INTERNATIONAL MONETARY FUND

# GLOBAL FINANCIAL STABILITY REPORT

Steadying the Course: Uncertainty, Artificial Intelligence, and Financial Stability

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OCT

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# CONTENTS

## Tables



## Figures

## Online-Only Annexes

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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.

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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 under the general direction of Tobias Adrian, Director. The project was directed by Mahvash Qureshi, Assistant Director; Jason Wu, Assistant Director; Charles Cohen, Advisor; Jay Sanat Surti, Division Chief; Nassira Abbas, Deputy Division Chief and Chapter 3 co-lead; Caio Ferreira, Deputy Division Chief; Sheheryar Malik, Deputy Division Chief; Mario Catalán, Deputy Division Chief and Chapter 2 co-lead; Dirk Jan Grolleman, Deputy Division Chief and Chapter 3 co-lead; Benjamin Mosk, Senior Financial Sector Expert and Chapter 3 co-lead; and Andrea Deghi, Financial Sector Expert and Chapter 2 co-lead. It benefited from comments and suggestions from the senior staff in the MCM Department.

Individual contributors to the report were Rafael Barbosa, Yuhua Cai, Mustafa Oğuz Çaylan, Yingyuan Chen, Fabio Cortes, Mohamed Diaby, Gonzalo Dionis Fernandez, Andrew Ferrante, Deepali Gautam, Sanjay Hazarika, Esti Kemp, Johannes S. Kramer, Harrison Samuel Kraus, Jiayi Li, Yiran Li, Xiang-Li Lim, Li Lin, Corrado Macchiarelli, Saurav Mazumdar, Kleopatra Nikolaou, Tatsushi Okuda, Sonal Patel, Silvia Loyda Ramirez, Francesco de Rossi, Patrick Schneider, Puja Singh, Richard Stobo, Gabriela Elizabeth Conde Vitureira, Jeffrey David Williams, Tao Wu, Dmitry Yakovlev, Mustafa Yasin Yenice, Aki Yokoyama, and Aleksandr Zotov. Stefano Giglio of Yale University and Ian Dew-Becker of the Federal Reserve Bank of Chicago served as expert advisors for Chapter 2. Markus Pelger of Stanford University served as an expert advisor for Chapter 3. Monica Devi, Javier Chang, Lauren Kao, and Srujana Sammeta 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 service from Grauel Group and Absolute Service, Inc.

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, 2024. 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 October 8, 2024. 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.

# FOREWORD

The *Global Financial Stability Report* (*GFSR*) has repeatedly highlighted how the financial regulatory reforms implemented since the global financial crisis have helped support global financial stability. Strengthened supervision and regulation, better crisis management preparedness and resolution processes, enhanced data collection, and a macroprudential approach to financial sector oversight have raised the financial sector's resilience to the multitude of shocks experienced in recent years.

Good policymaking, however, is a forward-looking activity. This is especially relevant today, as the structure of the global financial system is undergoing substantial transformations, most notably with the growing participation of nonbanks in financial intermediation (NBFI). While these changes have been in train for some time, the magnitudes are becoming ever larger, with several drivers: (i) constraints imposed by postcrisis regulations on banks' leverage have encouraged diversification and the transfer of risk to other financial intermediaries; (ii) pension funds, insurance companies, and sovereign wealth funds have grown from 50 percent of global GDP to close to 90 percent over the past two decades, with much of their assets deployed to nonbanks; and (iii) new digital technologies are revolutionizing how financial services are distributed, how credit is evaluated, and how trading and market making are conducted.

This evolving nature of the financial sector landscape has positive implications for financial markets and economies worldwide. Market-based finance and nonbank credit intermediation have generated alternative sources of financing for firms, better capital allocation, and greater market efficiency through capital markets activity, private equity and private credit, hedge funds, and high-frequency market making and trading. The growth of NBFI can also strengthen prospects for financial stability. A broader set of financial intermediaries with different risk profiles, time horizons, and expertise avoids overreliance on banks, increases competition, provides diversification to borrowers and investors, and creates mechanisms for risk transfer away from the banking system. These benefits, however, are unevenly distributed across countries at the moment, with many advanced, emerging market, and developing economies remaining bank-centric and standing to benefit from further development of NBFI and market-based finance.

While these benefits are likely sizable, reaping them requires policy steps to contain risks to global financial stability. Past GFSRs, for instance, have discussed vulnerabilities arising from liquidity mismatches in open-ended mutual funds, highly leveraged trading strategies used by hedge funds, and opaque interconnectedness in the broad NBFI sector. The GFSR has also shown that, as nonbank financial institutions become vital to intermediation in core financial markets—such as government and corporate bonds—the availability of market liquidity in times of stress has come into question. Recent episodes of stress have required central banks to intervene. International standard setters are making progress in enhancing NBFI resilience. It is paramount that these international policy initiatives continue expeditiously and that national authorities implement them in a timely and consistent manner.

Enhancing the resilience of the financial sector is particularly relevant in the current context, where both economic and policy uncertainty are elevated against a backdrop of rising geopolitical risks. As shown in Chapter 2, economic uncertainty increases downside risks to future growth, asset prices, and bank lending. Additionally, uncertainty can trigger cross-border spillover effects through trade and financial linkages.

## Thinking Through the "Future of Finance"

With the financial sector continuing to transform, it is imperative that policymakers think through the "future of finance." Technological innovation in financial activities can increase efficiency and competition, while increasingly disrupting financial services traditionally provided by banks. Novel lending modalities for private credit are likely to continue growing,

artificial intelligence may support further growth in NBFI (see Chapter 3 of the *GFSR*), and digital banks are growing in systemic importance.

Policymakers must ensure that the balance between benefits and risks in this new state of financial intermediation remains appropriate. Traditionally, *prudential regulation* of nonbanks tends to be either absent or less strict because they do not take deposits from retail investors and largely do not have recourse to central bank backstops. However, with the growth in the relative size of NBFI and its close linkage with the banking sector, more substantive externalities may be generated, potentially requiring novel policy approaches. The regulatory framework needs to be proportionate to the systemwide risks posed by different institutions and acknowledge that risk-taking is needed for financial intermediation, as someone—not only central banks—should be there to "catch the falling knife" during stress times. However, policy must weigh the costs and benefits of such risk-taking carefully, and with broad financial stability objectives in mind. The discussion of the August 2024 turmoil in this edition of the GFSR is a recent illustration of this challenge. When volatility spiked, many leveraged investors reached risk limits and received increased margin calls, which forced them to rapidly close their positions. Such practices helped protect individual institutions from a potential worsening of the turbulence but also caused nonlinear effects that likely exacerbated the sell-off. Therefore, regulation and supervision of NBFI also need to consider broader financial stability objectives.

Making the most of the ongoing transformation and ensuring that the financial sector can sustainably fuel economic growth requires further progress on several fronts:

- **Expand data collection:** Regulators need to collect more comprehensive data on NBFIs that allows a better evaluation of the risks to global financial stability and a more complete map of the interlinks of the sector. Information on the use of leverage and asset holdings will allow the development of more effective policies to address systemic risks while avoiding stifling financial innovation.
- **Increase transparency:** Nonbanks tend to be relatively opaque and often do not provide enough information to investors and the public. The growing potential for spillovers from NBFIs to the broader financial system and the increasing participation of retail investors require more transparency. Conduct requirements, including public disclosure, are also important to support market discipline and price discovery.
- **Design appropriate liquidity facilities and backstops:** Liquidity stress in the NBFI sector can spill over to the broader financial sector—as seen during stress episodes such as the March 2020 dash-for-cash—and eventually to the real economy. In such circumstances, central banks may face a trade-off between providing support to NBFI—and therefore safeguarding financial stability in the short term—and introducing moral hazard whereby NBFIs can rely on central banks to resolve the fallout from excessive risk-taking. If market stress occurs during periods of high inflation and monetary policy tightening, another trade-off could also arise between the central bank mandates of financial and price stability. Consequently, it is necessary to develop mechanisms for central bank support that minimizes moral hazard and encourages nonbanks to internalize liquidity risks. Communication plans that avoid central banks being perceived as working at cross purposes, such as purchasing assets to restore financial stability while tightening monetary policy to fight inflation, are also critical.
- **Improve the financial "plumbing":** A diverse financial system requires an underlying "plumbing" structure that allows for the smooth movement of money and assets. Maintaining trust in the system requires ensuring that financial transactions are safely completed even in times of stress. It is therefore key to ensure that payments and settlements systems work effectively and securely. In this regard, it is first order to continue working toward ensuring interoperability (for example, that different systems and platforms work together seamlessly, especially on a cross-border basis) and integrating new technologies including artificial intelligence to enhance efficiency and security.
- **Enhance the resilience of central counterparties:** The international regulatory reform agenda after the global financial crisis called for the use of central counterparties (CCPs) for clearing certain types of derivatives. The shift toward CCPs created a more robust and transparent financial system but also increased their systemic importance, making it paramount to enhance their resilience. This requires ensuring that CCPs have enough resources to cover

potential losses, business continuity plans are in place, and recovery and resolution plans clearly outline the measures a CCP will take to restore its stability or wind down its operations if it fails. Margining requirements also need to be reviewed aiming not only to protect the CCP but also to consider the impact that margin and collateral calls during times of stress might have in the broader system.

- **Undertake a systemic approach to enhancing resilience of NBFI:** Vulnerabilities in the NBFI sector can amplify shocks and have systemic implications. For instance, liquidity mismatches in bond funds may add selling pressure in times of stress; significant increases in margin calls in the derivatives market may create systemic liquidity stress during times of elevated market volatility; and the failure of highly leveraged nonbanks, such as in the case of Archegos, might generate substantial losses for banks. Despite the potential for significant negative externalities from NBFIs, the prudential framework for NBFI in most countries is focused on specific institutions and sectors and does not include system-wide and cross-sectoral perspectives. The absence of a macroprudential perspective for nonbanks means that, during good times, risks in the NBFI sector can grow and create externalities throughout the financial system. It is necessary for the relevant authorities to coordinate more closely in order to ensure that sound governance structures, mechanisms, and processes to monitor NBFIs from a systemic perspective are in place. It is also necessary to sharpen existing tools and potentially develop new ones to address potential systemic risk.

This is a long and challenging list. In summary, the ask is to enhance the prudential framework to address systemic risks from a larger NBFI sector while also considering that leverage facilitates financial intermediation and that interconnectedness means more efficient capital mobility and allocation, which is the core role of the financial sector. The IMF is ready to continue working with its member authorities, other international finance institutions, and global standard-setting bodies to achieve these goals.

Tobias Adrian
*Financial Counsellor*

# EXECUTIVE SUMMARY

## Steadying the Course: Financial Markets Navigate Uncertainty

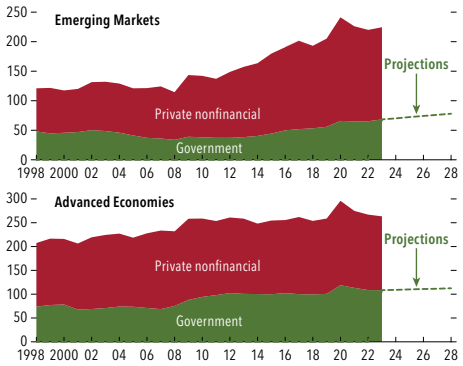
Since the April 2024 *Global Financial Stability Report*, global economic activity has moderated, and inflation has continued to slow. With monetary easing under way among major central banks, financial conditions have remained accommodative, emerging markets have remained resilient, and asset price volatility has stayed relatively low, on net. Near-term financial stability risks, according to the IMF's one-year-ahead growth-at-risk measure, remain contained at around the 40th historical percentile. However, accommodative financial conditions that keep near-term risks at bay also facilitate the buildup of vulnerabilities—such as lofty asset valuations, the global rise in private and government debt (Figure ES.1), and increased use of leverage by nonbank financial institutions—which raises risks to financial stability in the future.

These mounting vulnerabilities could amplify adverse shocks, which have become more probable due to elevated economic and geopolitical uncertainty amid ongoing military conflicts and the uncertain future policies of newly elected governments. In particular, the widening disconnect between uncertainty and market volatility (Figure ES.2) increases the chance of sudden surges in volatility and sharp asset repricing, which could be amplified by the vulnerabilities. As shown in Chapter 1, the market turmoil in early August 2024—when stock market volatility spiked in both Japan and United States (Figure ES.3) and global asset prices declined significantly—provided a glimpse of the violent reactions that can ensue when spikes in volatility interact with the use of leverage by financial institutions to create nonlinear market reactions and hasten sell-offs.

Indeed, Chapter 2 quantitatively demonstrates that further rises in economic uncertainty could increase downside risks to future growth, asset prices, and growth in bank lending. For example, assuming global real economic uncertainty jumps by an amount equivalent to its rise during the global financial crisis, the downside outcome (specifically, the 10th percentile) of one-year-ahead global real GDP growth worsens by 1.2 percentage points (Figure ES.4). This effect is stronger when macrofinancial vulnerabilities are more elevated or when market volatility is more disconnected from uncertainty. Uncertainty can also trigger cross-border spillover effects through trade and financial linkages.

This *Global Financial Stability Report* delves into the financial vulnerabilities and imbalances challenging financial stability, highlighting the urgency for policymakers to address them.

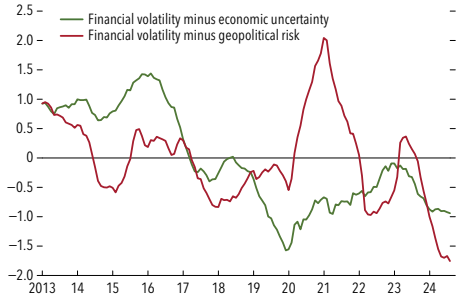
**Figure ES.1. Aggregate Debt-to-GDP Ratios**
*(Historical z-scores)*




Sources: Bank for International Settlements; and IMF staff calculations.

Note: Dashed green lines are government debt-to-GDP ratio projects based on the IMF's Global Debt Database.

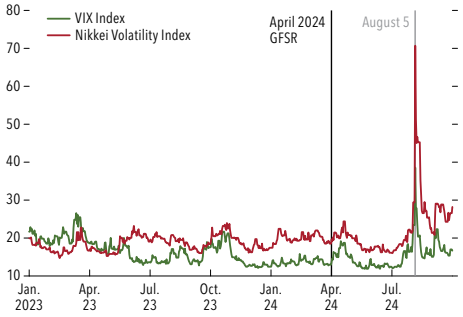
**Figure ES.2. Difference of the Standardized Measures of Financial Volatility, Economic Uncertainty, and Geopolitical Risk**
*(Historical z-scores)*




Source: Bloomberg Finance L.P.

Note: "Economic uncertainty" is from Baker, Bloom, and Davis (2016); "financial volatility" is the average of the Chicago Board Options Exchange Volatility Index (VIX), High-Yield Corporate VIX, and Currency VIX; "geopolitical risk" is from Caldara and Iacoviello (2022). Figure shows 12-month moving average values of the differences in z-scores.

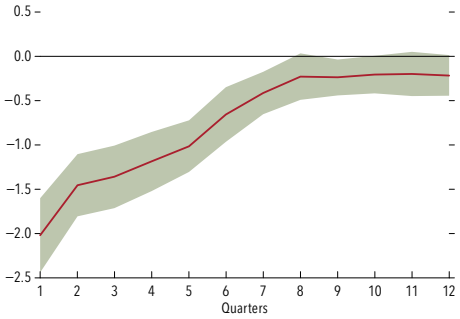
**Figure ES.3. Equity Market Volatility in Japan and the United States**
*(Percent)*




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

Note: The Chicago Board Options Exchange Volatility Index, or VIX, is the benchmark measure of US stock market volatility, based on S&P 500 options. Its Japanese counterpart is the Nikkei Stock Average Volatility Index.

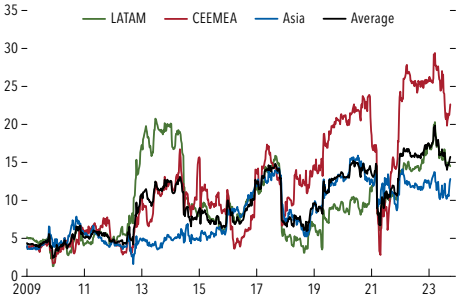
**Figure ES.4. Effect of Real Economic Uncertainty on Growth-at-Risk by Horizon**
*(Percentage points, annualized)*




Sources: IMF, Global Debt and International Financial Statistics databases; Organisation for Economic Co-operation and Development, Main Economic Indicators database; and IMF staff calculations.

Note: The figure shows the average effect of a one-standard-deviation increase in a real economic uncertainty index on the 10th percentile of the future real GDP growth distribution for a panel of advanced and emerging market economies. See Chapter 2 for a more detailed description.

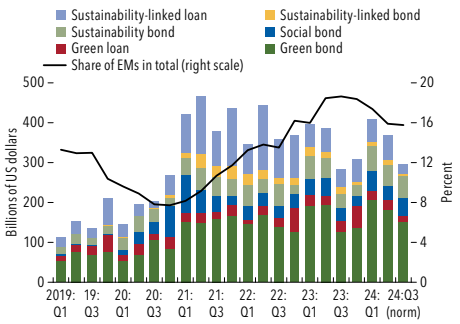
**Figure ES.5. Spillover to Emerging Market Term Premiums From US Term Premiums**
*(Percent)*




Sources: Based on Diebold and Yilmaz 2009; Bloomberg Finance L.P.; and IMF staff calculations.

Note: The figure shows the proportion of variation in emerging market term premiums explained by shocks to US term premiums (TPs). CEEMEA = Central and Eastern Europe, the Middle East, and Africa; EMs = emerging markets; LATAM = Latin America.

**Figure ES.6. Global Issuance of Sustainable Debt**
*(Billions of US dollars, left scale; percent, right scale)*




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

Note: The share of EMs shows the four-quarter moving average of total issuance in EMs as a percentage of global issuance, and the Q3 2024 value is based on the latest available information as of August 2024. "24:Q3 (norm)" refers to the normalized value for Q3 2024, based on issuance during July–August 2024.

## Vulnerabilities and Imbalances

High levels and rapid growth of sovereign debt remain a global challenge, with many jurisdictions failing to achieve their longer-term debt-stabilizing primary balances. In many advanced economies, increasingly large shares of issuances of government debt will need to be absorbed by price-sensitive buyers amid ongoing quantitative tightening by their central banks, potentially increasing bond market volatility. Emerging markets and frontier economies with weak and worsening fiscal buffers have seen their sovereign bond and credit default swap spreads increase more than those of other jurisdictions, making debt servicing more challenging.

Emerging markets have continued to demonstrate resilience since the April 2024 *Global Financial Stability Report*. Central banks have remained focused on domestic economic and inflation conditions in setting monetary policy, relying on adjustments in exchange rates to mitigate external headwinds. With major advanced economies set to ease monetary policy, pressure on emerging markets could moderate in the near term. Further ahead, however, elevated uncertainty regarding trade policies and geopolitics and a slowing growth outlook in China, a key trading partner for many emerging markets, could make preserving financial stability in emerging markets more challenging. Portfolio flows may become more volatile and access to international funding may be more difficult, especially for frontier economies. Indeed, interest rate spillovers from advanced economies to emerging markets have increased over the past decade, as changes in the 10-year US term premium—risk premiums investors demand to hold longer-term securities—have explained an increasing share of the changes in the term premiums of 10-year emerging market bonds (Figure ES.5).

Global issuance of sustainable debt has rebounded in 2024. However, emerging markets account for just 13 percent of year-to-date issuance (Figure ES.6), and the share of emerging market sustainable debt denominated in local currencies is small. Underinvestment in climate finance could delay mitigation and adaptation efforts and could challenge financial stability in the future.

Even if global interest rates are declining, many firms would find debt servicing a challenge in coming years. Although solid economic activity and healthy corporate balance sheets have kept margins robust for some firms, defaults have steadily risen as weaker firms have struggled. Some midsized companies borrowing at high interest rates in private credit markets are becoming increasingly strained and have resorted to payment-in-kind methods, effectively deferring interest payments and piling on more debt. In addition, trade restrictions and geopolitical events are likely to affect corporations through higher

input costs and a reduced capacity to make interest payments. Despite mounting signs of credit deterioration, corporate bonds have continued to trade within tight spreads by historical standards, leading to pricing misalignments that indicate an increased risk of an abrupt repricing of credit risk.

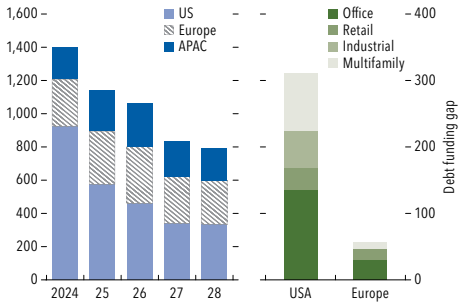
Although stability risks from residential real estate appear contained in most countries, pressures on the commercial real estate (CRE) sector remain acute. Misalignment in prices and fundamentals point to further corrections in the CRE market, especially the embattled office sector. Funding could be withdrawn, pushing down prices and putting more financial institutions under pressure in an adverse feedback loop (Figure ES.7). Both banks with outsized concentrations in CRE and nonbank investors such as real estate investment trusts may experience strains.

The global banking sector has remained resilient, with ample capital and liquidity buffers. Although nonperforming loan ratios have increased for some forms of lending, such as consumer credit cards, automobile loans, and CRE, overall asset quality has not deteriorated significantly. However, net interest margin and bank profitability could be negatively impacted by interest rate cuts, and the temporary sell-off of some banks' stocks in early August highlighted some of the risks ahead, particularly for a relatively large tail of weaker institutions facing challenges related to their business models (Figure ES.8).

The market turmoil in early August serves as another example of how nonbank financial intermediations (NBFIs) can transmit strains through the financial system and amplify stress, as the rapid unwinding of leveraged positions can generate liquidity imbalances that increase volatility. With the growth of open-ended bond funds, hedge funds, and private credit, the use of leverage among several NBFI segments is increasing. Data gaps, which hinder authorities' ability to assess the vulnerabilities associated with nonbank leverage and to identify large and concentrated positions, present a key challenge in addressing these issues.

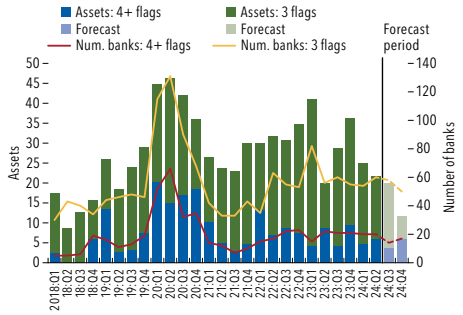
Use of artificial intelligence (AI) in capital market activities may further support the growth of NBFIs. Chapter 3 shows that although adoption of AI in trading and investment activities is still at a relatively early stage, it could accelerate in the coming years: For example, the share of applications related to AI and machine learning in patent filings in asset management has risen impressively in recent years (Figure ES.9). Although adopting these new technologies may bring efficiencies and cost savings to both banks and NBFIs, the latter are generally more agile and subject to fewer constraints in using AI. Indeed, NBFIs are already dominating several asset markets

**Figure ES.7. Maturing Commercial Real Estate Debt and Funding Gap**
*(Billions of US dollars)*



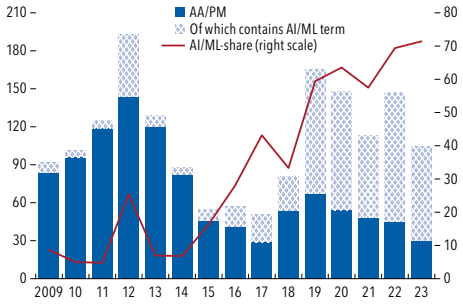

Sources: AEW; EUROPACE AG/Haver Analytics; Trepp; and IMF staff calculations.
Note: APAC = Asia and Pacific.

**Figure ES.8. Banks Signaling Vulnerabilities in Three or More Areas of Risk**
*(Total assets, trillions of US dollars)*




Sources: Visible Alpha; and IMF staff calculations.
Note: Forecast period is based on aggregate consensus analysts' forecasts. Num. = number of.

**Figure ES.9. Patents in Asset Management Related to Artificial Intelligence**
*(Number; percent, right scale)*




Sources: World Intellectual Property Organization, PATENTSCOPE database; and IMF staff calculations.
Note: Aggregate patents may not be an exhaustive accounting of all patents filed with national authorities and are limited to those available in the PATENTSCOPE database. See Chapter 3 for details. AA = asset allocation; AI = artificial intelligence; ML = machine learning; PM = portfolio management.

amenable to electronic trading. Widespread adoption could also worsen financial fragilities in the future, through potentially higher volatility during market stress, more opacity, and challenges in monitoring how AI is used in capital markets and by whom, reliance on a few key AI service providers increasing operational risks, and growing risks of cyber and market manipulation.

## Policy Recommendations

Although near-term financial stability risks appear contained, vulnerabilities are mounting in the financial system. Now is the time for policymakers to act to limit fragilities. For central banks, clear communications that the path of monetary policy should not react excessively to any individual data point would help reduce uncertainty. Where growth and inflation momentum are set to continue, central banks should gradually ease monetary policy toward a more neutral stance. Where inflation remains stubbornly above targets, central banks should push back against overly optimistic investor expectations for monetary policy easing.

With sovereign debt in many countries substantially above prepandemic levels, fiscal adjustments should focus primarily on credibly rebuilding buffers to keep financing costs reasonable, help anchor medium-term inflation expectations, and contain risks of sovereign rating downgrades. For countries with less fiscal space, the credibility of fiscal plans is imperative to prevent cliff effects in ratings that could adversely affect financing conditions. Sovereign borrowers in frontier economies and low-income countries should strengthen efforts to contain risks associated with their debt vulnerability through, among other measures, communications with creditors, multilateral cooperation, and support from the international community.

With the continued growth of NBFIs, from open-ended investment funds to hedge funds and private funds, the risks from increased maturity mismatches and leverage underscore the need for more active regulatory and supervisory engagement. It is crucial to enhance reporting requirements for NBFIs and to strengthen policies that mitigate vulnerabilities and mechanisms of amplification stemming from nonbank leverage. Improving NBFIs' liquidity preparedness, implementing the Financial Stability Board's agreed-upon standards, and enhancing stress testing for nonbanks could reduce systemic risks.

Continued buildup of debt and elevated economic uncertainty underscore the need to strengthen the macroprudential policy framework to contain excessive risk taking in the nonbank financial sector and to ensure that capital and liquidity buffers in banking systems are adequate to support the provision of credit through periods of stress. Policymakers should tighten macroprudential tools to increase resilience against a range of shocks while avoiding a broad tightening of financial conditions.

Continued vigilance is warranted to monitor vulnerabilities of corporations and the CRE sector. To ensure resilience within the banking system and to inform decisions regarding capital adequacy, authorities should conduct stress-testing exercises that incorporate scenarios involving trade restrictions, geopolitical events, and significant declines in CRE prices. Given the increasingly significant role of private credit in financial markets, enhancing reporting requirements to improve monitoring and management of risks is imperative.

The tail of weak banks in the global financial system and the risk of contagion to healthy institutions underscore the need to be ready to address financial instability. It is crucial to ensure that supervisors are equipped to intervene early and that banks are prepared to access central bank liquidity. Further progress on adopting and implementing frameworks for recovery and resolution is critical for addressing weak or failing banks without undermining financial stability or risking public funds. Full, timely, and consistent implementation of international standards remains important in enhancing prudential frameworks.

# IMF EXECUTIVE BOARD DISCUSSION OF THE OUTLOOK, OCTOBER 2024

*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 October 8, 2024.*

Executive Directors broadly agreed with staff's assessment of the global economic outlook, risks, and policy priorities. They welcomed the continued growth resilience of the global economy in the face of recurring shocks. Directors highlighted that monetary policy has managed to bring about disinflation with so-far limited cost to output and employment, increasing the likelihood of a smooth landing. They noted, however, that the recovery remains uneven and that growth, while steady, remains underwhelming, reflecting weak productivity growth. They noted that mediocre medium-term growth and rising debt trajectories increase the risk that the global economy will become entrenched in a low-growth, high-debt environment. Against this backdrop, they agreed that, as monetary policy becomes less restrictive, a renewed emphasis on gradual and sustained fiscal consolidation, coupled with ambitious structural reforms, is needed, with due regard for country-specific conditions.

