology networks are not inherently interoperable.

This structure requires new mechanisms that provide coordination layers across ledgers and networks, such as bridges, and oracle services. Bridges and other interoperability solutions facilitate the technical communication needed to enable transfers across otherwise separate ecosystems. Oracle providers supply external information from outside a ledger—including prices, interest rates, reference data, and corporate actions—to smart contracts operating on other distributed ledgers. However, these additional layers create a trade-off among competition, resilience, and efficiency. As the number of ledgers increases, so does the need for bridges and interoperability mechanisms, potentially making the system operationally more fragile and fragmenting liquidity across different platforms.

Different ledger configurations may lead to an outcome in which infrastructure becomes increasingly concentrated in a small number of dominant networks that effectively act as private "public utilities." Concentration may reduce some operational and cybersecurity risks compared with highly fragmented architecture. However, a small number of network operators may acquire substantial influence over market rules, pricing structures, and access conditions. The resulting market structure may be more efficient but not necessarily more competitive. Entities that remain legally responsible for critical functions of FMIs are still required (Cabedo and others 2026).

This box was prepared by Manisha Patel, Kleopatra Nikolaou, and Mindaugas Leika.

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Box 3.2. Tokenized Repos and Broker-Dealer Balance Sheets

Distributed ledger technology (DLT) is widely seen as boosting repo market efficiency through improved collateral mobility, with knock-on benefits for dealer balance sheet capacity. One use case for tokenized repos, as reflected in the growth of platforms such as Broadridge's Distributed Ledger Repo, is allowing transactions to be settled with greater precision, including on an intraday basis and over weekends. Rather than defaulting to overnight cycles, cash and collateral could exchange at a pre-agreed time, allowing dealers to shorten the time a position occupies balance sheet capacity. Moreover, by providing an instrument for immediate liquidity provision for short intervals, intraday repo can reduce precautionary liquidity buffers that cover intraday funding shortfalls, lowering effective balance sheet usage (DTCC 2026; Galper 2026; TBAC 2026).

However, much of dealers' current balance sheet efficiency comes from netting, not settlement speed. In the conventional repo market, dealers have designed their operations around matched trades to reap maximum benefits from netting procedures, that is, the ability to offset cash and securities flows, so that only a net balance needs to be settled (Bowman, Huh, and Infante 2024). This approach materially reduces gross settlement volumes and intraday liquidity needs.

Shorter settlement cycles can reduce bilateral netting opportunities (McLaughlin 2023). As settlement moves closer to real time, the share of transactions that can be netted could fall substantially, leaving a dealer running a matched book exposed to gross bilateral positions and higher balance sheet and liquidity needs. This may be particularly relevant in arrangements involving multiple intraday atomic bilateral settlements, which can require participants to prefund transactions by holding the full amount of cash or securities needed for settlement.

If transactions increasingly settle outside central clearing counterparties (CCPs), multilateral netting benefits may also decline. Unlike a decentralized DLT environment, CCPs centralize trading exposures, enabling the offset of positions across all clearing participants through multilateral netting. By contrast, DLT-based market structures, in their purest form, push toward gross, atomic, bilateral settlement. While CCPs could benefit from adopting tokenization and DLT technologies to enhance collateral management, margining, and post-trade processes, the extent to which netting efficiencies are preserved depends on whether central clearing remains an integral part of the market structure (Eurex 2025). Overall, the efficiencies gained from faster settlement may come at the cost of lower netting efficiency.

Programmable batching could partly restore the efficiency gains from netting, albeit at the cost of settlement speed. Tokenized market infrastructure can use smart contracts to separate the timing of trade execution from the timing of settlement. Instead of settling each transaction immediately, trades can be grouped and settled periodically in batches, allowing offsetting positions to be netted against each other. This can reduce the amount of cash and securities needed for settlement and partly recover the efficiency benefits of today's market infrastructure. Evidence from equity trading suggests that, combined with central clearing, such arrangements may preserve substantial netting efficiencies, even with settlement windows as short as one hour in an equity-trading setting (McLaughlin 2023).

Both traditional and tokenized repo market data suggest that demand for intraday funding remains limited. In the United States, a very small share of traditional bilateral repo trades are intraday transactions (Figure 3.2.1, panel 1). Similarly, the use of Federal Reserve daylight overdrafts, a form of intraday credit, has remained at historically low levels (Figure 3.2.1, panel 2). Anecdotal evidence points to a similar pattern in Europe, where same-day trades account for a small share of repo activity, despite some recent growth.

Taken together, these findings suggest that the net effect of tokenized repo on broker-dealer balance sheet utilization can be constrained by the loss of netting efficiencies. Settlement speed alone is unlikely to determine net benefits. Instead, specific design choices embedded in tokenized infrastructure—particularly the extent to which such infrastructure preserves or recreates opportunities for bilateral or multilateral netting alongside faster settlement—remain key.

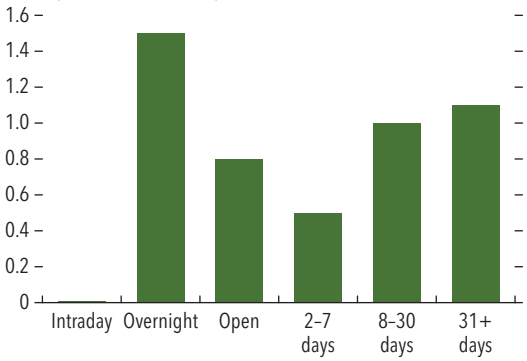
This box was prepared by Kleopatra Nikolaou.