While most Directors agreed that risks to the outlook are now tilted to the downside, a number of Directors also cautioned against overstating the deterioration in the balance of risks. Directors noted, in particular, risks from potentially more persistent underlying inflation, increased geopolitical conflicts and tensions in different regions, and the intensification of protectionist policies that could weigh down on medium-term growth. Directors noted that while the monetary easing underway has helped keep financial conditions accommodative and near-term financial stability risks at bay, this may in turn facilitate the buildup of financial vulnerabilities. They stressed that the widening disconnect between subdued financial market volatility, relative to elevated economic and geopolitical uncertainty, increases the chances of sharp disorderly repricing. Further volatility surges could impair financial stability as well as investment and growth, especially in emerging market and developing economies heavily reliant on external financing. Directors also noted still-acute pressures on commercial real estate sectors and ongoing property sector adjustments in some countries. Some Directors highlighted upside risks to the outlook, including a stronger recovery in investment in advanced economies, better performance in some emerging market economies, and economic benefits from artificial intelligence.

Directors called on central banks to carefully calibrate monetary policy to restore price stability, avoiding a tighter-than-necessary stance that could weaken growth and employment. They emphasized the importance of remaining data dependent and clearly communicating policy decisions. Directors stressed that, in economies where core inflation persists at above-target levels, policy rates should remain in restrictive territory until underlying inflation shows clear signs of moving toward target. They agreed that moving to a more neutral stance is appropriate in economies where inflation is unambiguously abating, long-term inflation expectations remain anchored, and output gaps are closing. Given elevated economic and policy uncertainty, Directors called on central banks to stand ready to mitigate the potential disruptive impacts of foreign exchange volatility and capital flows, including by leveraging, where appropriate, the country-specific guidance provided by the IMF's Integrated Policy Framework.

Directors welcomed that the global banking sector has remained resilient and emphasized that further progress on adopting and implementing frameworks for recovery and resolution is critical for addressing weak or failing banks. They concurred that full, timely, and consistent implementation of international standards, including Basel III, remains important to enhance prudential frameworks. Directors stressed the need

to improve non-bank financial institutions' liquidity preparedness, implement the Financial Stability Board's agreed-upon standards, close data gaps, and enhance stress testing for non-banks to reduce systemic risks.

Directors generally called for sustained, gradual, and carefully designed fiscal adjustments amid elevated public debt and associated risks. They noted that larger adjustments than currently envisaged in many countries are needed to stabilize debt and build necessary buffers against adverse shocks. Directors stressed that the pace of adjustment should be calibrated to country-specific economic conditions, should ensure continuous support to the most vulnerable and protect public investment, and should be well communicated and anchored in credible medium-term frameworks. They stressed that strengthening fiscal governance should be a priority and would help reduce the debt buildup from contingent liabilities and arrears.

Directors stressed the importance of advancing structural reforms to boost growth and accelerate the green transition, noting the need to enhance the social acceptability of these reforms through enhanced communication and trust-building mechanisms. They emphasized that targeted reforms are needed to boost productivity, enhance competition, improve human capital, and increase labor force participation. Directors reiterated the need to advance with climate mitigation and adaptation reforms. In this context, some Directors emphasized the need to strengthen efforts to increase climate finance for adaptation, especially for vulnerable countries exposed to significant climate risks.

Directors underscored that stronger multilateral cooperation is essential to facilitate debt restructuring processes, mitigate risks from geoeconomic fragmentation, and accelerate the green transition in a manner consistent with World Trade Organization rules.

CHAPTER 1

# STEADYING THE COURSE: FINANCIAL MARKETS NAVIGATE UNCERTAINTY

## Chapter 1 at a Glance

- Since the April 2024 *Global Financial Stability Report*, near-term financial stability risks have remained contained. Global economic activity has moderated, inflation has slowed, emerging markets have remained resilient, financial conditions have remained accommodative, and volatility in financial markets has remained low, on net.
- However, accommodative financial conditions facilitate the further buildup of vulnerabilities. Asset valuations appear lofty, debt has climbed globally, and the use of leverage among nonbank financial intermediaries has increased. Fragilities in corporate and commercial real estate sectors remain.
- These imbalances could worsen future downside risks by amplifying adverse shocks, which have become more probable due to the widening disconnect between elevated economic uncertainty—stemming from ongoing military conflicts and the uncertain future policies of newly elected governments—and low financial volatility. Market turmoil in early August, though short-lived, served as a reminder of how quickly volatility can catch up to uncertainty, force the unwinding of leveraged trades, and trigger feedback loops between asset prices and deleveraging.
- Certain types of nonbank financial intermediaries amplified the early August turmoil and warrant more active supervisory engagement. The banking system has remained sound, although a weak tail of banks is still confronting exposures to troubled sectors like commercial real estate and ongoing business model challenges.
- Emerging markets have broadly demonstrated continued resilience, but preserving financial stability could be more challenging going forward. The slowing growth outlook in China and fragilities in its financial system are a key downside risk to the global economy. Access to funding for frontier markets and economies with weaker fiscal buffers may become more constrained. Underinvestment in climate finance would delay climate mitigation and adaptation in emerging markets and developing economies, with financial stability implications to come.

**Policies to Address Financial Vulnerabilities**

- For central banks, clear communications that the path of monetary policy should not react excessively to any individual data point would help reduce uncertainty. Where growth and inflation momentum are set to continue, central banks should gradually ease monetary policy toward a more neutral stance. Where inflation remains stubbornly above targets, central banks should push back against overly optimistic investor expectations for monetary policy easing that would further stretch asset prices.
- With levels of sovereign debt in many advanced and emerging market economies substantially above prepandemic levels, fiscal adjustments should primarily focus on credibly rebuilding buffers to keep external financing costs reasonable and to help anchor medium-term inflation expectations. Sovereign borrowers in frontier economies and low-income countries should strengthen efforts to contain risks associated with high levels of debt vulnerability.
- Policies that address nonbank leverage and liquidity mismatches need to be strengthened. Renewed efforts to implement internationally agreed-upon bank prudential standards in a timely and consistent manner would reduce opportunities for regulatory arbitrage across borders and sectors.
- Authorities should expand recovery and resolution plans, ensure that financial institutions are prepared to access central bank liquidity, and intervene early to prevent future strains in the financial sector from turning systemic.

## Introduction

Since the April 2024 *Global Financial Stability Report*, global economic activity has moderated, and inflation has continued to slow. With major central banks undertaking monetary easing and modest risks of an imminent global recession (see the October 2024 *World Economic Outlook*), asset prices have stayed buoyant and financial conditions accommodative. Major emerging markets have remained resilient and have continued the proactive policymaking that has helped mitigate the multitude of shocks since the COVID-19 pandemic. Near-term risks to financial stability, according to the IMF's Growth-at-Risk (GaR) model, have remained contained at around 40th historical percentile.

However, accommodative financial conditions could prompt a further buildup of several vulnerabilities that worsen downside risks in the future. First, asset valuations appear lofty in equity and corporate credit markets, driven by buoyant investor sentiment seemingly undeterred by a slowdown in earnings growth of firms and the continued deterioration in more fragile segments of the corporate and commercial real estate (CRE) sectors. Second, government debt continues to mount, a consequence of still-expansionary fiscal policies in many countries (see the October 2024 *Fiscal Monitor*). A number of advanced economies are increasing the issuances of government bonds while central banks are conducting quantitative tightening, portending larger swings in bond yields. In emerging markets, sovereign credit spreads have become sensitive to countries' fiscal buffers, and certain weaker jurisdictions may have trouble refinancing debt maturing on the horizon at sustainable interest rates. Third, the use of leverage by financial institutions, especially by nonbank financial intermediation (NBFI) like hedge funds and private credit funds, have risen; maturity mismatches at some open-ended funds and insurers have widened.

These imbalances could worsen future financial stability risks by amplifying adverse shocks, which have become more probable due to elevated economic and geopolitical uncertainty. Much of this uncertainty is because half of the world's population has elected or will elect new governments this year, and future policies that these governments will enact—ranging from fiscal to trade to geopolitical—are in many cases difficult to pin down. Heightened uncertainty may also reflect the unpredictability of ongoing military conflicts, notably in the Middle East and in Ukraine. Adverse shocks are not only more probable; the widening disconnect between uncertainty and relatively low volatility in financial markets suggests that they could trigger a spike in volatility, bringing it in line with prevailing uncertainty.[1] This could raise value-at-risk measures, bind risk limits, and trigger margin calls, practices that can protect individual institutions from turbulent markets but may also cause nonlinear effects that hasten sell-offs.[2] For example, broker–dealers may find their balance sheets constrained by risk limits in volatile markets, curtailing their intermediation capacities (see FSB 2017; Adrian, Boyarchenko, and Shachar 2017), while NBFIs facing margin calls might be forced to deleverage by selling assets into a falling market.

The severe, albeit short-lived, market turmoil in early August provided a glimpse of the violent reactions markets can incur when volatility catches up to uncertainty. Global stock prices fell sharply (the Nikkei index declined by 12 percent on August 5)—what began as investors' unwinding of carry trades that borrowed yen to fund long positions in global risk assets was amplified by selling of risk assets following the Bank of Japan's monetary policy decision in late July and a weaker-than-expected July US labor market report. Equity volatility surged from compressed levels, contributing to further sell-offs (see Box 1.3) before subsiding over subsequent days.

Looking ahead, the uncertainty-volatility disconnect may increase downside risks to growth, as quantified in Chapter 2. When shocks arrive and volatility rises, hedge funds may further unwind leveraged positions, and algorithmic traders—which have gained significant market shares in various asset classes—may sell in falling markets to protect themselves against further losses, exacerbating price declines. Recent advancements in artificial intelligence and machine learning suggest that algorithms may play a larger role in future episodes of turbulence, as discussed in Chapter 3.

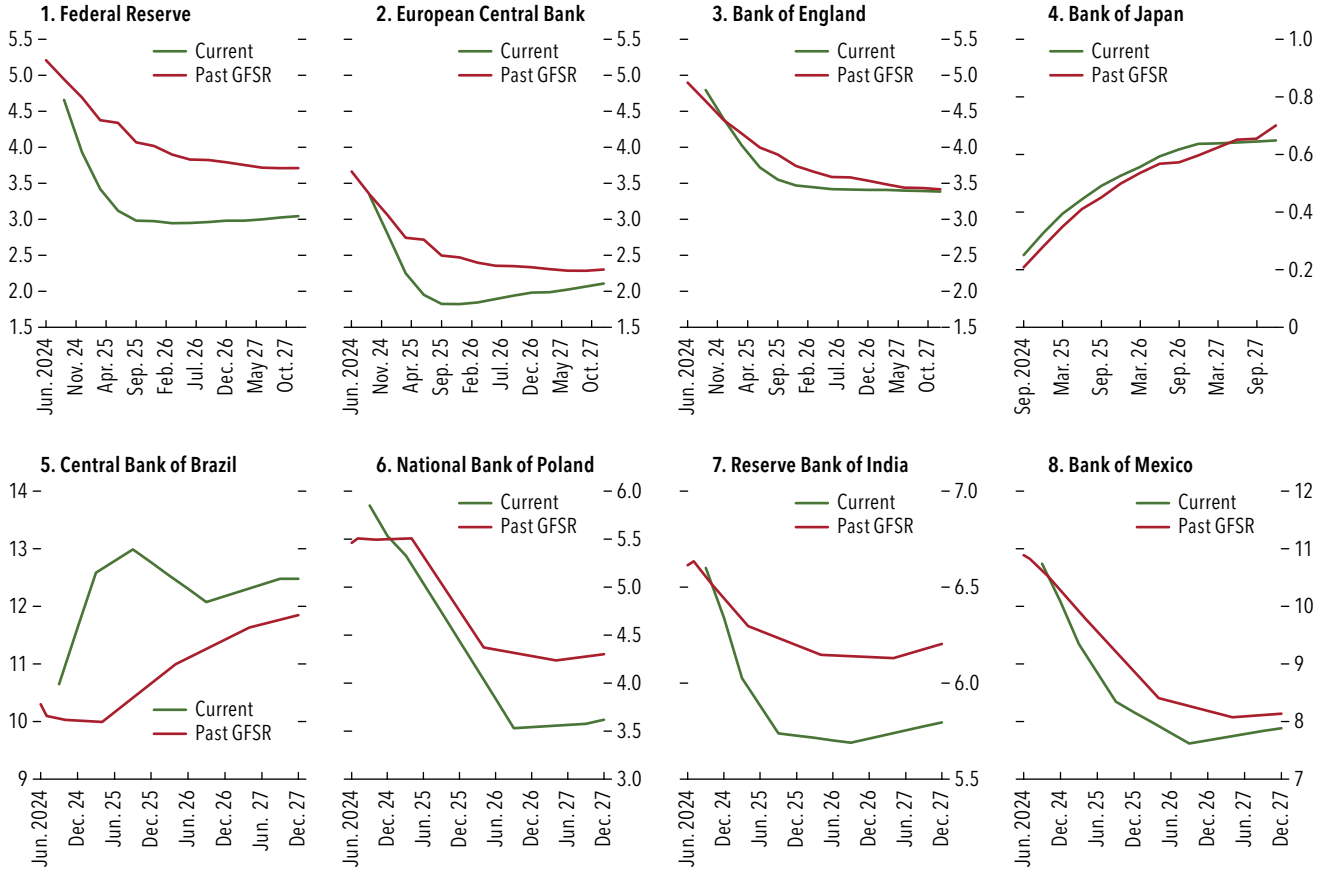
Emerging markets have continued to demonstrate resilience since the April 2024 *Global Financial Stability Report*, notably against pressures on their currencies. A number of major emerging market central banks remain focused on domestic economic and inflation conditions

[1]The asset price literature generally predicts a close link between uncertainty about economic growth and volatility of asset prices. See, for example, the seminal paper of Lucas (1978), in which asset prices and their returns are more volatile the higher the variance of consumption growth because the stochastic discount factor for asset prices is a function of intertemporal marginal utility from consumption. Deviations between the two are explained by the presence of risk premiums in financial markets. The current gap between uncertainty and volatility indicates low risk premiums and investor complacency.

[2]See Abboud and others (2021) for an example of value-at-risk rising with market volatility and Brunnermeier and Pedersen (2009) for a model of the procyclicality between margin requirements and volatility.

**Figure 1.1. Market-Implied Expectations of Policy Rates for Selected Advanced and Emerging Market Economies**
*(Percent)*

Market pricing suggests most major central banks will cut policy rates this year.




Sources: Bloomberg Finance L.P.; Federal Reserve; national authorities; and IMF staff calculations.

Note: Expected policy rates shown here are based on interest rate futures or swaps. Information conveyed by these markets may deviate periodically from other measures of policy rate expectations, such as those obtained from surveys of professional forecasters. Such deviations could reflect, for instance, the time-varying influence of risk premiums embedded in yield curves. GFSR = *Global Financial Stability Report*.

in setting monetary policy, relying on exchange rate adjustments to mitigate external headwinds. With major advanced economies having eased monetary policy, pressure on emerging markets could moderate in the near term. Further ahead, however, uncertainty regarding trade and geopolitical policies could make preserving financial stability more challenging. Financial flows may become more volatile and access to international funding may be more difficult, especially for frontier economies. The slowing growth outlook in China and fragilities in its financial system are key downside risks to the global economy, as the measured policy support so far has yet to stabilize the housing market downturn and restore consumer and business confidence.

This *Global Financial Stability Report* delves into the financial vulnerabilities and imbalances and offers recommendations on how policymakers can address them.

## Monetary and Financial Developments

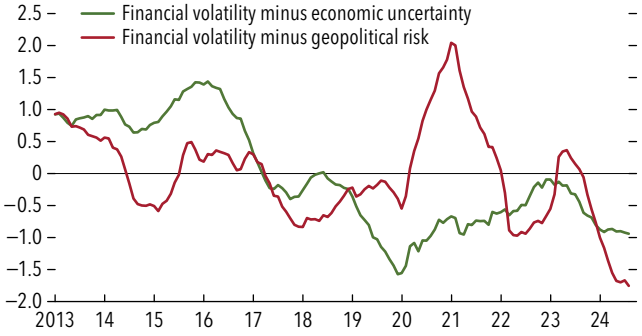
### Monetary Policy Is Expected to Ease Globally

With postpandemic supply chain disruptions and commodity price pressures having largely dissipated and labor markets coming into better balance, inflation has continued to move toward central banks' targets, and most have begun to ease monetary policy. Since the April 2024 *Global Financial Stability Report*, the European Central Bank, Bank of England, the Federal Reserve, and Riksbank have cut policy rates. Meanwhile, the Bank of Japan raised its policy rate in July, supported by broad-based wage growth projected to support sustainable and stable achievement of its inflation target (Figure 1.1). That said, the pace and extent of easing delivered by different central banks are expected to vary, with inflation still above target in many regions.

## Figure 1.2. Economic Uncertainty and Market-Based Inflation Expectations

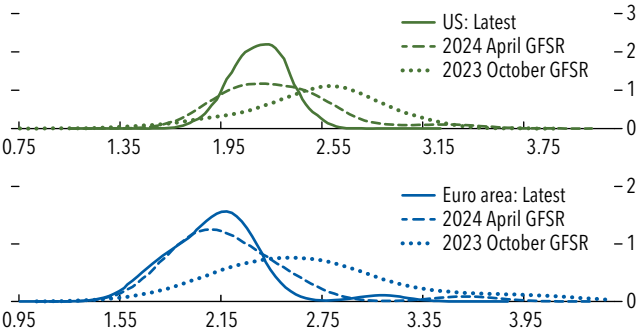
Economic uncertainty and geopolitical risk are elevated, while financial market volatility is compressed.

**1. Difference of the Standardized Measures of Financial Volatility, Economic Uncertainty, and Geopolitical Risk**
*(Differences in historical z-scores)*



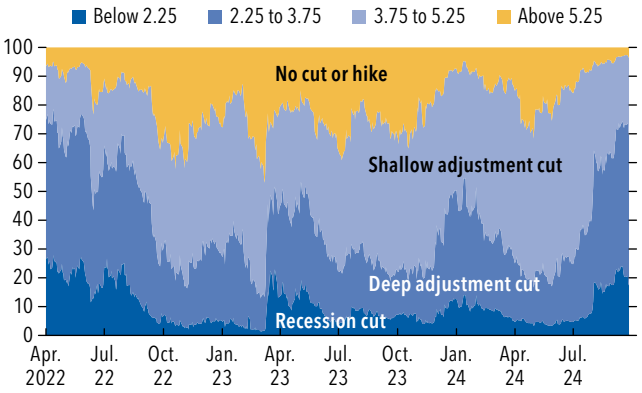

Upside risks to the inflation outlook over the coming year remain meaningful.

**2. Distribution of Analysts' Survey Forecasts: One-Year-Ahead Core Inflation**
*(Percent; probability density)*

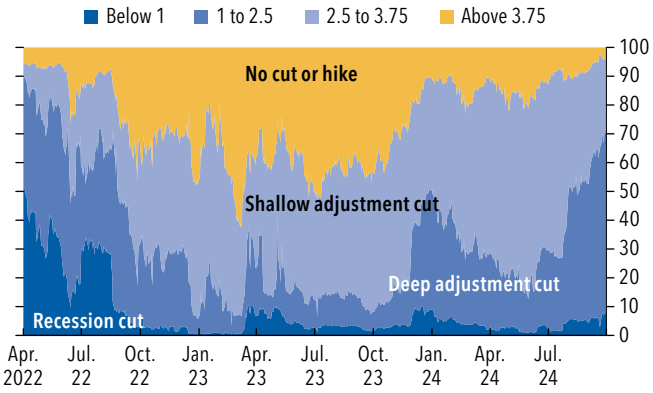



Interest rate derivatives suggest that both shallow and deep adjustment cuts are possible.

**3. Option-Implied US Monetary Policy Scenarios over the Next Two Years**
*(Probability in percent)*




**4. Option-Implied Euro Area Monetary Policy Scenarios over the Next Two Years**
*(Probability in percent)*




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

Note: In panel 1, "economic uncertainty" is the index of Baker, Bloom, and Davis (2016); "financial volatility" is the average of the Chicago Board Options Exchange's Volatility Index, High-Yield Corporate Volatility Index, and Currency Volatility Index; and "geopolitical risk" is the index of Caldara and Iacoviello (2022). All series are *z*-scores (from 2012 to 2024) of 12-month-moving-average values and then differences were taken. In panel 2, distributions are constructed, using kernel densities, from survey forecast responses submitted by economists and market participants to Bloomberg Finance L.P. Forecasts for core consumer price and personal consumption expenditures indices are shown for the euro area and the United States, respectively. GFSR = *Global Financial Stability Report*.

Markets are pricing in multiple cuts in policy rates among major central banks over the remainder of this year and during the next (Figure 1.1, panels 1–4). The Federal Reserve is expected to cut its policy rate by almost 150 basis points by the end of 2025, more than was expected at the time of the April 2024 *Global Financial Stability Report*. In emerging markets, policy paths have generally been revised downward, however, with some central banks having paused their cutting cycles as interest differentials with respect to advanced economy central banks have narrowed, or raised rates to ensure convergence of inflation to target.

### Financial Market Volatility Disconnected with Economic Uncertainty

Expectations for lower policy rates globally and investor optimism have helped compress financial market volatility despite elevated economic policy uncertainty and geopolitical risks. The wedge between volatility and uncertainty (Figure 1.2, panel 1) is currently quite large, raising the risk that volatility could surge when adverse shocks hit to exacerbate vulnerabilities. More specifically, inflation uncertainty is still elevated somewhat, as analysts forecast that upside risks to inflation—especially a 2 percent or higher core inflation in the year ahead—

remain in both the euro area and the United States (Figure 1.2, panel 2). Reflecting the wide range of possible economic outcomes ahead, investors are increasingly attuned to signs of economic or labor market slowdown, with some even discussing recessionary probabilities. As a result of the dual sets of risks, financial markets are pricing in substantial likelihood of shallow cuts as well as deep adjustments, especially in the United States (Figure 1.2, panels 3 and 4).

## Yield Curve Disinversion Partly Reflects Higher Expected Debt Levels

Long-term interest rates in most advanced economies and many emerging markets have changed little, on net, since the April 2024 *Global Financial Stability Report* (Figure 1.3, panel 1). In some major emerging market economies, however, long-term rates have seen upward pressure from rising term premiums (Figure 1.3, panels 2 and 3), possibly reflecting higher uncertainty about the pace and timing of policy easing by advanced economies and volatility in exchange rates (see "Global Monetary Policy Synchronization Leads to More Spillovers to Emerging Markets").

Since the April 2024 *Global Financial Stability Report*, the slope of the US yield curve—for example, the difference between 10-year and 2-year Treasury yields—has steepened, with the yield curve disinverting after a historically long period of inversion (Figure 1.3, panel 4). In general, yield curves can steepen when short-term rates fall faster than long-term rates (that is, during a so-called bull steepening) or when longer-term rates rise faster than short-term ones (a so-called bear steepening). Bull steepening episodes have historically been associated with easing of monetary policy and with policy rates being cut, whereas increasing term premiums—both real risk premium and inflation risk premium components—have typically driven bear steepening episodes (Figure 1.3, panel 5). Since the start of the year, the expected path of short-term rates has declined, on net, but this has occurred alongside the term premium moving higher, with the inflation risk premium—reflecting the compensation investors require for bearing risks of inflation uncertainty—notably displaying continued persistence (Figure 1.3, panel 6).

These changes to the yield curve are fairly unique and could lead to indeterminacy in investors' asset allocation and more volatile markets. Historically, bear steepening episodes have been more favorable to risk assets than bull steepening episodes (Figure 1.4, panel 1) because investors expect strong growth momentum, supporting corporate earnings, and spurring demand for equities.[3] Past bull steepening episodes, conversely, have typically occurred when investors expected a deteriorating economic outlook, thereby weighing on risk assets. That said, the recent steepening in the US yield curve is somewhat unique in featuring a decline in the expected policy rate path, as in bull steepening episodes, coupled with a rise in term premium, as in bear steepening episodes, of a broadly comparable magnitude (see Figure 1.3, panel 5). These two forms of steepening will likely continue to work in tandem: The Federal Reserve will probably continue to cut rates. At the same time, Treasury issuance, which is projected to remain high in coming years to fund government deficits, may spur fiscal uncertainty and concerns about the buildup of inflationary pressures (evidenced, in part, by persistent inflation risk premium; see previous discussion and Figure 1.3, panel 6), in turn exerting upward pressure on term premiums (Figure 1.4, panel 2; see also "Quantitative Tightening Has Proceeded in an Orderly Manner So Far").[4] Amid already-high economic uncertainty, the two steepening types operating in tandem may add to the murkiness of signals about the trajectory of economy.

## Quantitative Tightening Has Proceeded in an Orderly Manner So Far

Ongoing quantitative tightening has *so far* unfolded in an orderly fashion, reflecting the carefully calibrated pace and scope of balance sheet reduction by central banks aimed at maintaining smooth functioning of government bond and short-term funding markets. Group of Ten central banks have reduced their balance sheets (Figure 1.5, panel 1) from a peak of $28 trillion in March 2022 to $21.5 trillion. The key tail risk that remains is that quantitative tightening may drain bank reserves too much, causing the type of squeeze in funding markets exemplified by the US repo market turmoil in September 2019 (see the October 2019 *Global Financial Stability Report*). Currently, many central banks are engaging in quantitative tightening simultaneously, raising the odds that this type of risk can spill over more widely—for example, inadequate bank reserves in one jurisdiction may end up

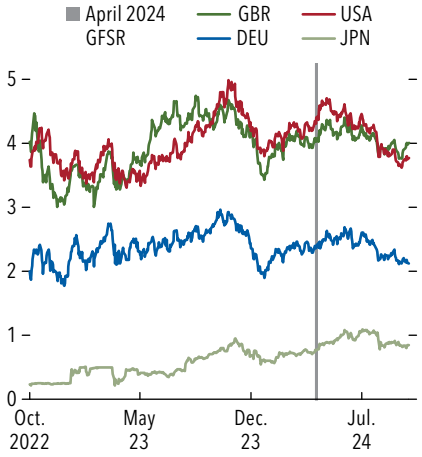
[3]Specifically, growth momentum is expected to more than offset negative effects of high long-term rates on corporate earnings, thereby leading to buoyant prices.

[4]Furthermore, long-term yields may also be bolstered by positive correlation between equity prices and bond yields, as can be expected during a period of high inflation uncertainty (see Aquilina and others 2024), rendering bonds a poor hedge for risk assets and in turn keeping term premiums high.

## Figure 1.3. Recent Developments in Longer-Term Interest Rates

Long-term rates remained broadly unchanged, on net, in most major advanced economies, and have moved up in many emerging markets since the April 2024 *Global Financial Stability Report*.

**1. Ten-Year Government Bond Yields for Selected Advanced Economies**
*(Percent)*

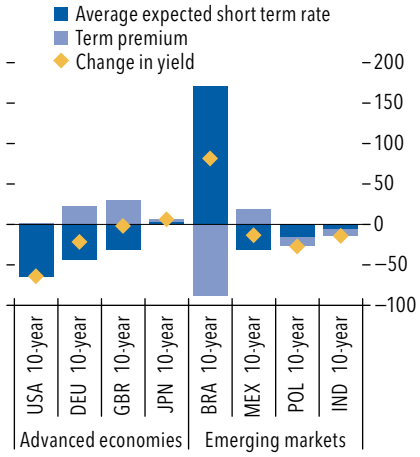



The US yield curve has disinverted after a long period of inversion ...

**2. Ten-Year Government Bond Yields for Selected Emerging Market Economies**
*(Percent)*


... with steepening reflecting both the falling expected policy rate path and rising term premiums.

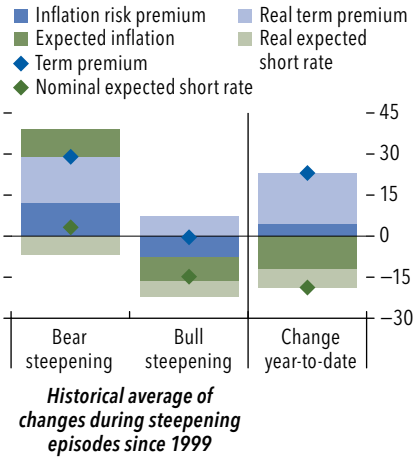
**3. Decomposition of Changes in 10-Year Bond Yields Since April 2024 GFSR**
*(Basis points)*




The inflation risk premium component of the term premium has displayed continued persistence.

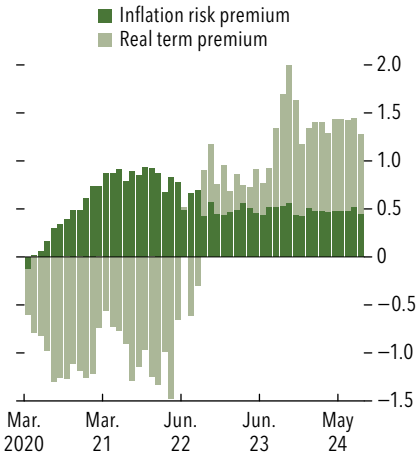
**4. Evolution of US Yield Curve Slope Since 1999**
*(Basis points)*


**5. Decomposition of Changes in US 10-Year Yields During Historical Steepening Episodes Versus During Recent Period**
*(Basis points)*




***Historical average of changes during steepening episodes since 1999***

**6. Inflation Risk Premium and Real Risk Premium Components of the US 10-Year Bond Yield**
*(Percent)*




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

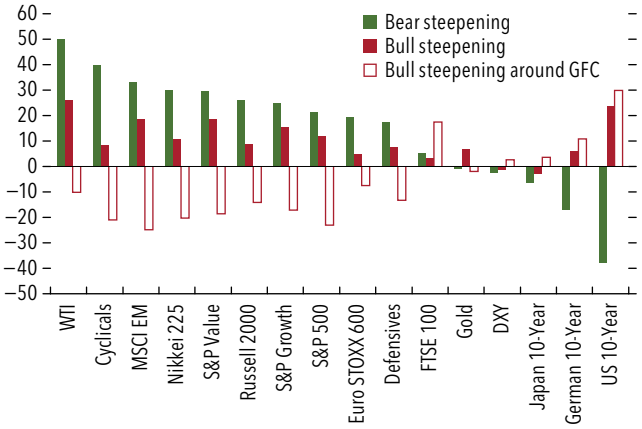
Note: Decomposition of bond yields into expected short-rate and term premiums in panel 3 follows the methodology of Adrian, Crump, and Moench (2013). In panel 4, the average reaction of the US 10-year government bond yield is calculated three months into a steepening episode since 2000. Steepening episodes are defined as in Goldman Sachs (2023). Joint decomposition of nominal and real yields into expected inflation, real expected short-term rate, inflation risk premium, and real term premium in panel 5 follow Abrahams and others (2016). Data labels in the figure use International Organization for Standardization (ISO) country codes. 2s10s = difference between 10-year and 2-year Treasury yields; GFSR = *Global Financial Stability Report*.

## Figure 1.4. Drivers of Steepening in the US Yield Curve

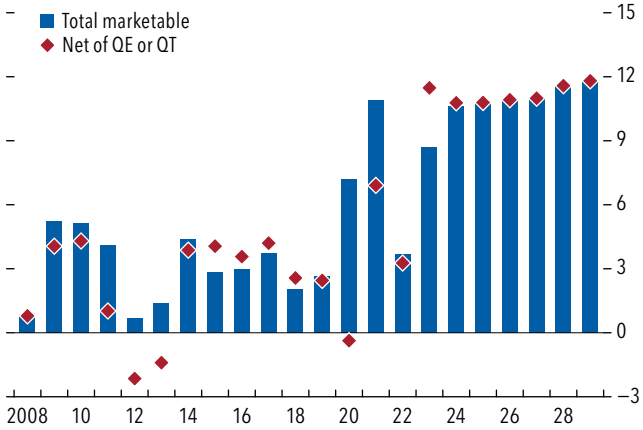
Bear steepening has favored risk assets more than bull steepening.

Net issuance of Treasuries is projected to remain elevated, possibly pushing up term premiums.

**1. Bear versus Bull Steepening Episodes for Asset Returns**
*(Percent)*




**2. Net Supply of Treasury Bonds Relative to GDP**
*(Percent, annualized average)*




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

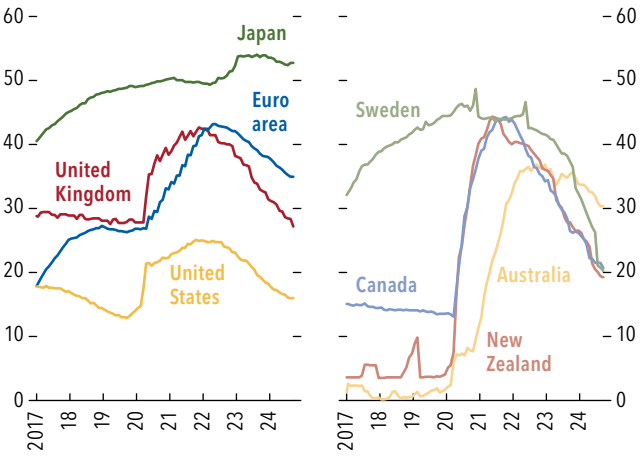
Note: Panel 1 shows the average annualized returns for selected assets over different steepening periods. Goldman Sachs (2023) defines the steepening episodes. Panel 2 shows net duration supply, expressed in terms of 10-year equivalent bonds net of domestic central bank purchases. Forecasts reflect consensus expectations for bond issuance and domestic Federal Reserve purchases. Higher values indicate deteriorating liquidity. DXY = US Dollar Index; FTSE = Financial Times Stock Index; GFC = global financial crisis; QE = quantitative easing; QT = quantitative tightening; WTI = West Texas Intermediate (crude oil).

## Figure 1.5. Shifts in Government Bond Buyer Base Toward Price-Sensitive Investors amid Progress on Quantitative Tightening

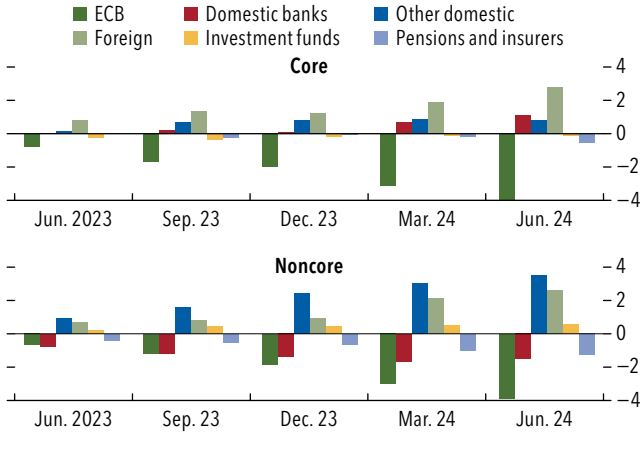
Since the April GFSR, advanced economy central banks continued reducing their footprint in domestic sovereign bond markets.

ECB's QT is shifting the EGB buyer base toward price-sensitive investors, with scarcity premium arising as banks are favoring core sovereign bonds.

**1. Central Bank Holdings as Share of Domestic Sovereign Bond Markets**
*(Percent)*




**2. Flows into Core and Noncore EGBs by Investor Type**
*(Percentage points)*



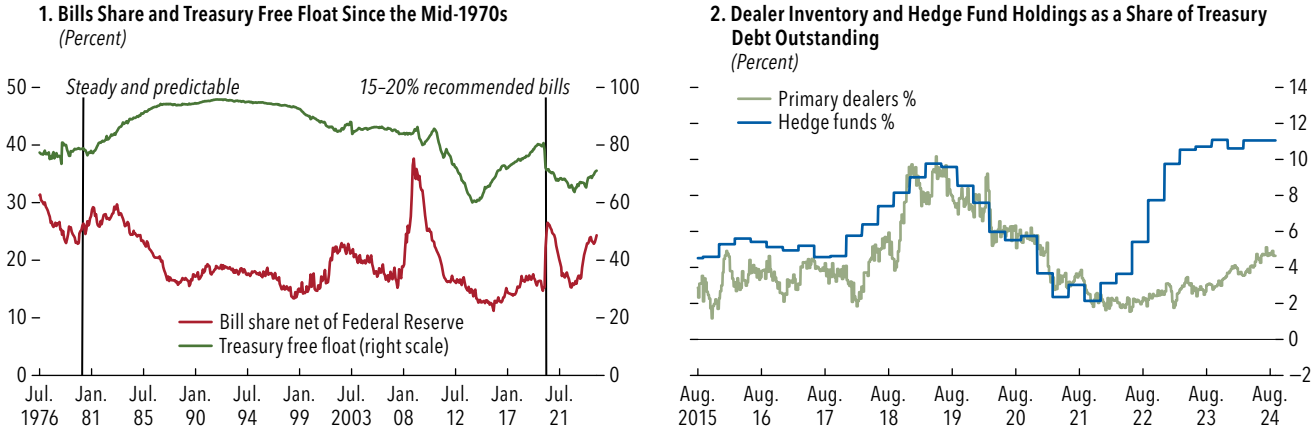

Sources: Bank of England; Bank of Japan; Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; European Central Bank; Federal Reserve System; national debt management offices; Reserve Bank of Australia; Reserve Bank of Canada; Reserve Bank of New Zealand; Swedish Riksbank; and IMF staff calculations.

Note: Panel 1 features eight central banks representative of the major bond holdings across the Group of Ten countries. Due to data limitations, panel 1 uses relative bond holdings (ignoring maturity profiles) to allow for cross-country comparison. Panel 2 shows cumulative flows using changes in nominal bond holdings relative to outstanding issued amounts of core and noncore EGBs using the ECB's Securities Holdings Statistics by Sector and Securities Issues Statistics databases. Domestic investors reflect aggregate debt holders within the euro area. ECB = European Central Bank; EGB = European government bond; GFSR = *Global Financial Stability Report*; QT = quantitative tightening.

**Figure 1.6. Expansion of Primary Dealers' Treasury Holdings amid Rising Free-Floating Securities and Share of Bills**

The share of bills in the market has risen amid more free-floating Treasury securities.

Primary dealers are increasingly warehousing longer-dated securities.




Sources: Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; Federal Reserve Bank of New York; Kuttner (2006); and IMF staff calculations.

Note: In panel 2, "Hedge funds" reflects the percentage share of Treasury securities held by households and nonprofit organizations–by and large composed of hedge funds–relative to outstanding marketable Treasury securities. "Primary dealer" reflects the percentage share of primary dealer positions in Treasury coupon securities relative to the corresponding outstanding issued amount.

amplifying funding pressures in others because globally active banks rely on interconnected funding markets. Continued vigilance on the part of central banks to monitor for possible strains in funding markets is needed to preemptively mitigate this tail risk.

Another risk is that quantitative tightening could increase bouts of volatility in government bond markets. As central banks reduce their holdings of government bonds, regardless of whether they are doing so using *active* or *passive*[5] methods, the buyer base of these bonds could continue to move toward more price-sensitive investors. In the euro area, the European Central Bank's reduced holdings of bonds of core issuers like Germany have been offset by more holdings by domestic banks and foreign investors (Figure 1.5, panel 2), who value German bonds for liquidity management and regulatory capital purposes. By contrast, for bonds of noncore issuers, reduced European Central Bank holdings are offset by "other domestic investors," which include households and the more price-sensitive hedge fund sector.[6] This trend would introduce more volatility in noncore bond markets; should government bond issuance increase—for example, to finance persistent fiscal deficits—higher volatility could be further amplified.

In the United States, quantitative tightening has increased the share of free float Treasury securities, or the portion of outstanding securities net of the Federal Reserve's holdings, which could exert an upward push on Treasury yields and volatility over time. Concurrently, the Department of the Treasury has increasingly issued more shorter-term debt to meet funding needs, which might lower borrowing costs in the near term, but could also expose the Treasury to higher future financing cost (Figure 1.6, panel 1).[7] As larger issuances have increased the prudence of other Treasury security buyers, only hedge funds and dealers have kept more securities on balance sheet

[5]Some—including the Bank of England, the Reserve Bank of New Zealand, and Riksbank—are taking an active approach by selling bonds alongside maturing assets, while others—including the Federal Reserve and European Central Bank—are taking a passive approach, by allowing bonds to roll off without reinvesting.

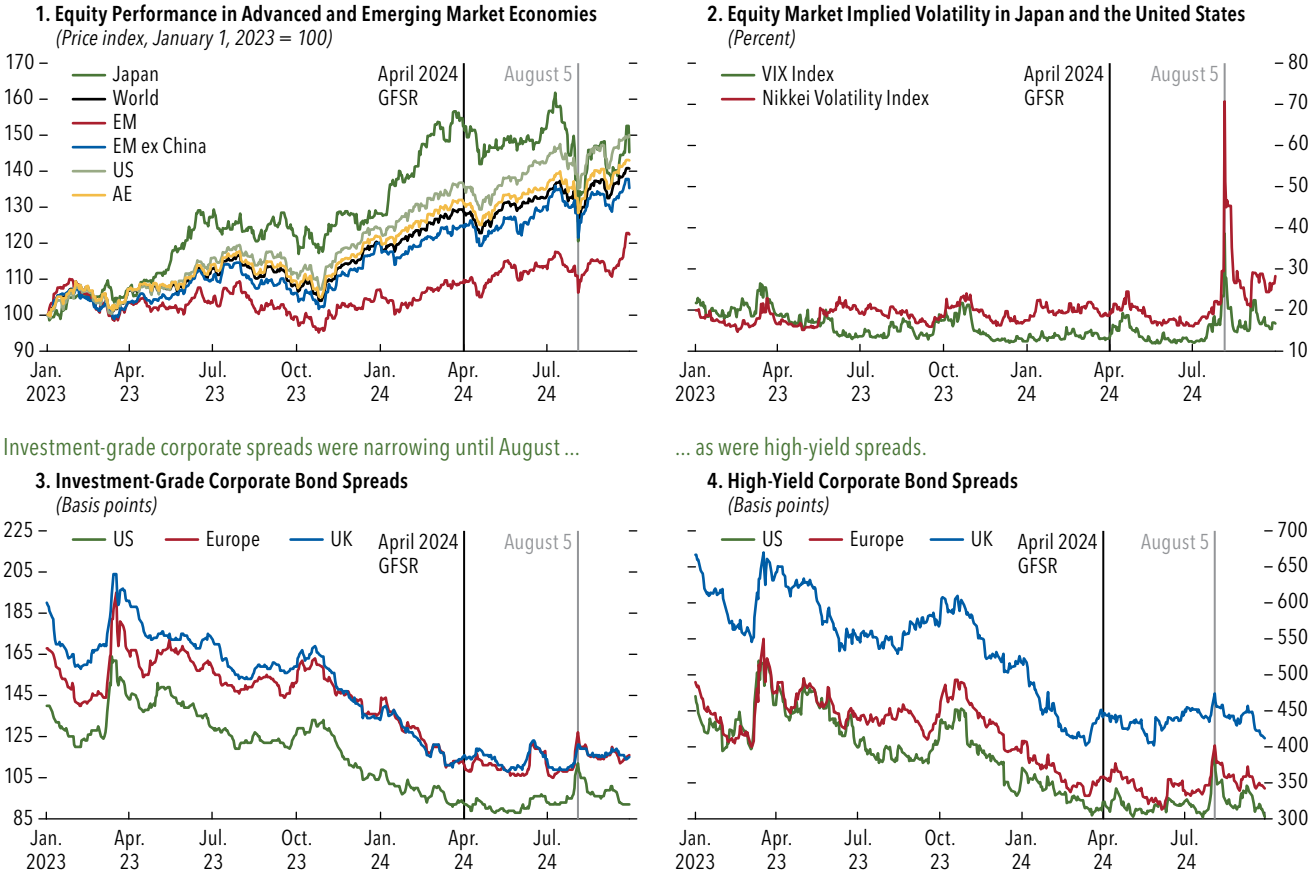
[6]For comparability with US flow of funds data, other domestic investors as holders of European Government Bonds include as categories households and domestic hedge funds, among others. For the increasing role of the latter, see also "Hedge Funds: Good or Bad for Market Functioning?" European Central Bank, blog post, September 23, 2024.

[7]Tentatively speaking, an economic backdrop of uneven normalization of inflation and potential economic deceleration amid unprecedented fiscal supply creates push and pull factors that induce higher volatility in Treasury yields. Some market commentators have linked this backdrop to a potential bear steepening (or bear twist), as investors increasingly favor intermediate maturities with Federal Reserve rate cuts coming into better focus. A historical outperformance of these securities over bills during previous easing cycles underscores this trend. Additionally, price-sensitive market participants remain apprehensive regarding longer-dated Treasury securities, whose real term premiums are being perceived amid the elevated fiscal supply as insufficient to offset the risks of interest rate changes during the life of the bond, as outlined in the April 2024 *Global Financial Stability Report*.

## Figure 1.7. Global Asset Prices

An equity rally was interrupted in August by economic slowdown concerns ...

... as implied volatility for equities spiked.




Investment-grade corporate spreads were narrowing until August ...

... as were high-yield spreads.

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

Note: Panel 1 uses the S&P 500 for the United States, Nikkei 225 for Japan, and corresponding MSCI indices for all other series. In panel 2, the Chicago Board Options Exchange Volatility Index, or VIX, is the benchmark measure of US stock market volatility, based on S&P 500 options. Its Japanese counterpart is the Nikkei Stock Average Volatility Index. Panels 3 and 4 employ option-adjusted spreads. Gray vertical lines in panels 1 through 4 mark the date of the early August sell-off peak (August 5). AE = advanced economies; EM = emerging markets; ex = excluding; GFSR = *Global Financial Stability Report*.

(Figure 1.6, panel 2).[8,9] Bloated dealer inventory presents a medium-term risk because in adverse market conditions where investors are selling Treasury securities (for example, if hedge funds were to unwind the Treasury basis trades as described in the April 2024 *Global Financial Stability Report*) primary dealers with larger Treasury inventories are more likely to face internal balance sheet constraints that could prevent them from absorbing the sales, worsening the sell-off.

[8]Unlike intermediaries such as brokers or primary dealers who might buy these securities to facilitate trading and liquidity in the market, end users, including pension funds, insurance companies, mutual funds, corporations, and individual investors, among others, are typically the ultimate holders of Treasury securities.

[9]Since the April 2024 *Global Financial Stability Report*, the rise in household Treasury holdings (primarily driven by hedge funds) has slowed, consistent with the increased warehousing by primary dealers shown in the latest Federal Reserve Board flow of funds statistics.

## Lofty Risk Assets Valuations Is a Vulnerability

The rally in global equity markets fueled by expectations of a global soft landing has continued since the April 2024 *Global Financial Stability Report*, although it was briefly interrupted by a severe but transitory sell-off in early August (Figure 1.7, panel 1). But even after accounting for solid economic and earnings outlook, equity valuations appear stretched in various parts of the world, which is a vulnerability to financial stability. Since April, Canada, China, and the United States have experienced the largest equity gains, with

performance in the latter predicated on an impressive run among information technology stocks. Signs of moderating inflation in early July prompted investors to rotate holdings into more rate-sensitive stocks, leading information technology stocks to underperform and small cap stocks to outperform notably. Then in late July and early August, the policy rate increase by the Bank of Japan was followed by worse-than-expected labor market data in the United States that renewed recession fears. These developments led to a brisk narrowing of the interest rate differential between Japan and the United States. This boosted the yen, which in turn reportedly led to a substantial unwinding of carry trades that used the yen as a funding currency to finance long positions in global stocks or emerging market currencies. An abrupt decline in stock prices around the world, along with a spike in volatility (Figure 1.7, panel 2; see also Box 1.3), ensued. Corporate bond spreads also widened for investment-grade and high-yield issuers in Europe and the United States after a long period of decompression (Figure 1.7, panels 3 and 4). NBFIs like momentum-following and commodity trading advisor hedge funds and algorithmic and quantitative traders reportedly contributed to the sell-off, as their strategies stipulated cutting of positions to stop losses (see "Hedge Funds Were Both Catalysts and Victims of the August Market Sell-Off").

Before the sell-off, positive earnings momentum and expectations of lower interest rates had pushed up stock prices since the April 2024 *Global Financial Stability* Report and equity risk premium has increased somewhat (see Figure 1.8, panel 1). But stock valuations are still lofty, risking abrupt corrections. Since January, the share of the Magnificent 7 (M7),[10] a group of large capitalization technology stocks, has increased from 20 to 30 percent of the overall S&P 500 index (market capitalization). Alongside evidence of an increase in correlation between the M7 and S&P (and within the M7) over recent months,[11] this would suggest that the overall index is more vulnerable to adverse developments among this group—that is, raising the level of concentration risk. In this regard, since 2023, there have been 69 days on which fewer than 150 stocks have moved in the same direction than the index (Figure 1.8, panel 2), signaling that headline index returns do not represent the performance of the majority of the constituents, as fewer stocks have dictated index movements.

More fundamentally, the S&P 500 is trading at a level above its historical upper quartile in terms of forward price-to-earnings ratio since 1990, suggesting that the market is expecting high earnings growth over the near to medium term. For this ratio to return to its historical 10-year average by 2026, earnings per share on of the S&P and Nasdaq would need to post compounded annual growth rates of close to 25 and 30 percent, respectively, which are far higher than current market expectations (Figure 1.8, panel 3); the MSCI World and MSCI Advanced Economy indices all require higher growth rates than current expectations to return to historical valuations, a sign that prices are lofty. By contrast, emerging market indices and the Russell 2000, an index of small capitalization stocks in the United States, are experiencing less pressure on current valuations, as required earnings growth to meet historical valuations is less than current expectations.

Declining inflation and expectations of US monetary policy easing led to a significant rotation across indices, with the Russell 2000 outperforming the Nasdaq by about 10 percentage points between the beginning of July and early August, as investors appear to shift from growth toward smaller stocks with less-demanding valuation (Figure 1.8, panel 4). However, as the equity market correction in early August showed, concerns about a slowing of the real economy disproportionally affect smaller stocks.

Market turbulence in early August has so far not affected emerging market assets significantly. Sovereign spreads for emerging market bonds denominated in US dollars have remained tight relative to spreads on investment-grade corporate bonds since the April 2024 *Global Financial Stability Report* (Figure 1.9, panel 1), and spreads between local currency bonds and some Latin American sovereigns have widened, with upward revisions to policy rate paths partly driving the movement (Figure 1.9, panel 2). The performance of emerging market equities has varied across countries this year, but for most countries, valuations remain below historical averages (Figure 1.9, panel 3). Various factors may challenge emerging market assets in the months ahead, including uncertainty induced by monetary policy in advanced economies—especially the United

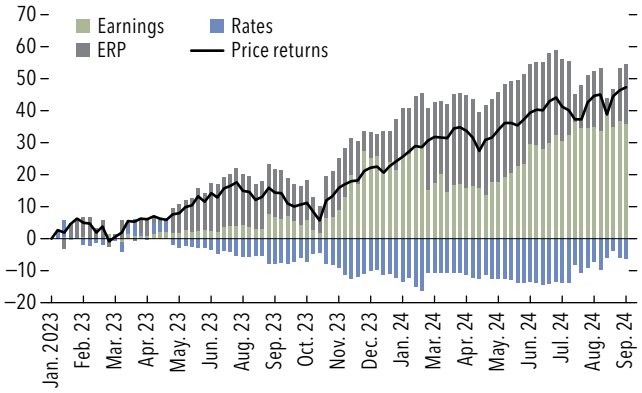
[10]The Magnificent 7 companies are Alphabet (Google), Amazon, Apple, Meta Platforms, Microsoft, Nvidia, and Tesla.

[11]Correlation estimates are calculated as the rolling six-month correlation of daily returns between the average M7 stock and S&P 500. Estimates indicate the correlation between M7 and the S&P has increased from around 40 percent to just above 65 percent since May. Correlation of average pairwise M7 has increased from 10 to 50 percent over the same period.

## Figure 1.8. Concentration, Expectations Regarding Growth, and Rotation in the Current Equity Rally

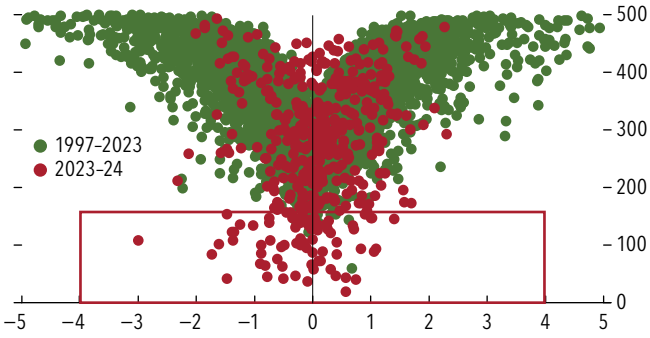
Stocks rallied on positive earnings momentum and supportive risk premiums.

**1. S&P 500 Decomposition**
*(Price index, January 1, 2023 = 100)*



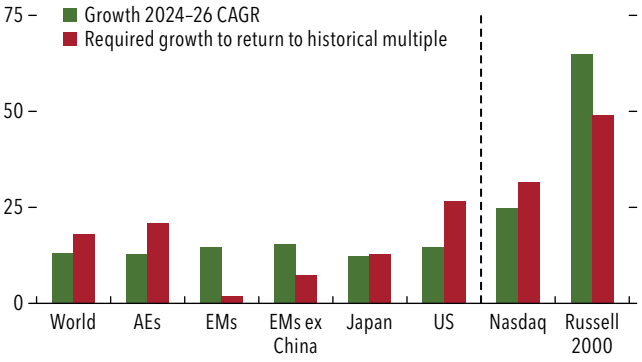

The fewest number of stocks are moving in the same direction as the index since 1997, with M7 stocks dictating index movements recently.

**2. S&P 500 Daily Returns and Constituent Movements**
*(Daily returns, percent; number of constituents)*



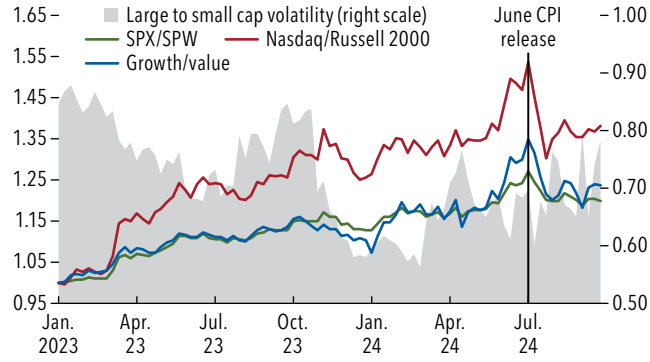

Current valuations of technology stocks demand high earnings growth, while smaller stocks appear undervalued.

**3. Required Earnings Growth to Justify Existing Valuation**
*(Percent)*




Expectations of declining inflation and falling rates led to strong asset rotation across indices.

**4. Return Ratios and Volatility of Large Stocks Relative to That of Small Stocks**
*(Ratios)*




Sources: Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; Thomson Reuters IBES and DataStream; and IMF staff calculations.

Note: In panel 3, "required growth to return to historical multiple" is calculated as the CAGR required to make the three-year-forward (end of 2026) price-to-earnings ratio to return to its 10-year historical average. Dashed vertical line indicates indices within the United States. In panel 4, ratios are based on weekly returns. "Large to small cap volatility" is the implied volatility for the S&P 500 divided by the implied volatility for the Russell 2000. AEs = advanced economies; CAGR = compound annual growth rate; CPI = consumer price index; EMs = emerging markets; ERP = equity risk premium; ex = excluding; M7 = Magnificent 7; SPW = S&P 500 Equal Weighted Index; SPX = S&P 500 Index.

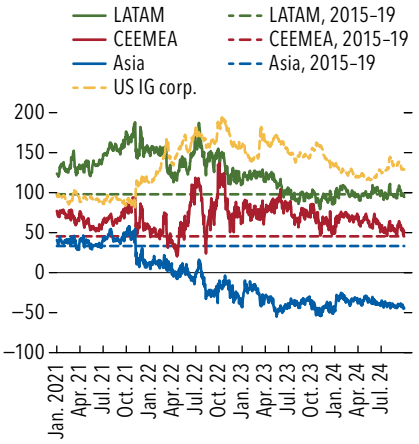
States—and the policies of newly elected governments around the world, especially those that would affect the geopolitical landscape and fragmentation risks.

The crypto rally earlier this year has started to fade, as optimism spurred by the approval of spot Bitcoin and Ethereum exchange-traded products in January and May 2024, respectively, appears to have dissipated (Figure 1.10, panel 1). Meanwhile, the total market capitalization of crypto assets at $2.2 trillion remains below its historical peak in November 2021. Crypto valuations have been driven recently by high rolling correlation between Bitcoin and other asset classes, such as equities (S&P 500) and gold, rather than idiosyncratic developments within this asset class (Figure 1.10). Widespread adoption of crypto assets could undermine the effectiveness of monetary policy, circumvent measures for managing capital flows (Cerutti, Chen, and Hengge 2024), exacerbate fiscal risks, divert resources available for financing the real economy, and threaten global financial stability. In addition, the growing interlinkages between crypto and broader financial markets, including the increasing

## Figure 1.9. Performance of Assets in Emerging Markets

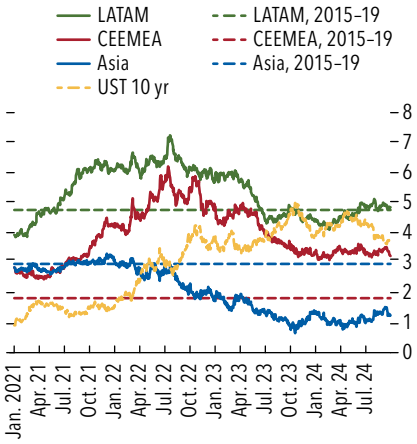
US dollar emerging market sovereign spreads remain tight relative to US investment-grade firms.