Box 3.2 *(continued)*

Figure 3.2.1. Funding Volumes in Repo Markets

Intraday repo is negligible in the US noncleared, bilateral repo market segment.

1. Outstanding Repo Volumes, by Tenor
(Trillions of US dollars)

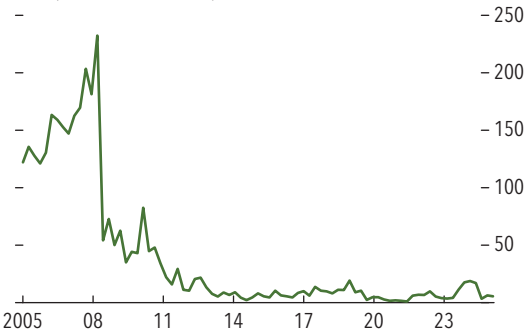


Sources: OFR 2026; and authors' analysis.

Note: Data are from July 1, 2025, through March 31, 2026. Values are average daily outstanding.

Daylight overdrafts from the Federal Reserve have dwindled considerably since the global financial crisis.

2. US Federal Reserve Peak Overdrafts
(Billions of US dollars)



Source: Board of Governors of the Federal Reserve System.

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Box 3.3. Selected Experiences in Hong Kong SAR with Building a Tokenized Bond Market through Iterative Infrastructure Development

Hong Kong SAR is one of the leading jurisdictions in tokenized government bonds, with cumulative issuance of about US$2.2 billion. Its experience is notable for the continuous exploration of new features in each issuance.

A Sequenced Transition from Pilot Issuance to Scalable Infrastructure

The first issuance in 2023 was designed to test whether tokenized bonds could be issued and settled in practice, both legally and operationally. The bond was issued by the Government of Hong Kong SAR and tokenized through Goldman Sachs's Digital Asset Platform, while the Central Moneymarkets Unit of the Hong Kong Monetary Authority handled clearing and settlement. Investors received digital tokens representing beneficial interests in the bond, and transactions were settled on a T+1 basis through the simultaneous exchange of securities and platform-specific cash tokens representing a claim for fiat in Hong Kong dollars against the Hong Kong Monetary Authority. While technically successful, the pilot also exposed a key limitation: investors or their custodians had to join the platform to participate creating "islands" disconnected from broader market infrastructure.

The second issuance in 2024 addressed this constraint by introducing a dual-access model. Investors could participate directly through the distributed ledger technology platform or indirectly through Central Moneymarkets Unit (CMU) and its external linkages, including Euroclear and Clearstream. The transaction also expanded to four currencies and reached HK$6 billion equivalent in issuance size. It was also Hong Kong SAR Government's first on-chain native bond issuance. Records on platform of claims against CMU, in the form of settlement tokens, were used for issuance's settlement. By leveraging existing infrastructure and linkages to Euroclear and Clearstream, the issuance expanded its reach to a broader global investor base.

The 2025 issuance further scaled the model. For the Hong Kong dollar and renminbi tranches, the option to settle using tokenized central bank money (in the form of e-HKD and e-CNY) was introduced alongside traditional settlement rails. This demonstrated the potential for tokenized central bank money in wholesale securities settlement and underscored that, for now, multicurrency tokenized settlement depends on a combination of instruments.

Implications and Remaining Constraints

Hong Kong SAR's experience points to two broader lessons. First, bond tokenization delivers limited market value if it is implemented as a standalone technology layer; digital platforms need to connect with existing market infrastructure that can contribute to scalability. Second, deep and liquid secondary markets require more than tokenized issuance alone. They also require sufficient issuance volume, broader investor participation, and trading conditions comparable with conventional bond markets.

This box was prepared by Jose De Luna Martinez and Xuege Zhang. Data sources: authors' calculations and HKMA press releases.

Glossary

anti-money laundering	Laws, regulations, and controls designed to prevent money laundering.
bridge	A mechanism that enables interoperability by connecting two or more distributed ledgers, allowing for the transfer of information and assets between them while preserving the integrity and consistency of those assets.
combating the financing of terrorism	Measures to detect and prevent terrorist financing.
composability	The ability of tokenized assets, liabilities, smart contracts, and protocols to be combined and reused across applications.
DLT	Distributed ledger technology, a shared database in which multiple participants maintain synchronized records without a single central administrator. Data can be shared or distributed to varying degrees, and control of those data can be decentralized to varying degrees.
oracle	A system that securely supplies and verifies off-chain real-world data (for example, macroeconomic data) on-chain.
platform	A software infrastructure provider that creates, issues, manages, and tracks tokens.
RWA	Off-chain assets—such as bonds, funds, real estate, and commodities—represented on a digital ledger as tokens.
tokenized reserves	A form of central bank reserves represented—"tokenized"—or natively issued on distributed ledger technology. Sometimes used interchangeably with wholesale central bank digital currency.
TradFi	TradFi (traditional finance) refers to regulated financial markets and services whose core business models are not predicated on distributed ledgers. This includes most banks, payment and remittance providers, insurers, investment firms, pension funds, and others.

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ISBN 979-8-22-905567-3



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