**1. Spread of Emerging Market Sovereign External Debt Against US Investment-Grade Firms, Spreads of US Investment-Grade Firms Against Treasuries**
*(Basis points)*



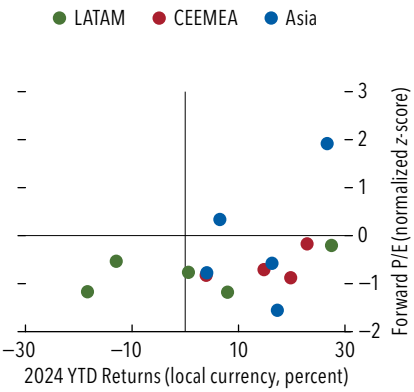

Emerging market government local yields remained broadly stable.

**2. Spreads of Local 10-Year Government Bonds as a Share of 10-Year Treasury Yields, and 10-Year Treasury Yields**
*(Percent)*




Emerging market equities have performed positively this year, though valuations remain lower than historical averages.

**3. Year-to-Date Total Returns to Equity in Emerging Markets and Normalized Forward Price-to-Earnings Ratio Against Historical 10 Years**
*(Percent of amounts in local currency; z-score)*



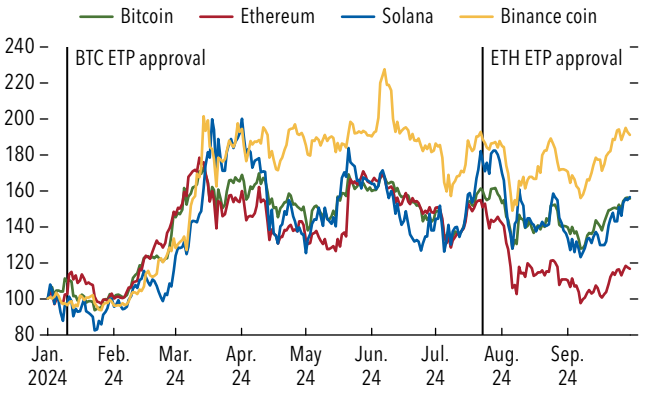

Sources: Bloomberg Finance L.P.; JPMorgan; MSCI; and IMF staff calculations.

Note: Fourteen major emerging markets are included in the calculations. Asia = India, Indonesia, Malaysia, the Philippines, Thailand; CEEMEA = Hungary, Poland, Romania, South Africa; LATAM = Brazil, Chile, Colombia, Mexico, Peru. Thailand is excluded from panel 1 because the sovereign has no outstanding hard-currency dollar-denominated debt. For panel 3, the *z*-score is calculated from the distribution of monthly observations of forward price-to-earnings ratios of the respective MSCI equity indices from January 2014 to August 2024. CEEMEA = Central and Eastern Europe, the Middle East, and Africa; corp. = corporations; IG = investment grade; LATAM = Latin America; P/E = price to earnings; UST 10 yr = Treasury 10-year yield; YTD = year to date.

## Figure 1.10. Fading Rally in Crypto Assets

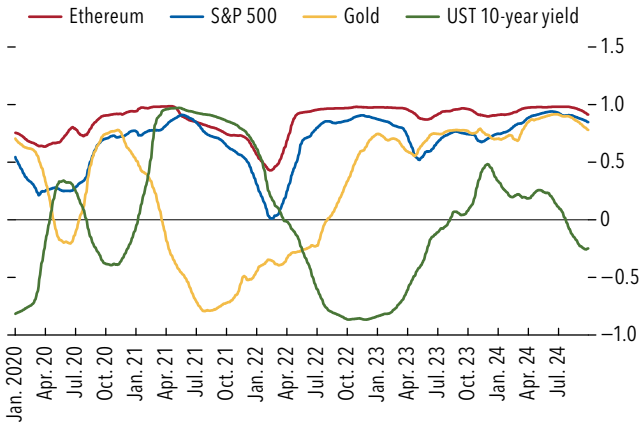
Optimism with regard to crypto assets has dissipated over the course of 2024 so far.

**1. Prices of Selected Crypto Assets and Approvals of Products Traded on Spot Exchanges**
*(Indexed, January 1, 2024 = 100)*




High correlations between Bitcoin and other asset classes suggest that broader risk sentiment drives crypto markets.

**2. Correlation Between Bitcoin and Other Assets**
*(One-year rolling correlation)*



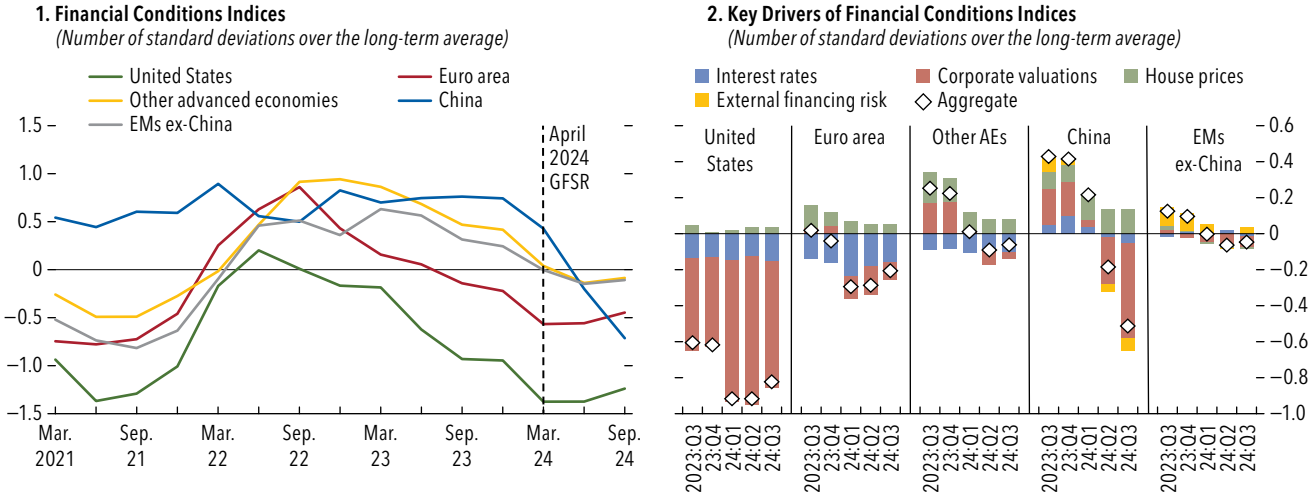

Sources: Bloomberg Finance L.P.; CoinGecko; and IMF staff calculations.

Note: Panel 2 shows the one-year rolling correlation between Bitcoin prices and the prices (or yields) of the assets. BTC = Bitcoin; ETH = Ethereum; ETP = exchange-trade product; UST = US Treasuries.

### Figure 1.11. Financial Conditions Indices

Financial conditions have remained accommodative in advanced economies ...

... driven, in part, by improved corporate valuations.




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

Note: The IMF's Financial Conditions Index is designed to capture the pricing of risk. It incorporates various pricing indicators, including real house prices, but does not include balance sheet or credit growth metrics. For details, see Online Annex 1.1 in the October 2018 GFSR. Panel 2 shows the key drivers of financial conditions indices in terms of the contribution of underlying components, which is the weighted average of the *z*-scores of these components. "Aggregate" represents the sum of these contributions, and its values are similar, but not identical, to Financial Conditions Index values shown in panel 1. AEs = advanced economies; EMs ex-China = emerging markets excluding China; GFSR = *Global Financial Stability Report*.

involvement of incumbent providers of financial services, may increase contagion risks in the future (see Box 1.2).

## Growth-at-Risk, the Global Macrofinancial Stability Assessment

### Financial Conditions Are Still Accommodative Globally

Financial conditions have marginally tightened in many regions, having been somewhat affected by the market turmoil in early August (Figure 1.11, panel 1). Still-elevated equity and corporate bond valuations have kept financial conditions in advanced economies relatively easy by historical standards. In China, where growth outlook and property sector issues had been weighing down risk sentiment over the past year, financial conditions measured by price indicators have loosened as a result of monetary policy easing, a narrowing in corporate credit spreads, and some diminishment of external headwinds (Figure 1.11, panel 2), while quantity indicators such as credit growth keep weakening. Although overall financial conditions in other emerging market economies have been slightly easy on net, external financing costs have risen, offsetting the impact of corporate valuations.

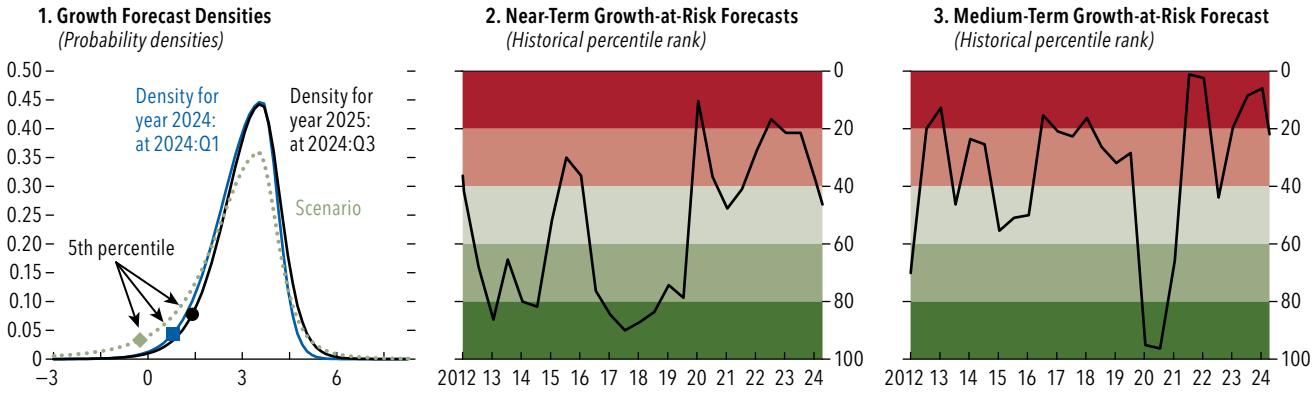
### Risks to Financial Stability Moderate in the Near Term; More Elevated over the Medium Term

The updated GaR assessment indicates that over the next year, there is a 5 percent probability that global real growth will fall below 1.2 percent (Figure 1.12, panel 1, black distribution and marker).[12] Although this is appreciably lower than the baseline forecast for growth of 3.2 percent in the *World Economic Outlook*, GaR is around the 40th historical percentile, indicating that near-term risk is contained owing to still accommodative financial conditions and moderate credit growth (Figure 1.12, panel 2). The forecast distribution of growth is skewed slightly more to the left than the forecast in the April 2024 *Global Financial Stability Report*, in line with the *World Economic Outlook*'s assessment that balance of risk to the global outlook is tilted to the downside. However, if financial conditions

[12]The GaR framework assesses downside risks by gauging the range of severely adverse growth outcomes falling within the lower 5th percentile of the conditional growth forecast distribution (that is, the GaR metric).

**Figure 1.12. Global Growth-at-Risk**

Downside risk to global growth remain elevated over the medium term.




Sources: Bank for International Settlements; Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; IMF, International Financial Statistics database; and IMF staff calculations.

Note: In panel 1, the mode (that is, the most likely outcome) of the estimate for current forecast density accords with the IMF, *World Economic Outlook* forecast for global growth for 2025, as of 2024:Q3. In panels 2 and 3, the black line traces the evolution of the 5th percentile threshold (the growth-at-risk metric) of the near-term and medium-term growth forecast densities. The quintile with the lowest percentile rank is bright red and with the highest bright green. The intensity of the shading depicts the percentile rank for the growth-at-risk metric. The scenario used in panel 1 calibrates the response of global financial conditions to a spike in Chicago Board Options Exchange Volatility Index, as seen on August 5, 2024 (EDT). The level of Chicago Board Options Exchange Volatility Index used to calibrate the FCI tightening is computed as the average of intraday VIX, recorded at five-minute intervals, from the start of business on August 5 to end of business on that day. Response functions of financial conditions are computed via linear regression methods applied separately over the full sample and the post–COVID-19 sample. The full sample regression starts in 1991:Q1, whereas the post–COVID-19 sample estimation begins in 2021:Q1, both running until the current period. A 75 percent weight is applied to the post–COVID-19 regression estimates to match comparable co-movements in Chicago Board Options Exchange Volatility Index and financial conditions during several historical stress episodes.

were to tighten by 2.5 standard deviations—broadly corresponding to the average of the intraday increases of the Chicago Board Options Exchange Volatility Index level on August 5 relative to its level at the open—and remain at that restrictive level for one quarter, the year-ahead GaR could worsen to its lowest historical quintile (see Figure 1.12, panel 1, dotted green distribution and green marker; and panel 2). This demonstrates that an abrupt tightening in financial conditions could raise near-term financial stability risks.

On the other hand, downside risk over the medium term, as indicated by GaR four years ahead, has been at around historically elevated levels since 2023. And while it has improved some over the past year, it remains at its worst quintile currently (Figure 1.12, panel 3). Easy financial conditions and strong credit growth have an intertemporal trade-off: Although they reduce near-term risks, they also prompt a buildup of vulnerabilities—like increased debt and leverage documented across this report—that raises downside risks in coming years. This intertemporal trade-off is more acute when economic uncertainty is elevated like at present, and importantly, the trade-off is nonlinear in uncertainty because it also depends on the size of the disconnection between economic uncertainty and market volatility (see Chapter 2).

## Emerging Markets

### Emerging Market Resilience Challenged by Uncertainty

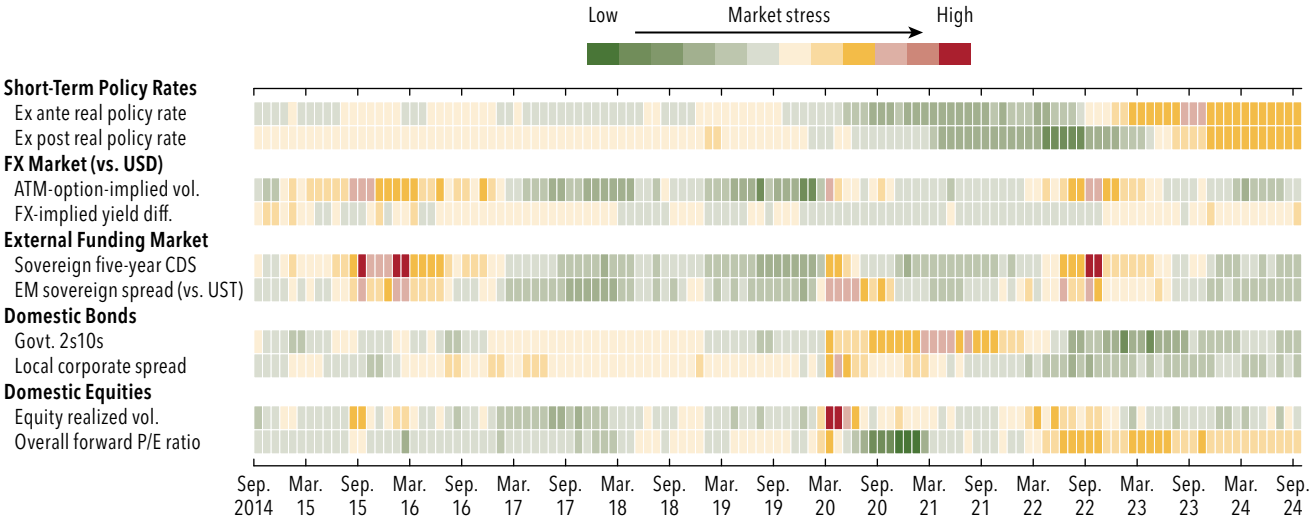
Emerging markets have confronted a multitude of global shocks and elevated economic uncertainty since the pandemic, deploying proactive monetary policy and in certain cases measures related to foreign exchange to strengthen their resilience to external headwinds (Adrian, Natalucci, and Wu 2024). As a result, the aggregate heat map for emerging market assets shows that market stress has remained largely moderate in interest rates, foreign exchange, and other assets (Figure 1.13). The market turmoil in advanced economies in early August has not changed this assessment. Looking ahead, as advanced economy central banks cut interest rates while global growth remains resilient, the dollar could weaken and investor sentiment on emerging market assets could turn more positive, spurring renewed portfolio inflows.

However, global uncertainty would likely remain elevated owing to geopolitical developments as well as uncertain future policies of newly elected governments. Some countries will likely have to navigate further external headwinds while coping with some idiosyncratic risks that led the recent depreciation of some emerging

### Figure 1.13. Continuing Resilience in Emerging Markets

Emerging markets continue to exhibit broad resilience, although some markets are showing evidence of pressures.

**Financial Market Stress in Emerging Markets**




Sources: Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; JPMorgan; MSCI; and IMF staff calculations.

Note: The heat map reflects funding situations based on key financial market indicators across 14 major emerging markets, including Brazil, Chile, Colombia, Hungary, India, Indonesia, Malaysia, Mexico, the Philippines, Thailand, Peru, Poland, Romania, and South Africa. Each country's indicators are transformed into a normalized *z*-score based on 10 years of monthly observations. High market stress (darkest red) reflects observations exceeding two standard deviations from mean (*z*-score > +2), and low market stress (darkest green) reflects observations more than two standard deviations below mean (*z*-score < −2). 2s10s = 2-year and 10-year local currency government yield differentials; ATM = at-the-money; CDS = credit default swaps; EM = emerging market; FX = foreign exchange; P/E = price-to-earnings; USD = US dollar; UST = US Treasuries; vol = volatility.

market currencies. Therefore, divergence among the emerging markets universe may be more pronounced down the road. Financial conditions for frontier markets remain challenging, with many countries that are grappling with higher borrowing costs and financial instability still not having access to funding through international markets despite sovereign spreads that are moderating lower.

## Global Monetary Policy Synchronization Leads to More Spillovers to Emerging Markets

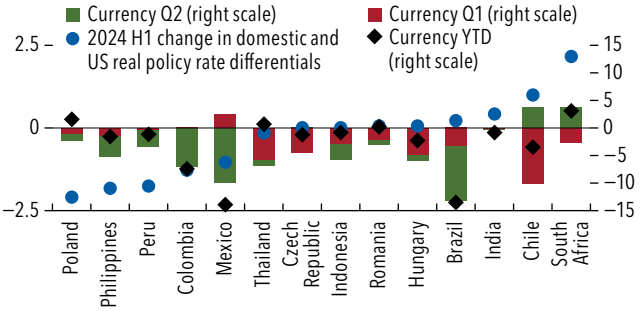
Positive interest rate differentials in emerging markets vis-à-vis advanced economies, a key source of resilience in 2023, have generally narrowed since the April 2024 *Global Financial Stability Report*, which has put some pressure on emerging market currencies (Figure 1.14, panel 1). At the same time, increased volatility in financial markets, including the rapid appreciation in early August in the Japanese yen—a common funding currency—have made carry trades less attractive on a risk-adjusted basis (Figure 1.14, panel 2; see also Box 1.3). But the narrowing of interest rate differentials and less attractive carry do not fully explain the year-to-date depreciation in emerging market currencies. Indeed, an IMF staff model finds that whereas the carry factor was the dominant driver of currency moves in 2023, an idiosyncratic factor, a proxy for domestic policy risks and uncertainty in global markets, has played an important role in 2024 alongside the strength of the US dollar, notably for Latin American currencies and the South African rand (Figure 1.14, panel 3). High-yield sovereigns and commodity exporters have generally been more susceptible to larger swings in foreign exchange rates. To manage the consequences of such an external shock, several central banks in emerging markets had turned more cautious and slowed or paused their rate cut cycles. Some central banks in emerging markets have also conducted foreign exchange interventions to smooth currency volatility. The Fed rate cut in September and the subsequent weakening of the US dollar have eased some of the pressures faced by EM central banks, and markets continue to expect easing across emerging markets broadly.

Henceforth, after two years of decoupling, market participants expect monetary policy cycles in emerging markets to be more synchronized with those in the

## Figure 1.14. Emerging Market Monetary Policy and Currencies

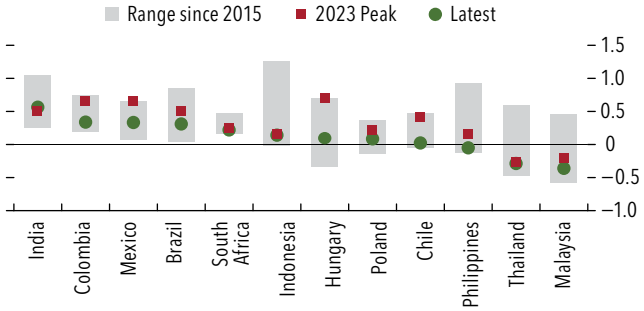
Most currencies depreciated in the first half of 2024, especially those of countries where real policy differentials have narrowed ...

**1. Currency Movements and Changes in the Difference Between Domestic and US Real Policy Rates**
*(Percent)*



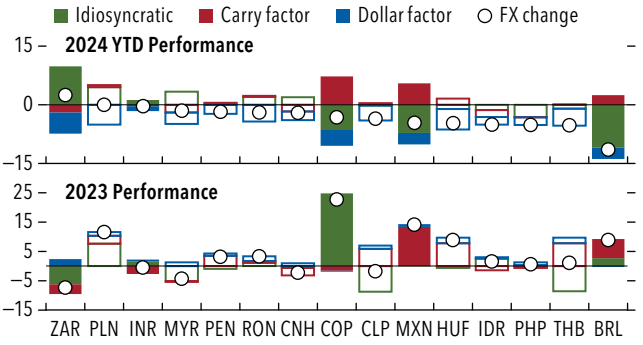

... and heightened volatility has eroded the attractiveness of carry trades.

**2. Emerging Market Carry, Adjusted for Volatility**
*(Three-month implied yield differential versus US dollar rate, divided by implied volatility)*



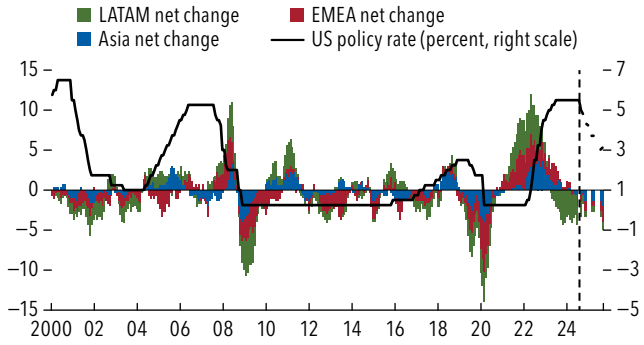

Country-specific factors drove currency returns in 2024, even in high-carry countries.

**3. Decomposition of Currency Returns**
*(Percent; solid bars refer to high-carry countries)*



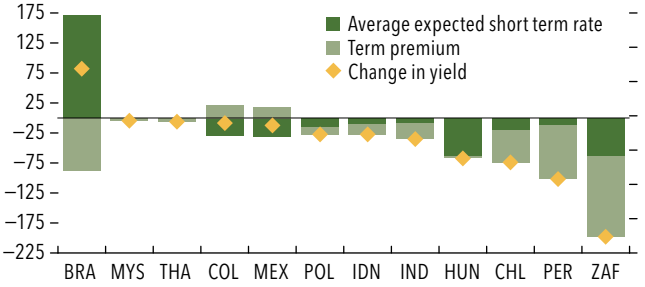

Markets expect emerging market central banks to be more in line with the Federal Reserve.

**4. US Policy Rate Versus Changes in Emerging Market Policy Rates**
*(Number of central banks changing policy and percent)*



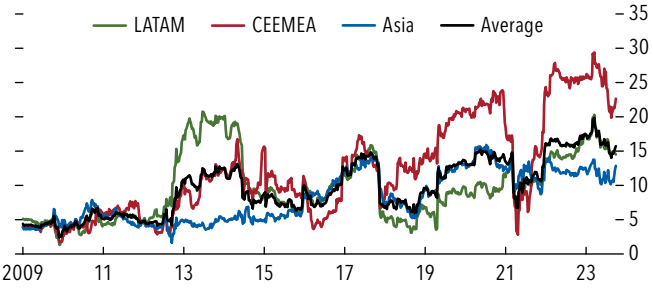

Term premiums have mostly driven longer-term yields in emerging markets ...

**5. Changes in 10-Year Yields Since the April 2024 GFSR**
*(Basis points)*




... and the spillover of changes in US term premium remains high, notably for CEEMEA.

**6. Effect of Changes in US Term Premium Across EM Regions**
*(Proportion of variance explained)*




Sources: Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; IMF, World Economic Outlook database; national sources; and IMF staff calculations.

Note: Panel 2 uses six-week averages. In panel 3, carry factor includes both interest rate differential and a global carry factor. The construction of the global carry factor and the dollar factor follows Verdelhan (2018), using a portfolio of 16 EM and 9 advanced economy currencies. The decomposition is based on a rolling regression over 18 months. Panel 6 reports spillovers from changes in US term premiums to EM term premiums. Specifically, the measure of spillovers reported here—using the methodology proposed by Diebold and Yilmaz (2009)—is the proportion of variation in EM term premiums that can be explained by shocks emanating from US term premiums. EMs include 15 countries accounting for about 76 percent of total EM GDP. The spillovers shown here correspond to a 100-week rolling window. Data labels in the figure use International Organization for Standardization (ISO) country codes. BRL = Brazilian real; CEEMEA = Central and Eastern Europe, the Middle East, and Africa; CLP = Chilean peso; CNH = Chinese renminbi; COP = Colombian peso; EM = emerging market; EMEA = Europe, the Middle East, and Africa; FX = foreign exchange; GFSR = *Global Financial Stability Report*; HUF = Hungarian forint; IDR = Indonesian rupiah; INR = Indian rupee; LATAM = Latin America; MXN = Mexican peso; MYR = Malaysian ringgit; PEN = Peruvian sol; PHP = Philippine peso; PLN = Polish zloty; Q1 = first quarter; Q2 = second quarter; RON = Romanian new leu; THB = Thai baht; YTD = year to date; ZAR = South African rand.

United States (Figure 1.14, panel 4). Greater policy alignment should stabilize interest rate differentials between advanced economies and emerging markets. That said, it may also increase the sensitivity of bond yields in emerging markets to those in advanced economies, both because expected policy paths will be more synchronized and as a result of spillovers from the term premium component that captures uncertainty in interest rates. Increases in term premiums in most emerging markets (Figure 1.14, panel 5), likely resulting from larger spillovers from higher US term premiums (Figure 1.14, panel 6), have primarily driven recent changes in yields.

## Portfolio Outflows Risks Have Receded Somewhat

Portfolio flows to emerging markets have been positive on net in recent months (Figure 1.15, panel 1). Several countries, notably Egypt and Türkiye, have experienced large inflows into local currency bonds amid renewed investor optimism about the outlook despite lingering debt challenges and elevated inflation, and flows into Indian markets have benefited from India's inclusion in global bond indices. Conversely, equity flows have been under pressure in some countries, which may reflect concerns regarding the growth outlook or political uncertainty in some cases. Year-to-date international issuance of sovereign bonds has risen to its highest level since 2021, although weak inflows into hard-currency bond funds suggest that market conditions could become more challenging absent a turnaround.

The IMF's capital-flows-at-risk measure indicates that there is a 5 percent probability that emerging market outflows could reach 2.4 percent of GDP over the next three quarters, a marginal increase in outflow risk since the April 2024 *Global Financial Stability Report*. However, rising market volatility, as seen during the early August shock, would materially increase outflows risks if sustained over a longer period (Figure 1.15, panel 2). Changes in the investor base have mitigated the risks of portfolio outflows to some extent, as long-term domestic investors like insurers and pension funds have absorbed increasing shares of emerging market bonds, likely serving as a stabilization force (see Box 1.4). Foreign investors appear to have become more cautious about emerging market assets in aggregate, as portfolio inflow cycles have become shorter and smaller on average (Figure 1.15, panel 3). Global factors—such as the interest rate environment or geopolitical uncertainty—may continue to affect the relative attractiveness of cross-border investment in emerging markets. Indeed, dedicated emerging market bond and equity funds domiciled in the United States have experienced cumulative outflows since March 2022 (Figure 1.15, panel 4).

## Emerging Markets with Weaker Fiscal Buffers Could Face More Constrained Funding Conditions

Although many emerging markets have experienced lower financing costs in recent years, investors continue to be attuned to these markets' fiscal sustainability. After progress following the pandemic, the momentum on fiscal consolidation has waned, and market analysts' consensus expectations regarding the budget balance for the aggregate government in 15 major emerging markets over the next three years have become more pessimistic and are firmly in deficit territory (Figure 1.16, panel 1), with 11 of these countries set to underperform[13] analysts' forecasts for fiscal year 2024.

Some sovereigns could be ensnared in a "debt begets more debt" quandary, especially considering that still-high global interest rates, larger financial spillovers from advanced economies, and weaker prospects in regard to longer-term economic growth are making it more difficult to service existing debt. To avoid such an outcome, these sovereigns need to improve their primary balances. And yet many emerging markets are operating well below their long-term fiscal buffers,[14]

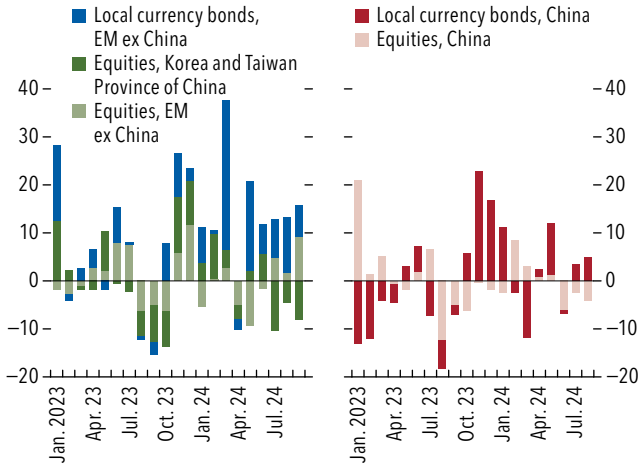
[13]Compared to analysts' consensus estimates made in the third quarter of 2022.

[14]The concept of fiscal buffers is motivated by the primary balance space, as described in the April 2024 *Fiscal Monitor*. The debt-stabilizing primary balance for the contemporaneous year can be defined as $P_t^* = \left(\frac{r_t - g_t}{1 + g_t}\right) \times d_{t-1}$, given the values of the nominal effective interest rate ($r_t$) and growth rate ($g_t$). In this context, the long-term debt-stabilizing primary balance is simplified as $P^* = \left(\frac{r - g^*}{1 + g^*}\right) \times d$, with the assumption that the effective steady-state long-term interest rate ($r$) is equivalent to the nominal forward five-year yield in five years, implied by the rate on current on-the-run government bonds, adjusted by differences in term premiums. The interest rate is also weighted by outstanding local- and foreign-currency-denominated debt and takes into account the cost arising from annualized depreciation of the external debt based on historical long-term data (January 2000 to July 2024). Long-term nominal growth ($g$) is derived from *World Economic Outlook* estimates, and gross debt ($d$) is based on the prevailing gross government debt level as of the end of 2023. The 2024 fiscal buffer is estimated by subtracting the long-term debt-stabilizing primary balance from the expected 2024 primary balance.

## Figure 1.15. Emerging Market Portfolio Flows

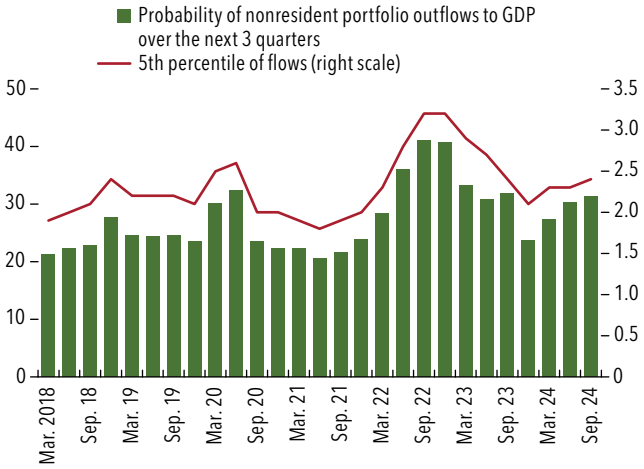
Portfolio flows have remained positive on net, though with considerable differentiation.

**1. Portfolio Flow Tracking: Local Currency Bonds and Equities**
*(Billions of US dollars)*



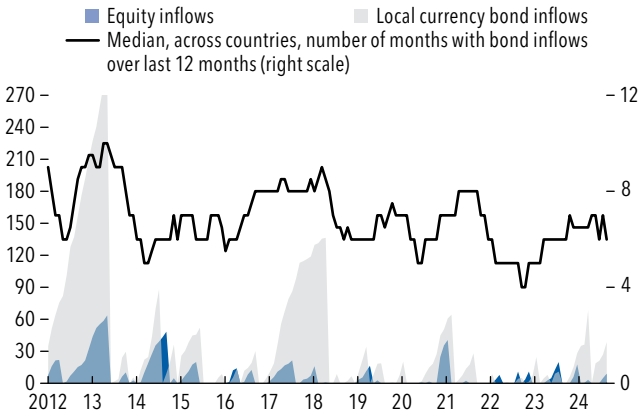

Capital-flows-at-risk worsened modestly; risks appear slightly higher than average.

**2. Capital Flows at Risk**
*(Percent of GDP)*



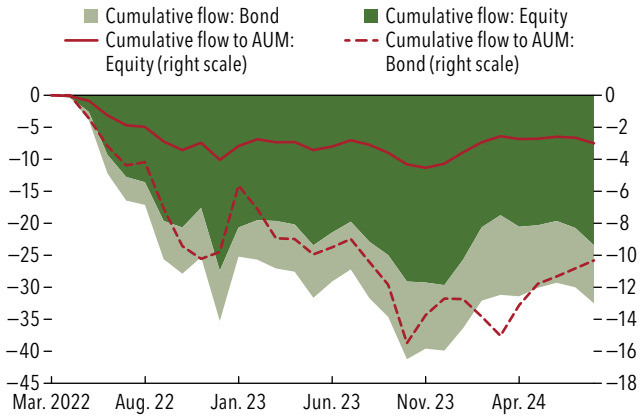

Portfolio flow cycles have become shorter in recent years.

**3. Portfolio Inflow Cycles**
*(Cumulative equity and local currency bond inflows before outflows, billions of US dollars, based on monthly data)*




Dedicated emerging market bond funds domiciled in the United States have seen large outflows since 2022.

**4. Flows in US-Domiciled Emerging Market Mutual Funds and Exchange-Traded Funds**
*(Billions of US dollars)*



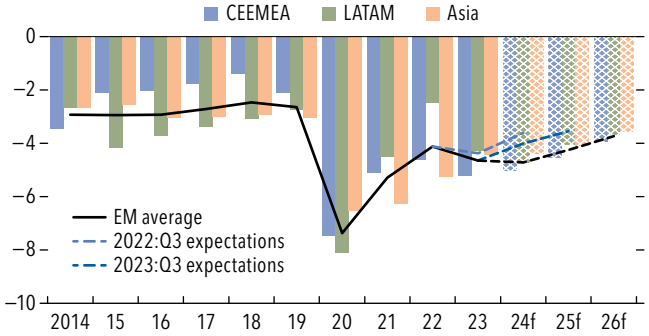

Sources: Bloomberg Finance L.P.; EPFR; EUROPACE AG/Haver Analytics; IMF, World Economic Outlook database; national sources; and IMF staff calculations.

Note: Panel 1 reports data separately for Korea and Taiwan Province of China because the IMF does not classify them as emerging markets. "EM ex China" includes an unbalanced sample of 20 emerging markets. Daily data on Chinese equity flows ceased being available as of August 11. In panel 2, "portfolio flows at risk" is defined as the 5th percentile of the three-quarters-ahead nonresident portfolio flows' probability density. Panel 3 includes monthly data on 16 countries for equity flows and 20 countries for bond flows. Inflow episodes are reset at the first monthly occurrence of outflows. AUM = assets under management; EM ex China = emerging markets excluding China.

## Figure 1.16. Emerging Market Fiscal Buffers and Financial Costs

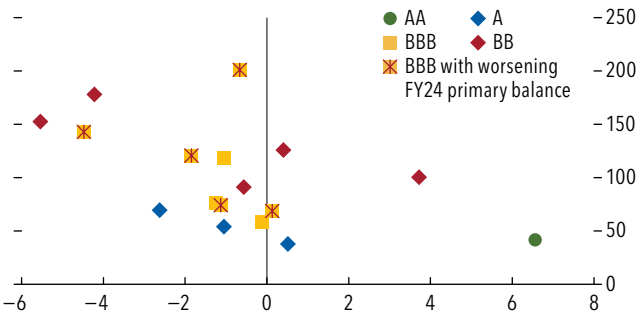
With fiscal consolidation delayed, deficits have remained above prepandemic levels.

**1. Overall Fiscal Balances and Analyst Expectations**
*(Percent of GDP)*



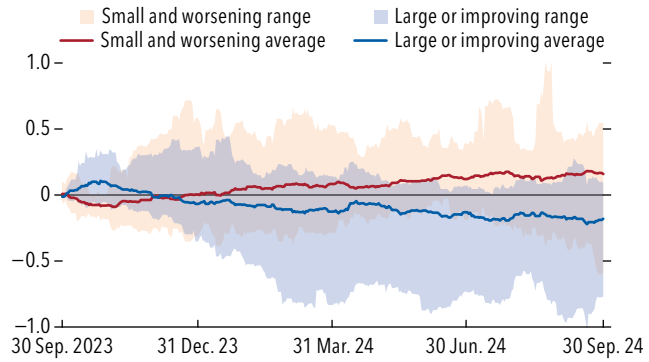

While some emerging markets have room for fiscal expansion, most face higher spreads.

**2. Five-Year Credit Default Swap Prices and 2024 Fiscal Buffers Estimates**
*(Basis points; percent of GDP)*



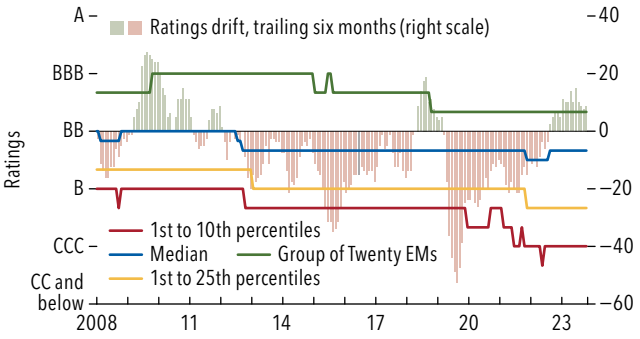

Sovereign risk premiums for emerging markets rose with worsening fiscal buffers ...

**3. Pricing of Sovereign Credit Risk**
*(Cumulative change in five-year credit default swap z-scores since 2023:Q3)*



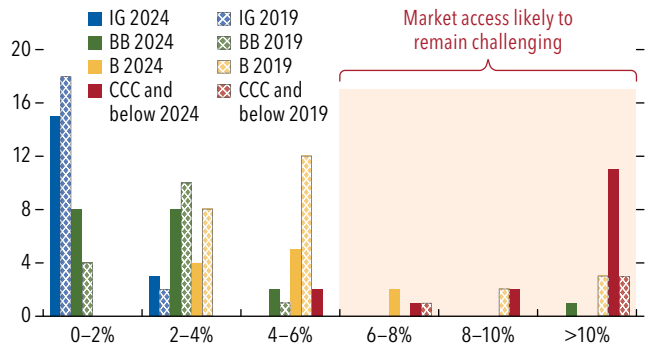

... and continued fiscal underperformance could precede rating reassessment and "cliff effects."

**4. Average Credit Ratings and Ratings Drift**
*(Rating by group; trailing six-month percentage)*



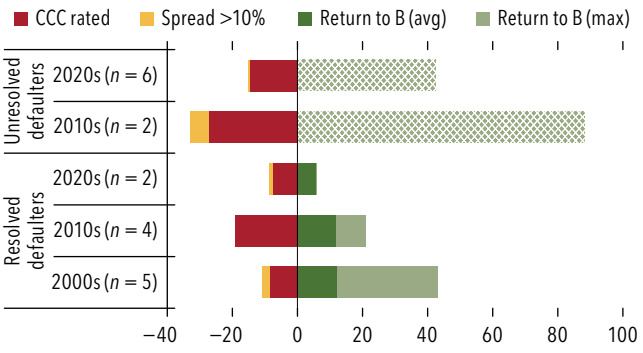

Downgrades to the B-rating band could push vulnerable EMs closer to the brink of losing market access.

**5. Distribution of EM Sovereigns by Hard-Currency Spreads**
*(Number of sovereigns by spread range)*




Recently, it has been taking defaulted sovereigns longer to return to B ratings or better.

**6. Timeline for Recently Defaulting Sovereigns**
*(Average months to and after default, t = 0)*




Sources: Bloomberg Finance L.P.; Fitch Ratings; JPMorgan; Moody's Investor Services; S&P Global; and IMF staff calculations.

Note: Data in panel 1 consist of those for 15 major EM sovereigns whose fiscal balance trajectories are tracked by broad analysts and for which expectations for a two-year forward-looking horizon are available. Sample in panels 2 and 3 includes 16 major EM sovereigns with outstanding external debt denominated in US dollars, with eight in each category. Panels 4 and 5 include a sample of 80 EM sovereigns that were continuously rated by at least one of three international rating agencies from December 2008 to August 2024. The sample excludes sovereigns whose ratings were withdrawn but includes those under default. "Ratings drift" is defined as total net change (as a percentage of total) in credit ratings by the three agencies over the preceding six months. Positive ratings drift is in green, while negative ratings drift is in red. avg = average; CEEMEA = Central and Eastern Europe, the Middle East, and Africa; EMs = emerging markets; f = forecast; FY = fiscal year; LATAM = Latin America; Q3 = third quarter.

with primary balances for the 2024 fiscal year failing to meet the requirements to achieve longer-term debt-stabilizing primary balances. Financial markets appear to have differentiated countries along this dimension: Emerging markets with worse fiscal buffers generally have higher credit default spreads (Figure 1.16, panel 2), and these spreads are diverging between countries with "large or improving" and "small and worsening"[15] buffers (Figure 1.16, panel 3). Nonetheless, with most sovereigns' fiscal buffers still hovering within a reasonable range,[16] many are still within reach to steer toward a more sustainable debt pathway.

Increased pricing of emerging market sovereign risks could also reflect fears of a reassessment in credit ratings. Ratings downgrades are susceptible to "cliff effects," for which downgrades can be extreme and can further constrain funding conditions owing to incorporation of ratings into regulations and risk limits (Figure 1.16, panel 4; see also Chapter 3 of the October 2010 *Global Financial Stability Report*). Worryingly, sequential downgrades involve a risk that even at ratings a notch or two above the "near default: CCC ratings" threshold, some sovereigns may already find themselves on the verge of losing market access (Figure 1.16, panel 5), as historical ratings transitions indicate a significant likelihood of default.[17] Critically, more sovereigns are finding themselves in that situation now relative to the number in 2019,[18] and the IMF's sovereign Debt-at-Risk framework (see the October 2024 *Fiscal Monitor*) estimates that debt risks may heighten further under high economic uncertainty.

[15]The relative risk-pricing differentiation among the sample group is measured using a normalized *z*-score methodology. "Small or worsening" sovereigns are identified as those with fiscal buffers beyond a deficit of 2 percent, and "borderline" sovereigns have fiscal buffers ranging from –2 to 2 percent and expect to have widening fiscal year 2024 primary deficits. "Large or improving" sovereigns are those with large fiscal buffers (exceeding 2 percent), as well as borderline sovereigns expected to experience narrowing fiscal year 2024 primary deficits.

[16]A "reasonable rate" is within the –2 to 2 percent range, as the average five-year standard deviation of sample sovereigns' primary balances is about 2 percent of GDP (based on expectations from fiscal year 2020 to fiscal year 2024).

[17]B-rated sovereigns have a cumulative default rate of up to 17 percent over a period of five years, based on historical five-year issuer-weighted rating transition studies for sovereigns based on Fitch ratings (1995 to 2023), Moody's issuer ratings (1983 to 2023), and S&P foreign currency ratings (1975 to 2023). The Moody's study also indicates that ratings of defaulted sovereigns, on average, tend to be in the B-rating range one year before a default event.

[18]Of the 80 sovereigns sampled, 17 (21 percent) have average ratings at CCC+ or worse, compared with 4 (5 percent) in December 2019.

And markets often front-run ratings actions, with some defaulting sovereigns' spreads having exceeded 10 percent before a downgrade to a rating band of CCC or lower (Figure 1.16, panel 6).[19] More concerning is the recent postpandemic trend wherein many defaulted sovereigns are experiencing an extended duration in rating bands of CCC or worse, with their prolonged stays in that range reflecting ongoing external and domestic challenges and a probable necessity for persistent fiscal reforms (see Kogan and others 2024). The continued struggle for market confidence and access underscores how important it is for emerging market sovereigns, especially during periods of strong growth, to maintain sufficient fiscal buffers and flexibility to mitigate effects of unexpected shocks.

## Frontier Markets Are Still Grappling with High Borrowing Costs

Frontier sovereign spreads[20] have followed global trends and tightened further in the second quarter, having approached long-term average levels (Figure 1.17, panel 1). Significant progress on debt restructuring has also helped lift investor sentiment toward frontier markets. For example, the Eurobond restructurings in Suriname, Zambia and Ghana were completed in December, June, and October, respectively, while an agreement in principle was reached with creditors in Sri Lanka in September. Policy actions by local authorities have also resulted in positive developments; for example, in Nigeria, rate hikes and the clearing of overdue domestic central bank foreign exchange obligations have helped the naira show more signs of stability.

Against this backdrop, frontier economies continued to issue international debt in the second quarter, although yields remained high. Some frontier economies and low-income countries took advantage of strong investor risk appetite to issue sovereign bonds after a lengthy hiatus. However, although just 14 percent of frontier economies have sovereign spreads above 1,000 basis points—a lower share

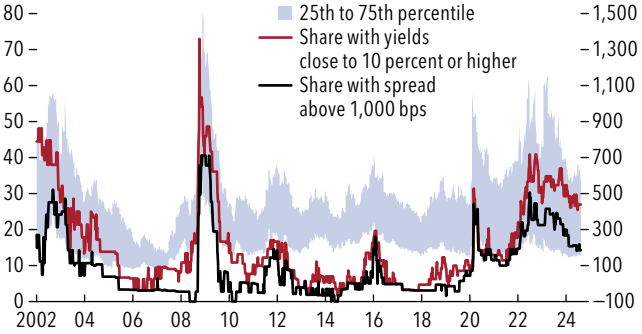
[19]An examination of default events since 2020 suggests that hard-currency spreads for 12 out of a sampled 19 defaulting sovereigns exceeded 10 percent before a downgrade to CCC or worse.

[20]The "frontier market" classification comprises 43 countries that either are included in the JPMorgan Next Generation Market index or, if not included in that index, are low-income countries with international bond issuance.

## Figure 1.17. Frontier Market Developments

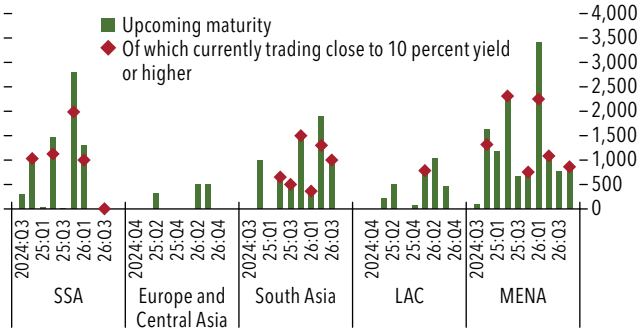
Sovereign spreads have tightened for frontiers, but yields remain high.

**1. Frontier Market Spreads and Yields**
*(Basis points; percent)*



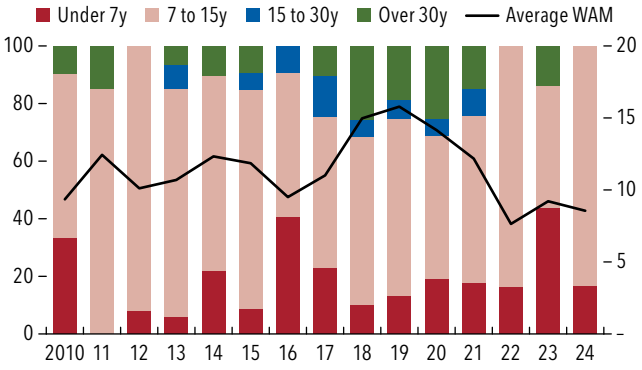

A large proportion of debt maturing in coming months is trading close to or above 10 percent.

**2. Coupon at Issue Versus Current Yield of Eurobond Maturities**
*(Millions of US dollars; yields)*



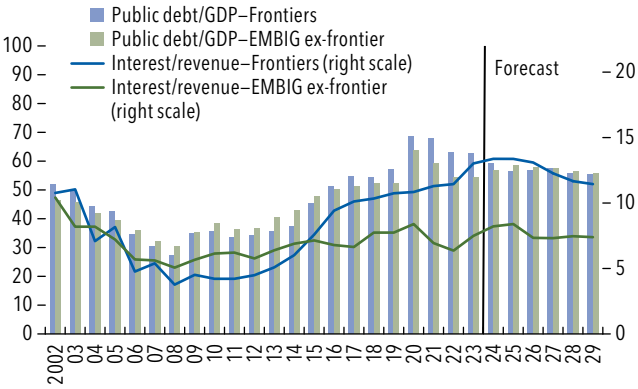

The maturity of eurobond issuances has declined over time and remains relatively low, indicating higher upcoming refinancing needs.

**3. Maturity Distribution of Frontier Market Eurobond Debt Issuance**
*(Distribution of maturities frontier market Eurobond issuances, percent)*




Median public debt levels are high by historical standards, but interest-to-revenue ratios are much higher in frontiers, indicating lower capacity to service debt.

**4. Median Fiscal Metrics**
*(Percent of GDP; percent of fiscal revenue)*




Sources: Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; IMF, World Economic Outlook database; JPMorgan; and IMF staff calculations.

Note: Panel 1 shows the 25th and 75th percentiles of the JPMorgan Next Generation Market Index. Panel 3 shows the weighted average maturity of international debt issuance by frontier economy sovereigns. bps = basis points; EMBIG = JPMorgan Emerging Market Bond Index Global; LAC = Latin America and the Caribbean; MENA = Middle East and North Africa; SSA = sub-Saharan Africa; WAM = weighted average maturity.

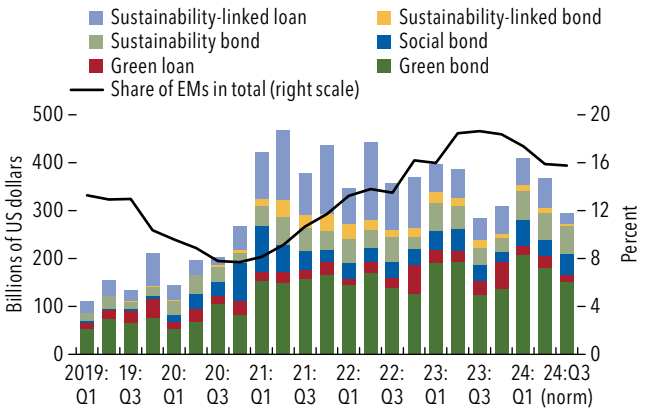
than a year ago—roughly a fifth of frontier economies still have yields close to 10 percent or higher, a materially larger share than the long-term average. Significant amounts of frontier debt are coming due in the remainder of 2024 (roughly $4 billion) and in 2025 and 2026 (roughly $13 billion and $14 billion, respectively), with roughly 60 percent of maturing bonds issued by countries with prevailing yields close to or above 10 percent, notably frontier economies in South Asia, and sub-Saharan Africa (Figure 1.17, panel 2).

A decline in global interest rates would alleviate refinancing pressures for these frontier economies, although the decline in the weighted average maturity of frontier debt issuance—that is, reliance on shorter-term debt—makes frontiers more exposed to gyrations in expectations regarding monetary policy, as refinancing would occur more frequently (Figure 1.17, panel 3). More fundamentally, debt-to-GDP ratios for both emerging market and frontier economies remain well above historical average levels. Under IMF staff projections, these debt levels are not expected to come down meaningfully in the medium term, and interest repayment burdens for frontier economies are projected to ease somewhat but remain relatively high in the medium term (Figure 1.17, panel 4).

## Figure 1.18. Update on Sustainable Debt Issuance by Emerging Markets

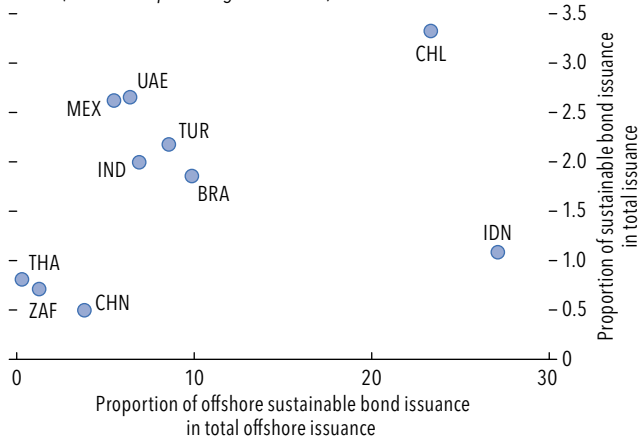
Global sustainable debt issuance has improved this year, led by record green bond issuance.

**1. Global Sustainable Debt Issuance by Instrument**
*(Billions of US dollars; percent of total)*




Emerging market sustainable debt makes up a relatively larger share in offshore markets than in total debt issuance.

**2. Country-Level Sustainable Bond Issuance in Emerging Markets as a Share of Total Domestic and Offshore Issuance**
*(Cumulative percentage since 2015)*




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

Note: In panel 1, the share of EMs shows the four-quarter moving average of total issuance in EMs as a percentage of global issuance, and the third quarter of 2024 value is based on the latest available information as of August 2024. "24:Q3 (norm)" refers to the normalized value for the third quarter of 2024, based on issuances during July–August 2024. Data labels in panel 2 use International Organization for Standardization (ISO) country codes. EMs = emerging markets.

### Adaptation and Mitigation Can Strengthen Emerging Markets' Climate Resilience

Global issuance of sustainable debt rebounded in the first half of 2024. Green bonds remained the largest component, accounting for roughly half of sustainable debt issuance and exceeding the amount issued in the first six months of past years. The share of issuance by emerging markets has somewhat declined recently (Figure 1.18, panel 1). Moreover, issuance of sustainable debt continues to account for a relatively small portion of total debt issuance in emerging markets, even though the share of offshore issuance of sustainable debt in total issuance of sustainable debt is somewhat higher (Figure 1.18, panel 2), likely reflecting that demand for sustainable bonds from emerging markets originates from investors based in advanced economies who prefer hard-currency over local-currency debt. Underinvestment in climate change mitigation and adaptation in emerging market and developing economies could lead to global risks to financial stability through greater exposure to systemic climate-related financial risks, including contagion effects along value chains (see Chapter 2 of the October 2022 *Global Financial Stability Report*).

Different estimates suggest that about 75 to 90 percent of climate finance flows are directed toward mitigation efforts (CPI 2023; OECD 2023; UNEP 2023), even though there is growing awareness that investing in climate adaptation, in addition to mitigation, is both an inevitable and necessary priority. Specifically, mitigation is focused on reducing or eliminating the emission of greenhouse gases to limit further climate change, but adaptation finance is aimed at assisting communities and ecosystems to cope with climate change impacts already occurring or expected to occur. Emerging market and developing economies are disproportionately affected by both climate change and a lack of adaptation investment despite historically contributing the least to greenhouse gas emissions, while international adaptation finance flows to developing countries are 10 to 18 times below estimated needs, and the gap is widening (UNEP 2023). A significant portion of private sector capital providers are unfamiliar with the adaptation investment thesis, and even among those who are familiar, the perceived risk remains prohibitively high. Among private sector investors, mitigation is typically seen as an opportunity, whereas adaptation is often

viewed as a government responsibility, too complex, or lacking clear metrics or sufficient investment returns (IMF, forthcoming). To date, tracked adaptation finance is dominated by public actors (98 percent) (Climate Policy Initiative 2023). While three out of five surveyed private financial institutions intend to increase their allocation to adaptation investments, they also highlight multiple barriers to investment and call for more product innovation and public–private partnership to unlock capital for adaptation, practical investment guidance, and investor-relevant metrics (Standard Chartered Bank 2024).

## Slowing Growth and Deflationary Pressures Weigh on China's Financial System

China continues to experience deflationary pressures amid slowing demand both domestically and from external markets. Policy support across the monetary, fiscal, and housing fronts continues to be measured so far and appears unable to offset the drag that housing market adjustment, now heading into its fourth year, is exerting on business and consumer confidence. In addition, slowing global growth and rising pressures related to fragmentation may weigh on the export sector, the key driver of growth in recent quarters. Against this backdrop, expectations regarding inflation continue to decline, with one-year-ahead expected consumer price index inflation having nearly halved from a year ago, to 1.3 percent, and the probability that it will fall below its current level of 0.3 percent has also increased (Figure 1.19, panel 1). Coupled with a housing market turnaround not yet in sight—home price declines have accelerated again recently, with primary and secondary home prices down 7 and 13 percent from their peaks, respectively, and primary market sales 40 percent lower than their prepandemic peak—these pressures call for more decisive and vigorous policy support.

Recent declines in government bond yields reflect the downbeat sentiment. Both the 2- and 10-year central government bond yields have fallen to near record lows. The compression of term premiums (Figure 1.19, panel 2), especially those for longer-term rates, indicates a weaker economic outlook and flight to safety, as returns on other assets like housing and stocks have continued to disappoint. The outperformance of stocks in defensive and high-dividend sectors, like utilities and energies, also points to low appetite for risk (Figure 1.19, panel 3).

At the end of September, Chinese authorities unveiled a series of monetary and regulatory stimulus measures aimed at bolstering the domestic economy and stabilizing the property sector and consumer sentiment. The announcement initially triggered a strong appreciation in stock prices, which was partially retraced in subsequent days as investors reportedly await details on potential fiscal stimulus measures viewed as crucial in addressing the structural challenges faced by the Chinese economy.

A decline in benchmark bond yields has also driven other bond yields lower, led by local government financing vehicles debt following the fiscal support for financially weak regions. Institutions like retail-focused wealth management products and mutual funds have displayed a strong appetite for fixed income assets.[21] In addition, foreign investors have also increased their holdings of renminbi-denominated bonds, particularly negotiable certificates of deposit in the interbank market (Figure 1.19, panel 4). A sudden rise in benchmark bond yields could trigger a sharp repricing in the broader fixed income markets, redemptions from investment funds, and significant market volatility.

The performance of China's banking system in this challenging environment is crucial to financial stability. Asset quality will continue to deteriorate if policy support fails to restore growth momentum, and weak credit demand is weighing on lending volumes and profit margins. So far, despite financial troubles in the property-related sectors, including local government financing vehicles, banks reported nonperforming loan (NPL) ratios have remained low. Low mortgage defaults (NPL ratios less than 1 percent) and manageable direct exposures to developers (less than 6 percent of total bank loans) have alleviated pressures. Importantly, banks have been proactive in addressing nonperforming assets (NPAs[22]), with write-offs and disposals topping 3 trillion yuan each year since 2020 (Figure 1.20, panel 1). Since 2012, the cumulative reported NPLs amounted to less than 3 trillion yuan in 2023, and write-off and

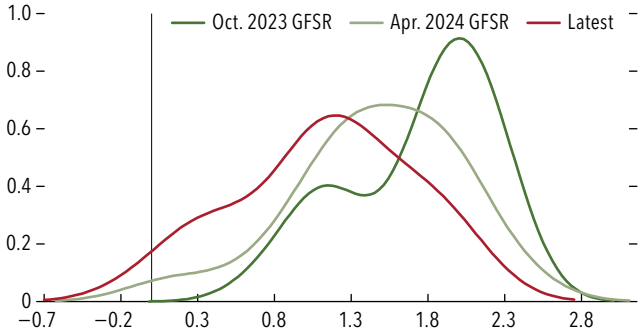
[21]Over the past few months, the Chinese authorities have issued repeated warnings against interest rate risks and have taken preemptive measures, including administrative interventions, to guide smaller financial institutions to reduce their bond exposures. On August 31, the central bank announced to have conducted secondary market transactions in August by buying short-term central government bonds and selling long-term central government bonds, resulting in a net liquidity injection of 100 billion yuan.

[22]NPA includes nonloan assets and is broader than NPLs. However, disclosure of NPA ratio is limited.

## Figure 1.19. Inflation and Asset Developments in China

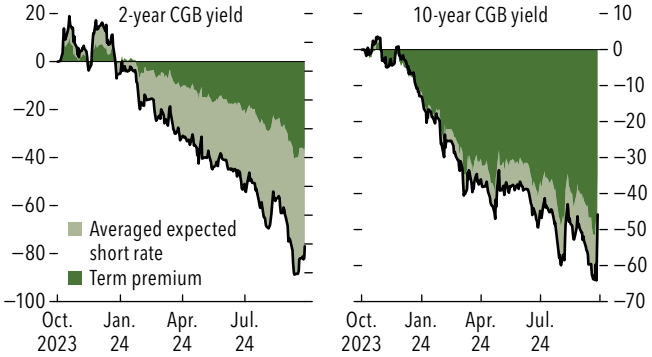
Deflation pressure is intensifying amid weak demand from home and abroad.

**1. Distribution of Analysts' Forecasts for One-Year-Ahead Headline Inflation**
*(Probability density)*




Government bond yields have dropped to record lows, with compressing term premiums on flight to safety driving the decreases.

**2. Decomposition of Changes in Yields on Central Government Bonds**
*(Cumulative changes since October 2023, basis points)*

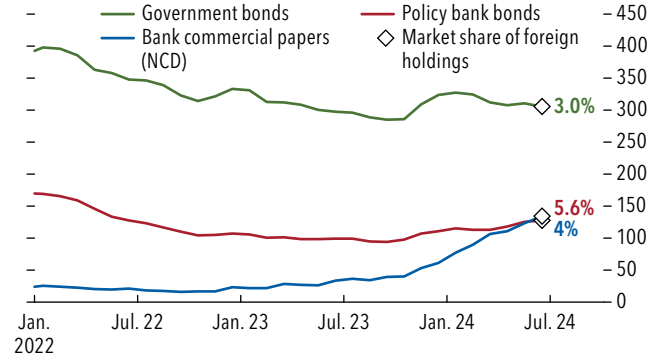



High-dividend and defensive stocks have outperformed.

**3. Performance by MSCI China Sectors in 2024**
*(Percent)*


Strong investor appetite from foreign investors as well as others has fueled a bond rally.

**4. Foreign Holdings by Instrument**
*(Billions of renminbi)*




Sources: Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; and Thomson Reuters.

Note: In panel 2, decomposition of bond yields into expected short rate and term premiums follows Adrian, Crump, and Moench (2013). In panel 3, the decomposition is based on 12-month-forward measures of valuation and earnings. CGB = central government bond; Comm. = communications; Cons. disc. = consumer discretionary; GFSR = *Global Financial Stability Report*; IT = information technology; NCD = negotiable certificates of deposit.

disposal totaled 22 trillion, which have effectively lowered banks' headline NPL ratios by 1.5 percentage points.[23] Disposals have been done mainly through transferring NPAs to state-owned asset management companies (AMCs) in the primary market, while the secondary market—non-AMC buyers of NPAs—remains nascent. Disclosures from listed AMCs show the bulk of NPA acquisitions in 2023 originating from the property market, small and medium enterprises, and local government financing vehicle–related sectors (Figure 1.20, panel 2).

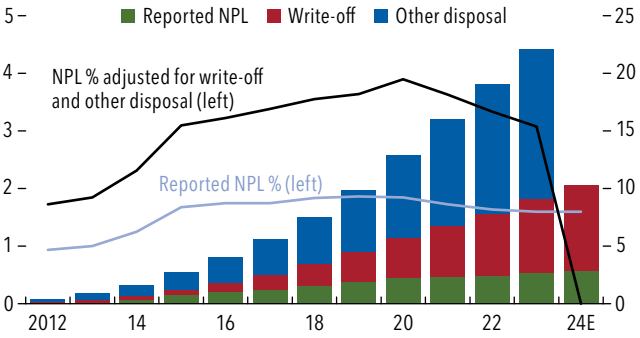
The key question is whether AMCs will continue to have the capacity to absorb problem assets with their balance sheets weakening. The four national AMCs established in 1999 (80 percent market share), which mainly serve state-owned and joint-stock banks, dominate the primary market for NPAs, along with more than 50 regional AMCs established since 2015

[23]The adjusted NPL ratios are likely still underestimating asset quality risks given the frequent use of regulatory forbearance and systematic perceptions of implicit guarantees.

## Figure 1.20. Drill-Down on Chinese Asset Management Companies

Banks have relied on write-offs and disposals to manage bad debt.

**1. Cumulative Changes in Banks' Nonperforming Loans, Write-Offs, and Other Disposals Since 2012**
*(Percent; trillions of renminbi)*

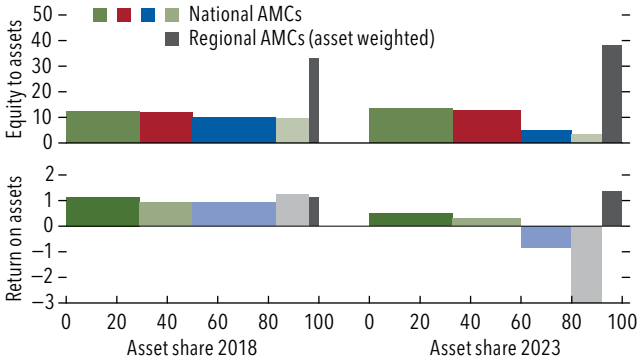



Disposals have focused on property and LGFV-related nonperforming loans.

**2. Acquisitions of Nonperforming AMCs by Sector, 2023**
*(Percent, based on disclosure of the largest AMC)*

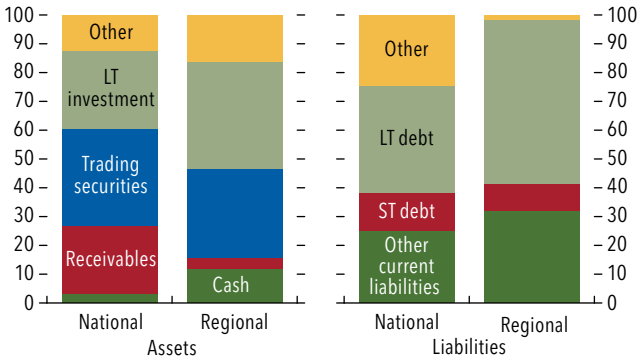

AMCs' fundamentals have weakened since the pandemic and the property downturn.

**3. Equity and Profitability of AMCs**
*(Three-year average percent of total assets)*




Failure of AMCs could generate macrofinancial instability.

**4. Composition of Assets and Liabilities of AMCs**
*(Percent)*




Sources: China, National Financial Regulatory Administration; company disclosures; EUROPACE AG/Haver Analytics; and S&P Capital IQ Pro.

Note: In panel 1, "other disposal" is disclosed periodically, and the value is imputed for some years based on actual volume of nonperforming loans. AMC = asset management company; E = estimate; LGFV = local government financing vehicle; LT = long term; NPL = nonperforming loan; ST = short term.

that target smaller banks in their regions.[24] In previous years, the national AMCs have grown into conglomerates through networks of subsidiaries offering services beyond NPA acquisition, such as lending, trust, insurance, brokerage, and real estate. The fundamentals of the national AMCs have weakened since 2018, as profitability from both NPAs and other business lines has suffered as a result of the pandemic, the property market downturn, and in some cases, overexpansion. Capital levels, as proxied by equity-to-asset ratios, have dropped to distressed levels of below 5 percent at two of the national AMCs (Figure 1.20, panel 3). Based on disclosures from a limited sample, regional AMCs appear more resilient on these two measures, likely reflecting more confined business models,[25] though limitation on the availability and granularity of disclosures warrants caution about this finding. Moreover, in the near term, regional AMCs are unlikely to fill any gap left by their national peers.

Financial distress in China's AMCs could generate macrofinancial instability. They are intertwined with the rest of the country's financial system through

[24]A fifth national AMC, established in 2020, remains small, holding less than 0.2 percent of total AMC assets.

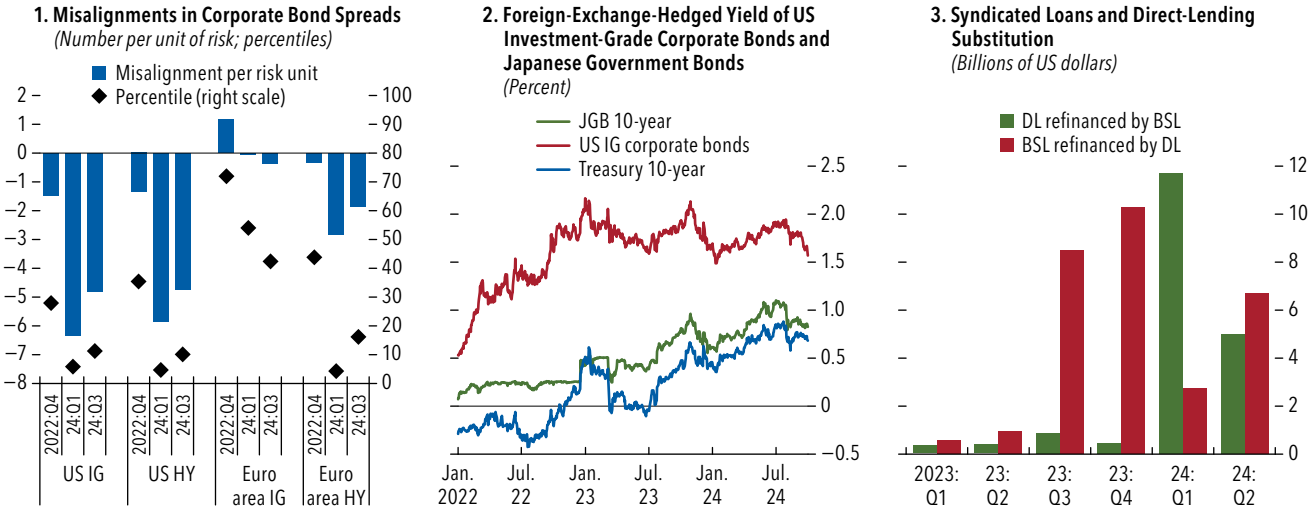
[25]Regional AMCs have not expanded beyond the NPA market and are required to operate within their jurisdictions.

**Figure 1.21. Corporate Market Dynamics**

US corporate bond valuations remain stretched, though they have eased somewhat.

Foreign-exchange-hedged US corporate bonds are attractive to Japanese investors.

The syndicated loan market has become active recently, regaining share from private credit direct lenders.




Sources: Bank for International Settlements; Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; JPMorgan; PitchBook Data, Inc.; Thomson Reuters DataStream; and IMF staff calculations.

Note: In panel 1, misalignment is the difference between market spread and model-based spread scaled by the standard deviation of monthly changes in spread. Negative values indicate overvaluation. For the model details, please see the October 2019 *Global Financial Stability Report*, Online Annex 1.1. Intuitively, this measure indicates how many standard deviations of monthly changes in spread (or "risk units") it would take for the spreads to get back to fair value. "US" valuations are based on the Bloomberg US corporate bond index and includes non-US issuers. "Euro area" valuations are based on the Bloomberg Euro Corporate Bond Index and includes non–euro area issuers. Panel 3 shows yields hedged in Japanese yen. BSL = broadly syndicated loans; DL = direct lending; HY = high yield; IG = investment grade; JGB = Japanese government bond.

investments, lending (or receivables), and reliance on bank and market financing (Figure 1.20, panel 4). A credit event at a large AMC would hamper a source of NPA disposal for banks, putting some banks at risk. Distress in one national AMC generated significant ripple effects in the financial system, requiring a $6.6 billion state-led bailout in 2021. The Chinese authorities have strengthened regulations on AMCs in recent years by, among other things, centralizing the supervision of local AMCs under the National Financial Regulatory Administration.

Rising asset quality and profitability pressures create additional challenges to the banking sector's capacity to manage bad debt on its own. Asset quality risk will continue to rise if policy support fails to restore growth momentum. Profitability pressures will remain in the near term as weak credit demand and downbeat sentiment continue to weigh on business volumes and profit margins.

## Corporate Credit

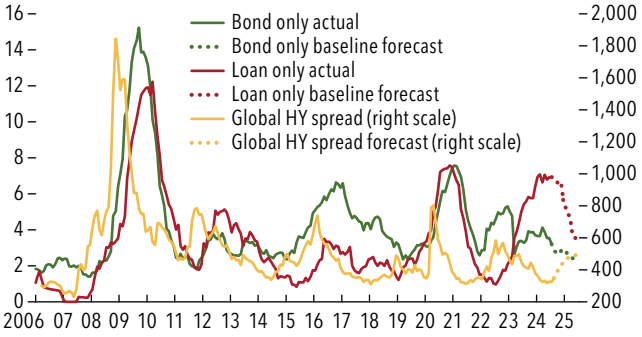
### Debt Servicing Remains Challenged for Many Firms Even with Monetary Policy Easing

Investor optimism that the global economy will achieve a soft landing has helped keep corporate bond spreads tight (see Figure 1.7, panels 2 and 3). However, the misalignment in corporate bond valuation, based on a model that account for macro fundamentals, has remained at levels similar to those at the time of the April 2024 *Global Financial Stability Report*. The degree of overvaluation among US issuers is elevated by historical standards (Figure 1.21, panel 1). In addition to confidence in the global economy, strong demand from overseas investors drove valuation up; for instance, Japanese investors have reportedly preferred US investment-grade corporate bonds to Treasury securities because the yields on the former more than compensate for costs associated with foreign exchange

## Figure 1.22. Corporate Credit Fundamentals

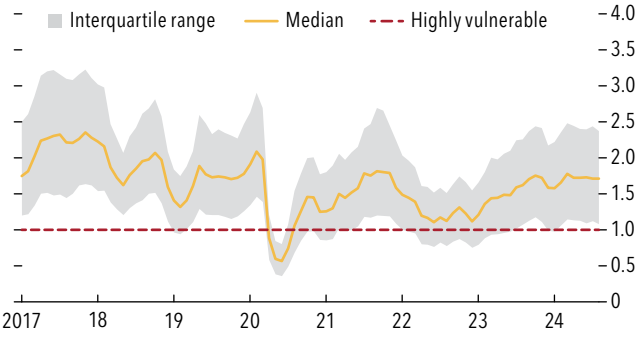
Default rates have risen somewhat ...

**1. Corporate Default Rate**
*(Percent, last 12 months, left scale; basis points, right scale)*



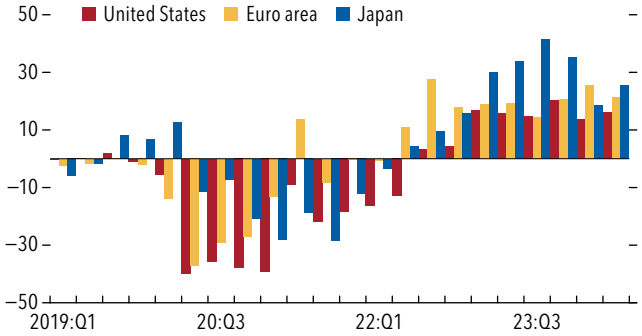

... and some firms are not far from insolvency.

**2. Distance to Insolvency in the United States and Europe**
*(Index)*



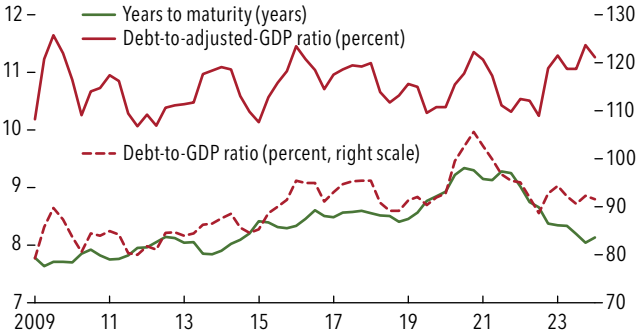

Bankruptcy cases continue to increase as smaller firms face difficulties.

**3. Growth Rate of Corporate Bankruptcies**
*(Percent, four-quarter change)*




Corporate-debt-to-GDP ratios, adjusted for the maturity of debt, are at their highest levels since the global financial crisis.

**4. Global Nonfinancial-Corporate-Debt-to-GDP Ratios and Average Duration of Outstanding Debt**
*(Years; percent, right scale)*




Sources: Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; JPMorgan; Moody's; and IMF staff calculations.

Note: Panel 2 shows distance to insolvency, based on Atkeson, Eisfeldt, and Weill (2013), for constituents of the S&P 500 and STOXX Europe 600. In panel 3, the last data point is 2024:Q2. HY = high yield.

hedging (Figure 1.21, panel 2).[26] Other credit instruments have also benefited from buoyant investor sentiment, as banks' syndicated lending has regained some market share from private credit lenders (Figure 1.21, panel 3; Figure 1.24, panel 2; April 2024 *Global Financial Stability Report*), and collateralized loan obligations have experienced their largest issuance[27] since the start of the Federal Reserve hiking cycle, as investors have sought alternative credit products.

Although solid economic activity and healthy corporate balance sheets with large cash buffers[28] have kept margins robust for some firms, loan and bond default have steadily risen as weaker firms have struggled (Figure 1.22, panel 1). Forward-looking metrics like the global distance to insolvency[29] indicate that around one-quarter of firms are vulnerable to insolvency (Figure 1.22, panel 2). Bankruptcies among smaller firms have continuously risen in recent months, with

[26]Japanese investors typically see US investment-grade corporate bonds as alternative to high-quality duration products such as Japanese government bonds or US Treasury bonds, although it does not mean that they do not manage credit risks.

[27]Collateralized loan obligation issuance volumes in the United States and euro area for the second quarter of 2024 were 60–90 percent higher than the average volumes between the first quarter of 2022 and the first quarter of 2024.

[28]On margins for firms, see the October 2023 *Global Financial Stability Report*.

[29]"Distance to insolvency" is a measure, based on Atkeson, Eisfeldt, and Weill (2013), that aims to measure the financial soundness of individual firms using data from financial statements and market-based information. US data include those for constituent firms of the S&P 500 stock index, and data for Europe include those of STOXX Europe 600 constituents.

cases exceeding prepandemic levels in Europe and Japan (Figure 1.22, panel 3). Among investment-grade firms, the amount of debts issued by "fallen angels"—issuers that have been downgraded to below investment grade—is now roughly equal to the amount of "rising stars"—debt upgraded to investment grade[30]—whereas up until the April 2024 Global Financial Stability Report, rising stars outnumbered fallen angels.

A decrease in average maturity has characterized the recent corporate debt market, as borrowers have issued less long-term debt, on average. Although this is in part a response to a monetary policy cycle with rate cuts expected in the near future, it has increased refinancing risks, as repayment obligations are concentrated over a short period, all else equal. Indeed, a version of the debt-to-GDP ratio that accounts for the remaining years of corporate debt[31] shows that corporate leverage has been rising and is now at about its highest levels since the period after the global financial crisis, even though the simple debt-to-GDP ratio has been declining (Figure 1.22, panel 4). Larger effective debt burdens could raise concerns relating to financial stability. More important, this risk is more pronounced in the high-yield segment, in which the maturity of debt has dropped much more steeply.[32]

A deeper look at individual firms reveals that cash buffers are dwindling, especially for a weak tail of companies. The share of firms with cash-to-interest-expense ratios below 1.5 has been increasing (Figure 1.23, panel 1; see also the April 2024 *Global Financial Stability Report*), especially among smaller firms. Worryingly, the share of weak small and medium firms has steadily become larger in advanced economies. Earnings relative to interest expenses, or the interest coverage ratio (ICR), have clearly deteriorated over the past year for some European and emerging Asian countries, including those that already have lower ICRs (Figure 1.23, panel 2).

For weaker firms, difficulties in servicing debt may be exacerbated by tough refinancing conditions. Refinancing yields are significantly higher than coupons on existing debt, particularly those on debt issued at very low fixed rates. Among global corporate debt coming due in 2025, for example, fixed-rate debt accounts for close to 50 percent, with existing coupons between 3.5 and 4 percent, significantly lower than the current refinancing yield of 5.5 percent (Figure 1.23, panel 3). Should monetary policy ease, global refinancing would become less costly, albeit not necessarily cheaper. If that does not happen, however, refinancing 2024 and 2025 bonds at higher interest rates would bring ICRs down by an average of 12 percent, reducing debt servicing capacity further.

Refinancing costs remain elevated specifically for emerging market corporations, especially those for foreign currency bonds, putting pressure on debt sustainability (Figure 1.23, panel 4). Correspondingly, issuance has remained much slower than before the current monetary tightening cycle (Figure 1.23, panel 5). An easing in monetary policy would help firms in emerging markets with their debt sustainability, as would a shift toward issuing in local, rather than foreign, currencies.

Trade restrictions or geopolitical events would also likely affect firms, through higher input costs.[33] The resulting margin compression would further deteriorate ICRs—in a scenario in which input costs increase by 10 percent, the weak tail of firms, with ICRs that are less than one, would increase by an additional 3 to 6 percentage points, depending on the region, with the impact especially large in emerging markets (Figure 1.23, panel 6). Although regional or industry heterogeneity are not taken into account in this

[30]The gap between the market return of a global investment-grade corporate debt index and the return implied by changes in yields (adjusted for duration) and coupons has been declining, on a 12-month rolling basis, since mid-2023, while remaining positive. This implies that the value of the index has declined at a faster pace than the yields and coupons, primarily because of an increase in the value of debt of fallen angels (which exit the index as a result of the downgrades in their ratings).

[31]A stock-to-stock approach is used here, wherein the flow variable of GDP is converted into a stock variable by interacting it with the remaining years to maturity of debt. This allows repayment obligations to be compared with the resources or earnings generated over the repayment period. The leverage of global nonfinancial corporations, measured in terms of the debt-to-GDP ratio under the stock-to-flow approach, has decreased from 108 percent in 2021 to below 100 percent currently, as recovery in GDP masks an increase in nominal debt value. However, the remaining years to maturity of debt are shortening at a faster pace. Hence, the leverage metrics that adjust for duration, that is, the debt-to-GDP ratio times the average remaining life of debts, have been increasing steadily.

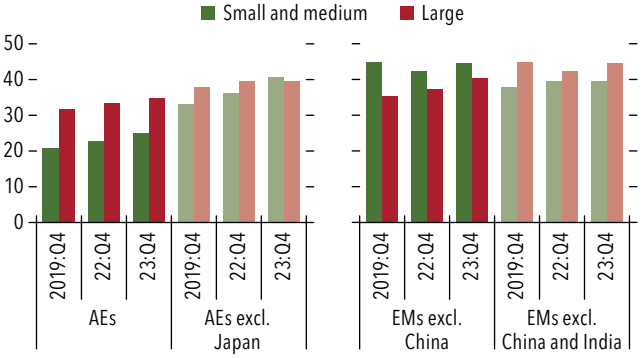
[32]The average remaining life of high-yield debt has declined at a faster rate, reaching 4.6 years in the fourth quarter of 2023 from 6.7 years in the third quarter of 2009, when leverage based on the stock-to-stock approach was near the levels seen recently.

[33]This part of the scenario being presented is calibrated to reflect higher marginal financing costs (by 150 basis points) and potential upward pressures on input costs because of factors like recalibration of international trade policies globally or supply chain disruptions caused by geopolitical events. These are seen as potentially compressing corporate margins in the near term, although such a compression would be contingent on the degree of market power (that is, a firm's ability to pass on the increase in costs to customers). In other words, the larger a firm's market power, the smaller the impact on margins. Broadly speaking, about 90 percent of firms in advanced economies have little or no meaningful market power (April 2019 *World Economic Outlook*). Hence, higher input costs will likely affect the profit margins of these firms adversely.

## Figure 1.23. Corporate Debt Sustainability

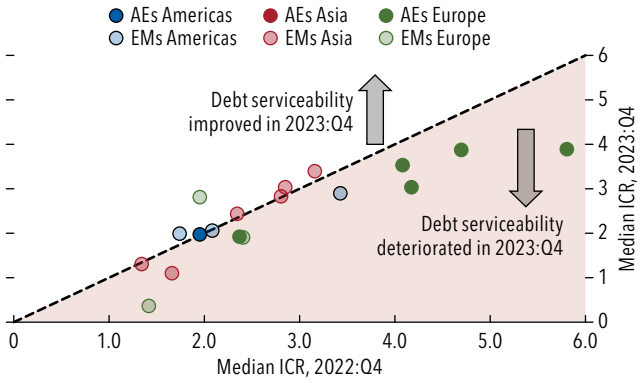
The shares of firms with less cash buffers are increasing.

**1. Share of Debt Issued by Firms with Cash Buffers to Interest Expense Ratio below 1.5**
*(Percent of total debt, average across countries)*



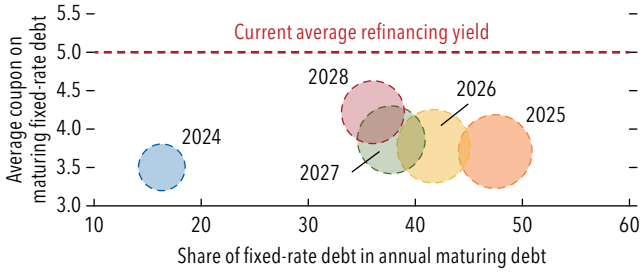

ICR has declined faster for European firms, although from high levels. ICR has slipped below two for some emerging Asia countries.

**2. Interest Coverage Ratios Across Regions and over Time**
*(Ratios)*



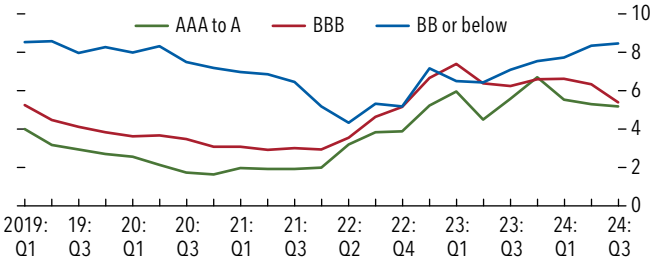

Firms have to refinance 30 percent of existing debts at higher funding costs ...

**3. Average Coupon of Maturing Debt versus Share of Fixed-Rate Debt**
*(Percent)*



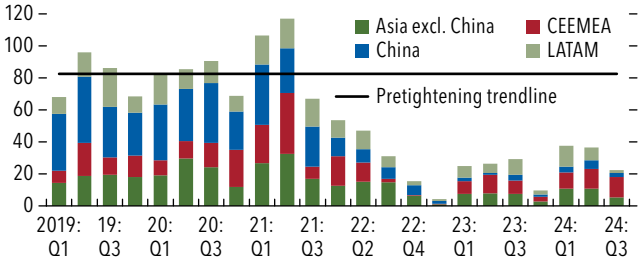

... and the average borrowing cost for EM corporates has increased over the past two years.

**4. Average Coupons for Emerging Market Corporate Bonds in Different Rating Categories**
*(Percent)*



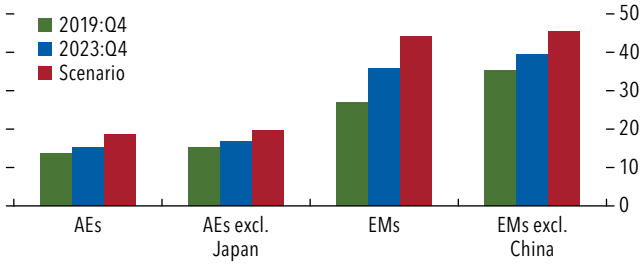

EM hard-currency corporate bond issuance has slowed.

**5. Emerging Market Hard-Currency Bond Issuance by Region**
*(Billions of US dollars)*




In a scenario where more trade tensions lead to higher input costs, the share of firms with low interest coverage rises meaningfully above prepandemic levels.

**6. Share of Corporate Debt with ICR Below One in Total**
*(Percent)*



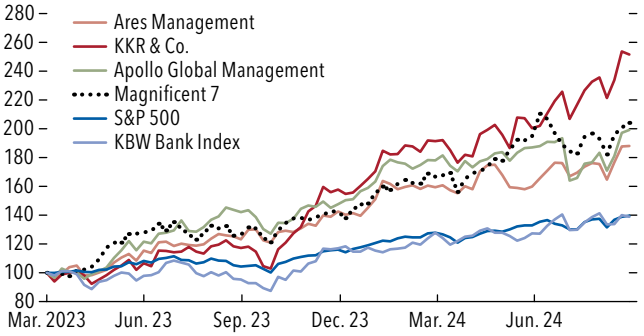

Sources: Bloomberg Finance L.P.; Bond Radar; Dealogic; IMF, World Economic Outlook database; S&P Capital IQ Pro; and IMF staff calculations.

Note: Panels 1, 2, and 6 are based on data from a sample of 19 countries comprising Brazil, Chile, China, France, Germany, India, Indonesia, Italy, Japan, Korea, Malaysia, Mexico, Poland, Russia, Spain, Thailand, Türkiye, the United Kingdom, and the United States. For these panels, the aggregate values represent the average weighted by outstanding debt. In panel 2, the outliers beyond the scale are not displayed in order to improve presentation. In panel 3, the size of the bubbles represents the total outstanding debt maturing. In panel 5, "pretightening trendline" is an average of values for 2019:Q1 and 2021:Q4 at $82.5 billion. In panel 6, "scenario" shows the share of debt that bears an interest coverage ratio of below 1 in the scenario explained in note 37. AEs = advanced economies; CEEMEA = Central and Eastern Europe, the Middle East, and Africa; EMs = emerging markets; excl. = excluding; ICR = interest coverage ratio; LATAM = Latin America.

## Figure 1.24. Expansion in Private Credit Despite Borrowers' Struggles

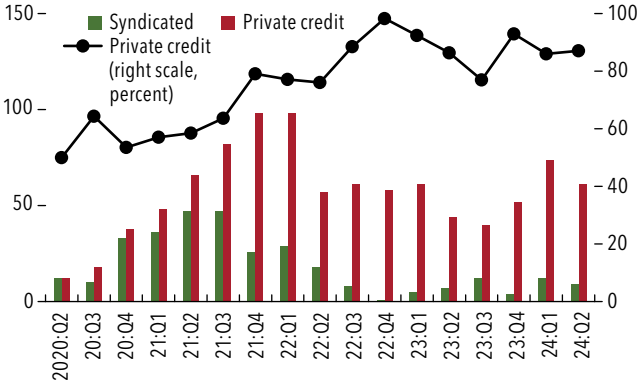
Favorable expectations for the private credit industry have supported stock prices of specialized asset managers.

**1. Stock Prices of Selected Asset Managers Versus the Rest of the Equity Market**
*(Normalized, March 2023 = 100)*



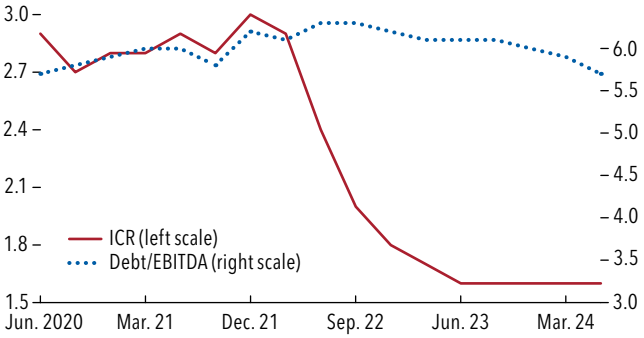

Private credit expansion beyond middle-market firms intensifies competition with banks on large deals.

**2. Number of LBOs Financed Through Broadly Syndicated Loans versus Private Credit**
*(Number of LBOs; percent)*



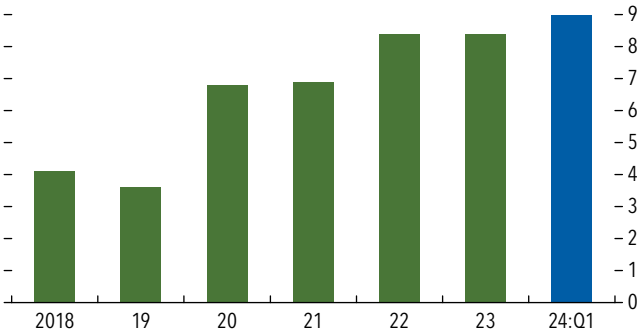

High interest rates and leverage have jeopardized borrowers' ability to service their debt ...

**3. Interest Coverage Ratio and Leverage (Ratio of Debt to EBITDA) for Borrowers from US BDCs**
*(Ratios)*




... and are exerting significant pressure on cash flows of private credit borrowers.

**4. PIK Income as Share of Interest and Dividend Income of US BDCs**
*(Percent)*




Sources: BDC disclosures; Bloomberg Finance L.P.; Fitch; PitchBook; and IMF staff calculations.

Note: Panel 2 is based on US data. In panel 4, when interest is paid in kind, no cash flow occurs. Instead, the interest coupon is added–usually at an extra cost–to the loan's principal. BDC = business development company; EBITDA = earnings before interest, taxes, depreciation, and amortization; ICR = interest coverage ratio; LBO = leveraged buyout; PIK = payment in kind.

scenario, negative fallout could be more pronounced in trade-dependent economies or industries. In contrast, some economies or industries could benefit from supply chain reorganization or trade reallocation.

## Private Credit Continues to Grow and Vulnerabilities Are Rising

Private credit—that is, credit provided outside the realms of either commercial banks or public debt markets—continues to grow, and the favorable outlook for this market has pushed up the stock prices of specialized asset managers, which have outperformed bank stocks and the broader equity market (Figure 1.24, panel 1). Private credit has now entered credit segments beyond lending to midsized corporate borrowers, intensifying competition with banks in the syndicated loan markets in which they dominate (Figure 1.24, panel 2).

However, signs are mounting that high interest rates are pressing private credit borrowers, and a severe downturn has not yet tested the many features designed to mitigate credit risks at the private credit industry's current size and scope. There are signs that the private credit industry's rapid growth, competition from banks on large deals, and pressure to deploy capital may be leading to a deterioration of underwriting standards and weakened covenants, amid interest rate pressure.

Business development companies are often used as a proxy for the overall industry, as their granular reporting provides a valuable window on the normally opaque world of private credit. They show that ICRs have continued to decline because of borrowers' high leverage, the floating rate nature of loans, and the slowdown of economic activity (Figure 1.24, panel 3). And although defaults, narrowly defined (that is, missed payments), are relatively rare among private credit borrowers because of the inherent flexibility of private credit vehicles to amend and extend loans (and potentially complement them with equity warrants; see McDonnell 2024), default under broader measures, including restructurings or breaches of covenants, is becoming frequent (Berlin 2024). Indeed, a significant share of borrowers are facing cash flow pressures, as the ever-growing share of payment-in-kind coupons shows (Figure 1.24, panel 4).

The opaqueness of the private credit industry makes it challenging to assess risks related to it and quantify the full extent of deterioration of private credit loans (Ellias and de Fontenay 2024; Chapter 2 of the April 2024 *Global Financial Stability Report*). In a downside scenario, stale and uncertain valuations of private credit could lead to deferred realization of losses followed by a spike in defaults (April 2024 *Global Financial Stability Report*). This possibility makes the private credit industry vulnerable to episodes of crisis of confidence, which may be triggered, for example, by an outsized share of defaults in a group of funds. An adverse feedback loop could ensue, wherein fundraising for private credit might be temporarily frozen, semiliquid funds might suffer runs, and at the same time, banks or other investors might refuse to continue providing leverage and liquidity to private credit funds. Such a scenario could force the entire network of institutions that participate in the private credit industry to reduce exposures to the sector simultaneously, triggering spillovers to other markets and the broad economy.

## Real Estate

### Home Prices Continued to Decline at a Modest Pace with Stability Risks Remaining Contained

The decline in global real house prices has continued at an increasingly modest pace but will be unlikely to affect the financial stability of households, given manageable debt burdens and the presence of only a limited number of complex financial instruments that can amplify a housing downturn into a broader turmoil. On an annual basis, real home prices in emerging markets have declined by 1.6 percent, and in advanced economies, the drop has been 0.3 percent. Still, global real house prices remain 5 percent above the prepandemic average, causing affordability to remain stretched globally (Figure 1.25, panel 1). Supply-side constraints, such as rising construction costs and shortages of construction materials, have partly dampened the pass-through of elevated interest rates on demand through lower affordability, particularly in some countries, resulting in a varying price elasticity of new housing supply (Figure 1.25, panel 2).

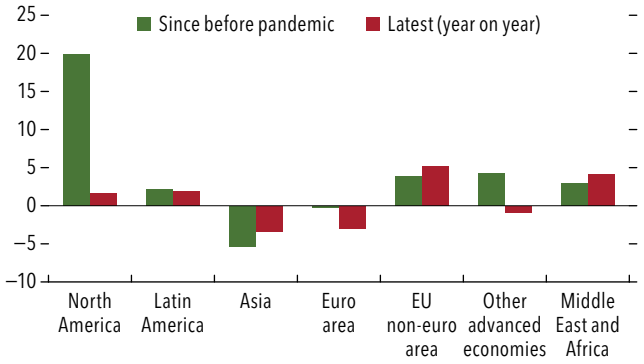
Year-over-year real home price changes are widely distributed (Figure 1.25, panel 3). Countries with a higher percentage of variable-rate mortgages, such as Norway (see also Chapter 2 of the April 2024 *World Economic Outlook*) as well as countries experiencing a very large price buildup in the aftermath of the pandemic (for example, Canada), have continued to record significant declines. Home prices in Korea, South Africa, and Sweden, and, to a lesser extent, the euro area and the United Kingdom, have also undergone annual declines, and weak demand has continued to weigh down China's property despite recent government support measures (see "Slowing Growth and Deflationary Pressures Weigh on China's Financial System"). The sharp decline in residential investment observed in some countries, however, suggests that the house price drop in those jurisdictions may not extend much further, especially as supply constraints continue to bind, with price being further supported by potential improvements in demand going forward. US house prices, on the other hand, have increased 2 percent year over year, as housing inventories have continued to be absorbed briskly and lower mortgage rates have boosted refinancing activity and mortgage origination. There is still room for house prices to decline in some jurisdictions, particularly those with high levels of household leverage (Figure 1.25, panel 4) and overvalued property markets, as well as those in which substantial easing in monetary policy is less likely. However, risks to financial stability are contained: Further increases in mortgage rates are not projected to raise household debt-servicing expenses significantly ("Scenario 1" in Figure 1.25, panel 4), a limited number of risky and complex financial instruments are tied to the housing market, and household and bank balance sheets are sound overall.[34]

[34]Of issuances, small amounts remain of the private-label residential mortgage-backed securities that played a role during the global financial crisis. See Sifma (2024).

## Figure 1.25. Developments in Global Residential Real Estate Markets

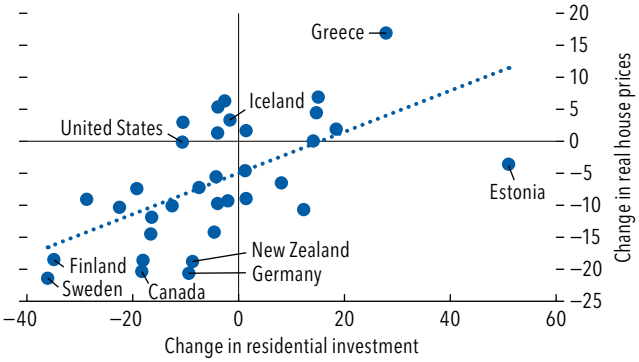
House prices continue to decline globally, however, at an increasingly modest pace, with Asia, the euro area, and other advanced economies leading the decreases.

**1. Real Growth in House Prices by Region**
*(Percent)*



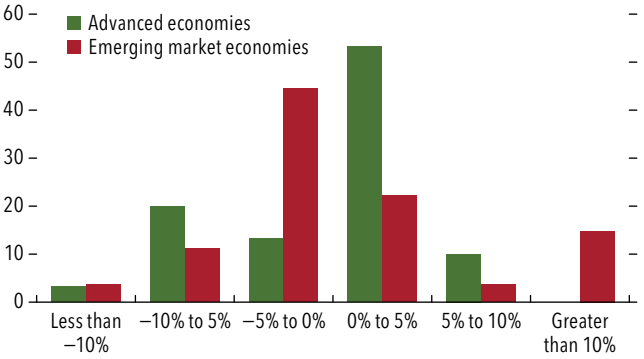

Price elasticity of new housing supply continues to show significant variation among countries.

**2. Changes in Real House Prices and Residential Investment (Proxy for Supply) since 2022**
*(Percent)*



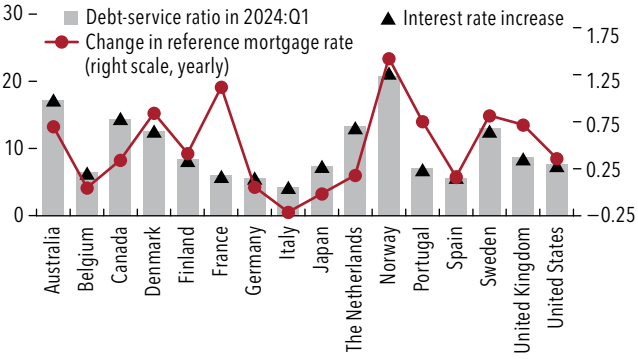

Price change has slowed, with less than 5 percent of jurisdictions recording double-digit declines.

**3. Distribution of Yearly Changes in Real House Prices Across Countries**
*(Percent of jurisdictions)*




Contained household debt limits debt-servicing ratios even at higher mortgage interest rates.

**4. Effect of Mortgage Rates on Households' Debt-Service Ratios**
*(Percent)*




Sources: Bank for International Settlements; EUROPACE AG/Haver Analytics (Group of Ten accounts); Federal Reserve Bank of New York Consumer Credit Panel/Equifax; National Association of Realtors; Organisation for Economic Co-operation and Development; and IMF staff calculations.

Note: In panel 1, "Since before pandemic" refers to 2019:Q4. Countries are grouped based on 2023 real GDP in purchasing power parity from the IMF's World Economic Outlook database. "Other advanced economies" includes Australia, New Zealand, Norway, Switzerland, and the United Kingdom. In panel 2, "change in residential investment" refers to gross fixed capital formation in housing. In panel 4, the debt-service ratio is defined as the ratio of interest payments plus amortizations to income, assuming debt is repaid in equal portions over the maturity of the loan (that is, no prepayments). The reference mortgage rate in each country is obtained from the Group of Ten accounts of EUROPACE AG/Haver Analytics. For Belgium, Denmark, Finland, France, Germany, Italy, The Netherlands, Portugal, Spain, Sweden, and the United Kingdom, the reference mortgage rate is represented by a weighted average of the prevailing mortgage interest rates. For Canada, the reference mortgage rate is the five-year average residential mortgage lending rate, and for the United States, it is the 30-year fixed mortgage rate. Scenario 1 considers a change in household debt-service ratios in proportion to the observed or predicted (based on the average mortgage rate change since 2023) change in mortgage interest rates over the following quarter, with credit obtained by extrapolating the previous year-on-year growth.

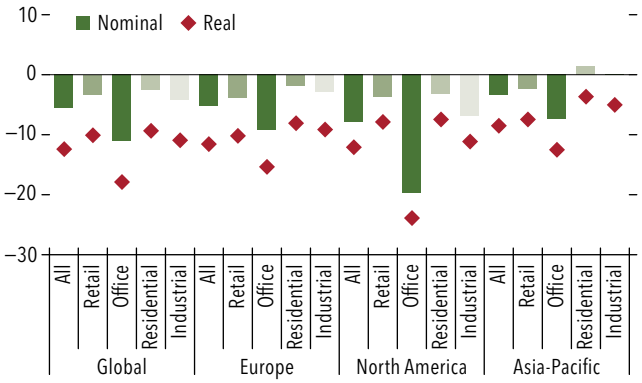
### Pressures on the Commercial Real Estate Sector Remain Acute

CRE is at risk of further correction, especially if financial institutions active in lending to this market come under strains, including real estate investment trusts, commercial mortgage-backed securities (CMBSs), and some banks. Funding could then be withdrawn discreetly, pushing down prices and putting more institutions under pressure in an adverse feedback loop. Based on latest available data, global CRE prices have fallen by 12 percent year over year, weighed down by still-high interest rates and poor investor sentiment (Figure 1.26, panel 1). The US (European) office sector is experiencing a 23 (16) percent decline. There are signs of stabilization as price decline of CRE owned by institutional investors has

## Figure 1.26. Developments in Commercial Real Estate Markets

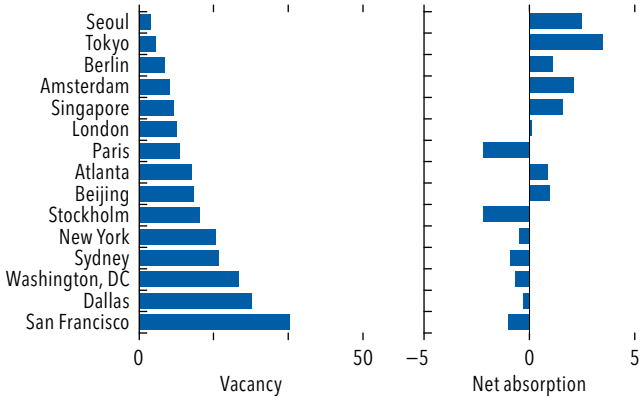
The global CRE market continues to reprice ...

**1. Changes in Private CRE Valuations**
*(Percent year over year, 2023:Q4)*



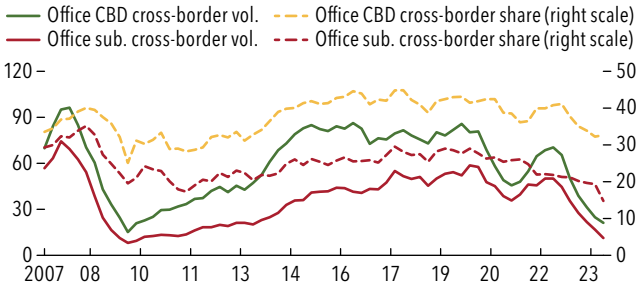

... although demand for CRE differs across regions.

**2. Vacancy and Net Absorption Rates Across Cities**
*(Percent)*



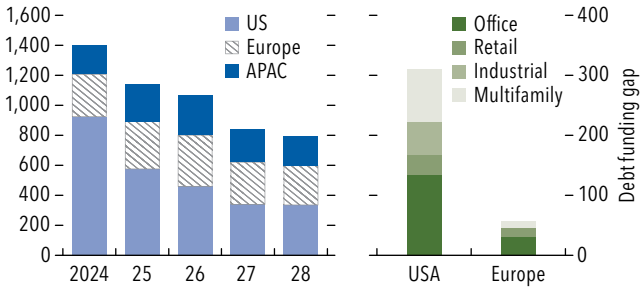

The office sector continues to face financing challenges.

**3. Cross-Border Investments in Office**
*(Billions of US dollars, left axis; share of total investment in sector, percent, right scale)*



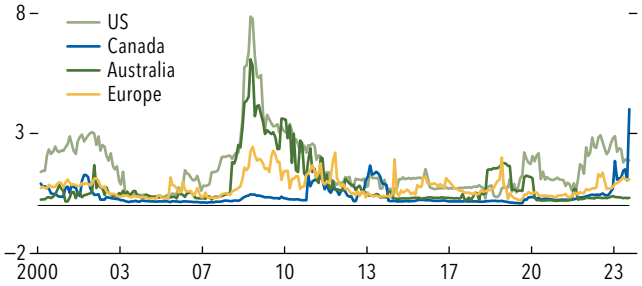

Significant volumes of CRE debt will mature in the next few years.

**4. CRE Maturing Debt and Funding Gap**
*(Billions of US dollars)*



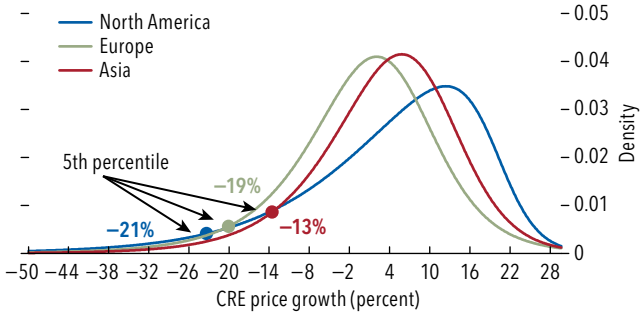

Funding conditions are also affecting alternative investors in CRE markets.

**5. Expected Default Frequency of REITs**
*(Percent, one year ahead)*




CRE markets continue to face downside risks.

**6. Downside Risk to CRE**
*(Probability density, cumulative real price growth over three years)*




Sources: AEW; Bloomberg Finance L.P.; EUROPACE AG/Haver Analytics; Green Street; JLL; MSCI Real Estate; RICS; and IMF staff computations.

Note: Panel 1 shows changes in the asset value growth index across different regions and CRE sectors. In panel 2, the net absorption rate indicates the proportion of total available space that has been absorbed (that is, leased or occupied) within a specific period, relative to the total inventory or supply of space in the market. In panel 3, the volume of cross-border acquisitions by property type is based on trailing four-quarter data. In panel 4, the debt funding gap for each origination year and sector is based on the fraction of loans maturing within five years divided by the average loan-to-value ratio for that year. This value is adjusted for expected price corrections and compared with agencies' forecast loan-to-value ratios to calculate the debt funding gap with respect to the original loan amount. In panel 6, probability densities are estimated for the distributions of three-year-ahead (cumulative) CRE price growth (in real terms), following the approach in Deghi, Mok, and Tsuruga (2021). Bullets indicate price declines with a 5 percent probability. APAC = Asia and Pacific; CBD = central business district; CRE = commercial real estate; REIT = real estate investment trust; sub. = suburban; vol. = volatility.

slowed, and the spread of prime property yields over long-term government bond yields has eased in some regions. Nonetheless, transaction volumes were just over $130 billion in 2023, a 37 percent decrease from the previous year.[35]

Changing international trade patterns, along with region-specific shocks and postpandemic shifts to remote working, are leading to diverging country and regional performance. US metro areas have higher vacancy rates than those anchored by other global cities and are projected to have negative net absorption rates, indicating that occupancy is outpaced by newly vacant space (Figure 1.26, panel 2). By contrast, technological transformations like artificial intelligence and cloud computing are expected to boost demand for data centers and other similar types of CRE, especially in Asia-Pacific.

Over the past few years, sources of CRE funding have shifted significantly. Tight bank lending standards and subdued investor sentiment are expected to further restrict CRE financing, leading to project delays or cancellations and reducing supply.[36] Equity investments by institutional investors have declined significantly as they favor debt instead.[37] Cross-border investment flows into global property markets, especially the office sector, would likely remain subdued in the near term as properties face high vacancy rates. Historically, offices accounted for 40 percent of cross-border CRE investments between 2010 and 2023 (Figure 1.26, panel 3). With the rise of hybrid work models, this share has declined by close to 10 percentage points since 2022.

In the United States, banks with global footprints have the greatest exposure to vulnerable loans on central business district offices, with this segment accounting for 26 percent of their total CRE loan originations over the past three years, whereas the same share is just 4 percent for national and regional and local banks. Banks could lend more conservatively toward central business district office and other vulnerable CRE segments, posing challenges to refinancing of a high volume of loans coming due (Figure 1.26, panel 4). In the United States alone, nearly $1 trillion in CRE debt will mature between 2024 and 2025, with a funding gap of almost $300 billion. Globally, about 40 percent of loans held by banks, 25 percent by commercial mortgage-backed securities, and 20 percent by investor-driven lenders like debt funds are maturing over this period. CMBS lenders have the largest exposure to loans maturing in 2024, accounting for nearly 30 percent of the balance. Strains in the sector are likely to persist, as delinquencies of CMBSs specializing in office properties are above 8 percent, up 3 percentage points from the previous year, and CMBSs still have very wide spreads. Real estate investment trusts, which depend on bank funding for liquidity, have elevated expected frequencies of default in Canada and the United States (Figure 1.26, panel 5).

Overall, the unprecedented combination of maturing debt, high interest rates, general dearth of CRE sales, and varied effects across property types distinguish this CRE cycle from past ones. Rate cuts alone might not resolve all the challenges facing investors in CRE, as many markets continue to contend with postpandemic remote work that has reshaped CRE demand, particularly in the market for central business district offices. Taking into account various supply, demand, and financing factors, the CRE price-at-risk model of Deghi, Mok, and Tsurunga (2021) indicates that CRE prices still have room to correct. With 5 percent probability, real prices are estimated to decline over the next three years by about 20 percent in North America and 19 percent in Europe (Figure 1.26, panel 6).[38]

[35]In Europe, for instance, the excess spread of prime property yields over long-term government bond yields is rebounding and nearing its 25-year historical average. Meanwhile, in the United States, market agencies project rates of capitalization—the ratio of a property's net operating income to its value—will peak in 2024.

[36]Total cumulative distress related to US commercial property reached $94.2 billion in the second quarter of 2024, with $10.6 billion of new distress in the period. Spikes in the numbers of terminated deals (when a property goes under offer and the transaction collapses) and of pulled offers (when assets are brought to market but do not sell) also indicate the dislocation. Globally, the number of such events spiked in the first quarter of 2024 to the highest levels since 2010.

[37]Debt funds have significantly outperformed equity investments in European real estate since the end of 2022, according to MSCI's recently launched Europe Quarterly Private Real Estate Debt Fund Index, as higher rates have led to a widespread correction in property values. The presence of CRE debt premiums, as indicated by the spread between 10-year fixed-rate CRE and corporate A to Baa rates, could be driving this correction.

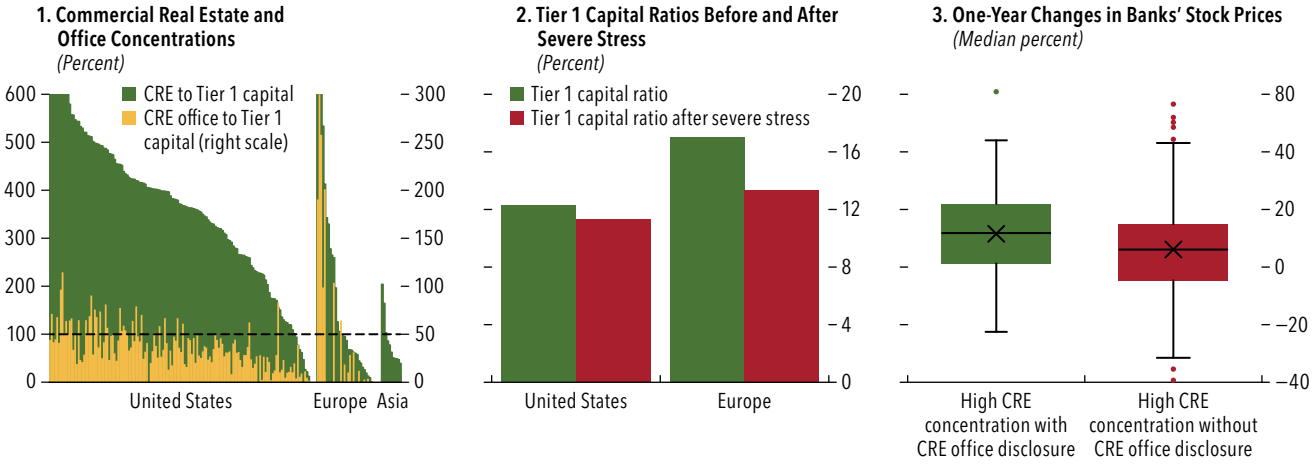
[38]CRE price projections in an adverse scenario with 5 percent probability are based on a CRE prices-at-risk model. For further details, see Deghi, Mok, and Tsuruga (2021). The analysis suggests that prolonged high interest rates and tighter financing conditions heighten downside risks to CRE.

## Figure 1.27. Bank Exposures in Commercial Real Estate Offices

A high share of banks has concentrations in CRE office exposures.

Most banks in Europe and the United States can withstand a severe CRE office shock, but some might face solvency challenges.

Banks with more detailed CRE disclosure outperform banks without office disclosures.




Sources: Bloomberg Finance L.P.; S&P Capital IQ Pro; US firms' annual reports and Securities and Exchange Commission Forms 10-Q and 10-K; and IMF staff estimates.

Note: In panel 1, dashed lines indicate high concentrations of CRE offices, defined as ratios of exposures of CRE offices to Tier 1 capital above 50 percent. In panel 2, high concentrations of CRE offices are defined as ratios of exposures to CRE offices to Tier 1 capital greater than 50 percent. Severe stress corresponds to a scenario in which exposures to CRE offices lose 50 percent of their value. In panel 3, "high CRE concentration" is defined as ratios of CRE exposures to Tier 1 capital plus loan loss reserves greater than 300 percent in the United States and ratios of CRE exposures to Tier 1 capital greater than 100 percent in Europe. Median shown as middle line in each box; dots depict outliers. CRE = commercial real estate.

### Concentrated Exposure in Office Commercial Real Estate May Challenge Some Banks

Pressures on CRE have kept banks with large exposures to it in the spotlight. Although most banks appear to have adequate loan loss reserves and capital buffers to absorb potential CRE losses, some, particularly those with exposures concentrated in the office segment, might face challenges. A review of the financial reporting of 398 banks in Asia, Europe, and the United States, including all global systemically important banks, reveals that many have a high ratio of CRE loans to Tier 1 capital, particularly in the United States (Figure 1.27, panel 1).[39] In this sample, only about one-quarter of publicly traded US banks disclose exposures to the embattled office sector, and only a few European banks disclose this information.[40] Nonetheless, among banks that report information on CRE offices, many have large exposures, with about 25 percent of sample US banks and almost 50 percent of sample European banks reporting CRE office exposures in Tier 1 capital greater than 50 percent (Figure 1.27, panel 1).

In an adverse scenario in which CRE office exposures lose 50 percent of their value, the aggregate Tier 1 capital ratio of US banks would decrease from 12.3 to 11.3 percent. Among European banks, the ratio would drop from 17 to 13.3 percent (Figure 1.27, panel 2).[41] Although such a shock seems manageable at an aggregate level, 4 percent of the banks in the sample (US and European banks)—representing 1 percent of assets—would find their Tier 1 capital ratios dipping below 7 percent. The lack of granular CRE disclosures complicates risk assessments, and investors appear to penalize banks that forgo providing detailed information. For example, stock prices of US banks with high CRE concentrations that disclose their office exposures tend to outperform those of banks not disclosing them (Figure 1.27, panel 3).[42]

[39]A high ratio is defined here as a CRE exposure in Tier 1 capital greater than 300 percent in the United States and 100 percent in Europe.

[40]More German banks opted to disclose CRE exposures in the second half of 2023 to alleviate investors' concerns. See IMF (2024a, p. 22).

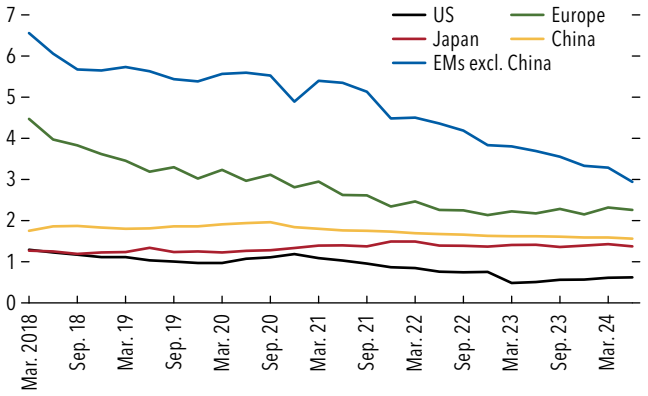
[41]A simplified severe CRE office stress test was performed for a sample of 14 banks in Europe and 145 banks in the United States that disclosed CRE office exposures in their periodic reporting as of the end of 2023 or the first quarter of 2024.

[42]As measured by changes in one-year stock prices as of July 31, 2024.

**Figure 1.28. Broad Resilience in the Banking Sector, with Persistent Weakness Among Several Small Banks**

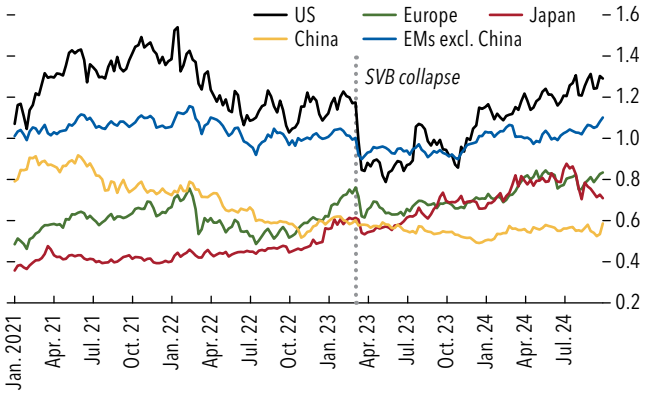
Modest deterioration of asset quality has helped banks' earnings.

**1. Ratio of Nonperforming Loans to Gross Loans**
*(Weighted-average ratio, percent)*



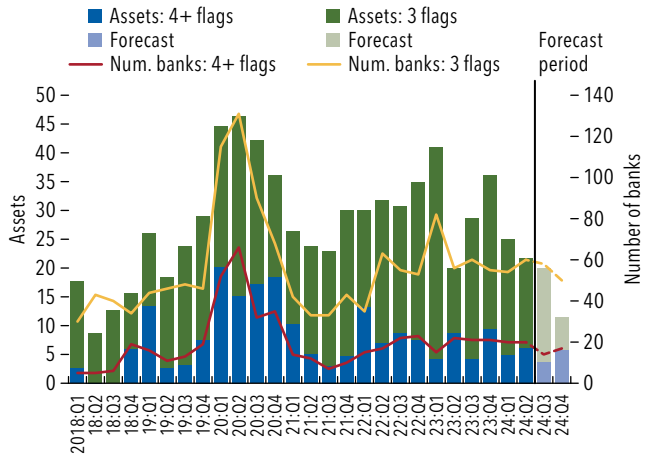

The relatively favorable outlook has improved valuations.

**2. Price-to-Book Multiplier**
*(Percent)*



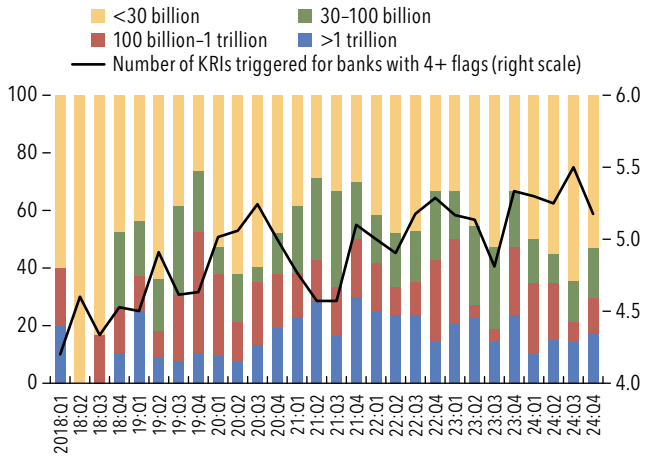

The number of banks with multiple flags has diminished, signaling receding risk.

**3. Total Assets of Banks Signaling Vulnerabilities in Three or More Areas of Risk**
*(Trillions of US dollars)*




The participation of small banks in the IMF monitoring list is increasing.

**4. Participation in IMF's Monitoring List by Banks' Size**
*(Percent, average number of KRI)*




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

Note: In panel 3, the forecast period is based on aggregate consensus analyst forecasts that are used to track the evolution of the key risk metrics over the subsequent three quarters as a measure of forward-looking risks. In panel 4, banks' size refers to banks' total assets in US dollars. EMs = emerging markets; excl. = excluding; KRI = key risk indicator; num. = number of; SVB = Silicon Valley Bank.

## Bank and Nonbank Financial Intermediaries

### The Global Banking Sector Is Resilient Although a Weak Tail of Smaller Banks Faces Challenges

The global banking sector has remained resilient since the April 2024 *Global Financial Stability Report*, with capital and liquidity buffers ample and profitability having improved. Although NPL ratios have risen in some forms of lending, such as consumer credit cards, auto loans, and CRE, overall asset quality has not deteriorated significantly (Figure 1.28, panel 1). Banks' profitability has benefited from higher noninterest income, like fees and commissions, and from measures to reduce operational costs, pushing up their stock valuations (Figure 1.28, panel 2). In the near term, net interest margin and bank profitability could be adversely affected by interest rate cuts, as banking assets tend to reprice more quickly than deposits. However, in the medium term, lower interest rates

could stimulate a rebound in lending, and reduced refinancing costs might help alleviate some of the pressures facing the CRE sector.

The IMF staff's key risk indicators (Chapter 2 of the October 2023 *Global Financial Stability Report*) capture the improved risk outlook, with fewer banks expected to be flagged as deficient in three or more risk indicators by the end of the year (Figure 1.28, panel 3). However, the number of banks with four or more weak risk indicators is expected to rise, suggesting that weak banks are becoming increasingly vulnerable. This trend appears to be more pronounced in Asia and reflects expectations for a deterioration of asset, liquidity, and market risk metrics.

Smaller banks with assets less than $100 billion have featured more prominently on the monitoring list in recent times (Figure 1.28, panel 4). Although specific reasons for their weaknesses vary, many face challenges related to their business models that result in lower earnings and underperformance or undervaluation of their stocks. In the United States, unrealized losses in securities portfolios and high CRE exposures remain a concern (see "Concentrated Exposure in Office Commercial Real Estate May Challenge Some Banks"). Some banks have recently increased their use of synthetic risk transfers to manage risks and boost capital ratios, which requires attention from supervisors (see Box 1.1).

Although the bout of market volatility in early August has led only to a temporary sell-off of some banks' stocks, its cause—investor fears about a forthcoming recession—highlights the challenges facing the banking industry. An economic slowdown can deteriorate asset quality and reduce loan demand, and the associated easing of monetary policy will likely lower interest income, at least in the short term. Importantly, during downturns, investors can shift rapidly from a balance sheet view to a mark-to-market view of risks, in which they assess a bank's viability based on the market value of its assets, irrespective of their accounting or regulatory value. Supervisory attention to the effect of a downturn on banks' safety and the soundness of their business models, especially for weak institutions, is paramount. The significant risk that financial crimes pose to macrofinancial stability also requires the integration of measures against money laundering and the financing of terrorism within the broader financial stability framework.

## Growth of Bond Funds Renews Concerns About Maturity Mismatches and Use of Leverage

The potential mismatch between the liquidity of underlying assets and redemption terms is a key vulnerability of the asset management industry because it could precipitate forced selling when asset prices are falling. There are signs that this vulnerability is growing among open-ended bond mutual funds. Many allow for daily redemptions, whereas the underlying assets are relatively illiquid compared to, for example, equity funds. Two trends are contributing to the growing significance of this vulnerability. First, bond funds have grown strongly over past decades, with assets under management increasing sevenfold between 2009 and 2024 in the US market. Holdings of US bonds among exchange-traded funds (ETFs) and open-ended mutual funds now account for about 25 percent of the total outstanding, up from about 10 percent in 2009 (Figure 1.29, panel 1). Second, there has been a rotation toward institutional investment funds and ETFs, with institutional mutual funds having overtaken retail mutual funds in size.

Bond ETFs and institutional mutual funds are more likely to face large and sudden outflows, with fund flows-at-risk that have higher (across funds) medians and larger ranges (Figure 1.29, panel 2). Although the structure of ETFs—through authorized participants—partly shields the underlying bond market from sudden redemptions, these funds may have a less stable investor base attracted to intraday trading and shorting of ETF shares (Cai and others 2024). There is considerable heterogeneity across types of ETFs, and some face large peak outflows, as their large fund flows-at-risk reflect.[43] Peak outflows are also larger for institutional mutual funds compared with those for retail mutual funds, possibly because institutional investors are more active in reallocating investments than retail ones.

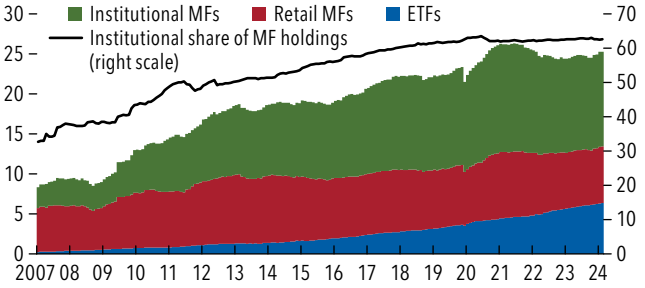
Sudden fund outflows could lead to forced sales of assets funds hold, affecting the broader market. And in less liquid markets, there may be an adverse feedback loop: Investors who are aware of the illiquidity of their funds' underlying assets may withdraw their investments more quickly and in larger quantities; these large outflows would have outsized price effects on

[43]Fund flows-at-risk are defined as the 5th percentile of the historical flow distribution. The analysis presented in this section uses monthly data covering 2014–24 to calculate the fund flows-at-risk, at the level of each individual fund.

## Figure 1.29. Growth, Outflows, and Leverage of Bond Funds

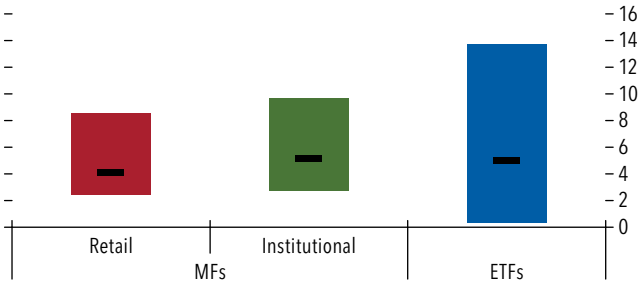
US bond funds' assets under management have grown strongly.

**1. US Bond Fund Assets Under Management**
*(Percent of bonds outstanding, left scale; institutional share of mutual fund holdings, percent, right scale)*



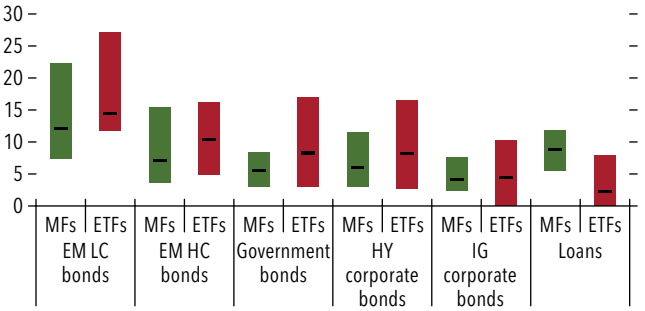

Peak outflows tend to be higher for institutional mutual funds and ETFs.

**2. Distribution of Monthly Fund Flows-at-Risk Among US Bond Funds**
*(Median and interquartile range, percent of assets under management)*



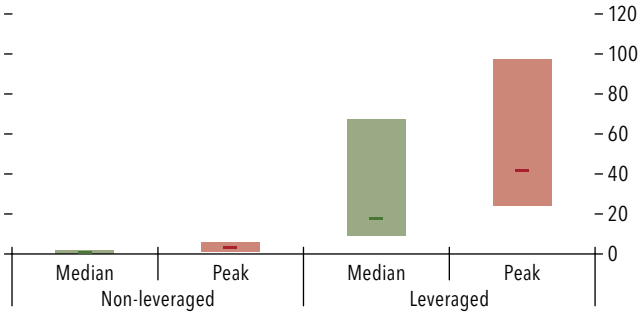

Fund flows-at-risk are particularly high for emerging market bond funds, especially ETFs.

**3. Median Fund Flows-at-Risk by Bond Fund Type**
*(Percent of assets under management)*



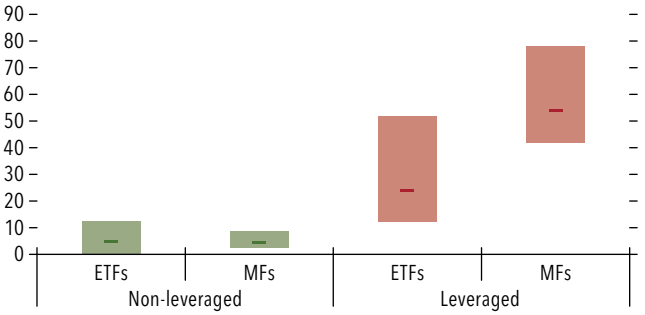

Leveraged bond funds take on significant leverage through repurchase agreements.

**4. Median and Peak US Bond Fund Repo Usage**
*(Percent of assets under management)*



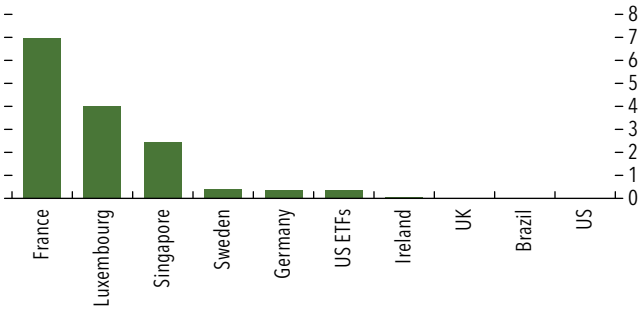

Leveraged funds can face very large outflows ...

**5. Monthly Fund Flows-at-Risk**
*(Percent of assets under management)*




... but account for a relatively small share of most jurisdictions' bond mutual fund universe, with some exceptions.

**6. Leveraged Fund Share by Country**
*(Share of bond funds, percent)*

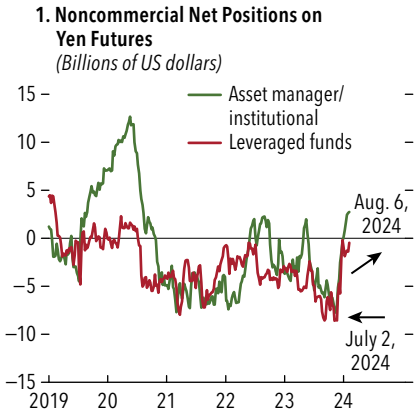



Sources: Bloomberg Finance L.P.; EPFR; Lipper; and IMF staff calculations.

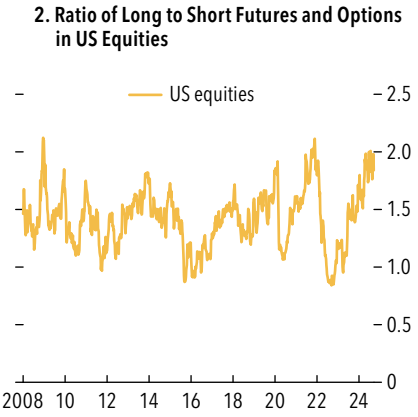
Note: "Fund flows-at-risk" are the 5th percentile of flows, based on historical flow data, that is, in 5 percent of cases, the outflows would have been larger. In panel 1, ETF and MF holdings of US-domiciled funds are compared with the market value of the Bloomberg Barclays US aggregate bond index. Some holdings, however, may be in foreign bonds, and some US bonds may be held by foreign funds. The percentages shown in panel 1 are therefore indicative. In panels 2–5, the analysis is based on Lipper data covering US-domiciled bond funds. The panels show median values and interquartile ranges across funds within each category of funds. The median flow, the fund flows-at-risk, and the median and peak repo usage are first computed for each individual fund, based on monthly data spanning 2014–24, before the distribution across funds is computed. Peak repo usage refers to the 95th percentile of a fund's monthly data on repo usage. The analysis in panel 6 is based on Lipper data covering bond funds and is subject to fund coverage and classification by Lipper. The panel shows a selection of jurisdictions. The share of leveraged US bond ETFs is added for illustration; for other countries, only the share of leveraged bond mutual funds is shown. In all panels, the analysis of MF flows covers open-ended MFs only, and "MFs" is used as shorthand for open-ended MFs. EM = emerging market; ETF = exchange-traded fund; HC = hard currency; HY = high yield; IG = investment grade; LC = local currency; MF = mutual fund.

**Figure 1.30. Hedge Funds and Carry Trades**

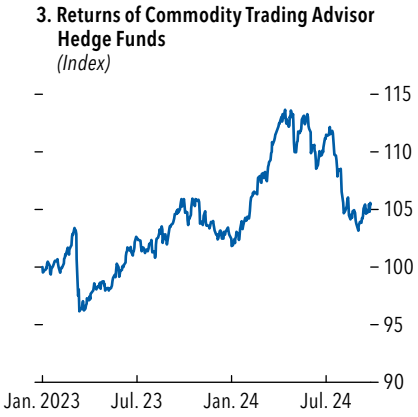
Hedge funds, along with other leveraged institutions and investment funds, built substantial short positions in yen futures ...




... and long positions in equity options and futures ...




... that contributed to market volatility and generated substantial losses when they were unwound in early August.




Sources: Bloomberg Finance L.P.; MSCI; US Commodity Futures Trading Commission; and IMF staff calculations.

Note: Panel 1 shows estimated net positions in US dollars based on the number of long and short contracts reported on a weekly basis. In panel 2, "US equities" comprises futures and options on E-mini contracts for the S&P 500, the Dow Jones, and the Nasdaq for both noncommercial asset managers and leveraged funds. The index in panel 3 is calculated as the weighted average return of 10 selected mutual funds managed by some of the largest commodity trading advisor hedge funds globally.

the underlying market, further exacerbating illiquidity. Bond funds in emerging markets—both those in local and those in hard currency—stand out in this regard, as they have relatively large fund flows-at-risk (Figure 1.29, panel 3) and the underlying market is also relatively illiquid (see Chapter 1 of the April 2024 *Global Financial Stability Report*).

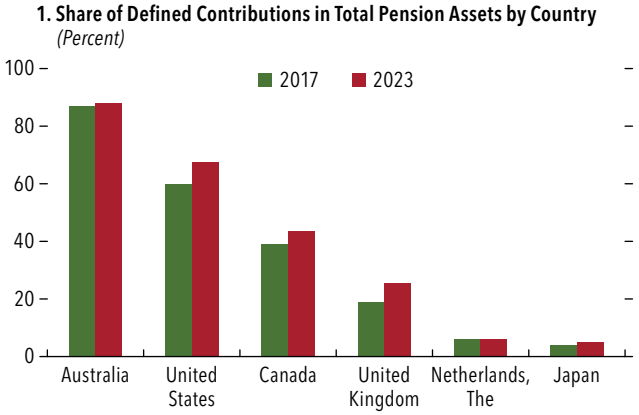
With investors likely aware of the risk associated with funds that employ repos (Figure 1.29, panel 4), leveraged bond funds tend to experience larger peak outflows compared with their nonleveraged peers (Figure 1.29, panel 5). The former currently constitutes a small share of the bond fund sector, although there are differences across jurisdictions (Figure 1.29, panel 6). Regulators should be aware that deleveraging by even a small set of funds could have an outsized effect on the broader financial system (see also Breeden 2022).

## Hedge Funds Were Both Catalysts and Victims of the August Market Sell-Off

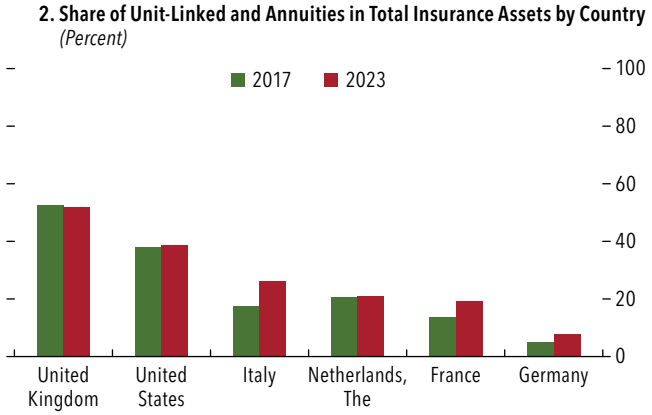
The spike in volatility observed in early August is another example of how leveraged NBFIs, such as hedge funds—a $7 trillion industry very much connected to the rest of the financial markets—can propagate strains through the financial system and amplify stress (FSB 2023; April 2024 *Global Financial Stability Report*). Hedge funds with strategies based on momentum and macroeconomic factors participate heavily in carry trades, a strategy that involves borrowing in a country with low interest rates to invest in other assets or currencies with a higher return. During the last few years, these hedge funds contributed to building up substantial short positions in yen (Figure 1.30, panel 1), which they often matched with long positions in US equity futures (Figure 1.30, panel 2) and in currencies of emerging markets (see Box 1.3). After the Bank of Japan's monetary policy decision, worse-than-expected labor market data in the United States sparked renewed fears of a recession and rapidly narrowed the interest rate differential between Japan and the United States, equities declined, and the yen appreciated. Because of these market moves, many hedge funds reportedly reached risk limits and received increased margin calls, which forced them to rapidly close their positions, erasing the year's returns for many hedge funds (Figure 1.30, panel 3). Even in the absence of hedge fund failures, which could generate counterparty risk and transmit the shock to bank and nonbank institutions, the rapid unwinding of

**Figure 1.31. Defined-Contribution Pension Funds and Unit-Linked and Annuity Insurers**

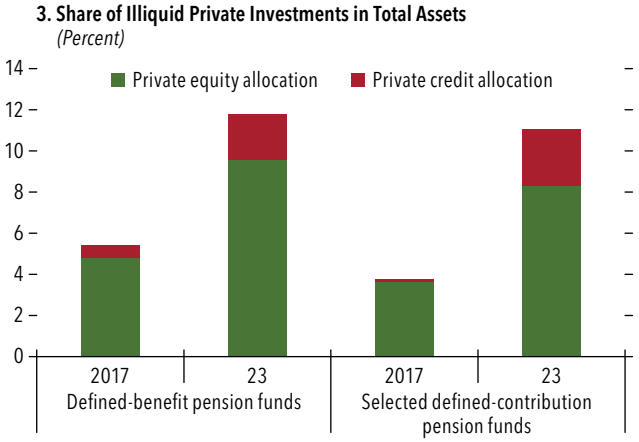
The shift toward defined-contribution pensions ...



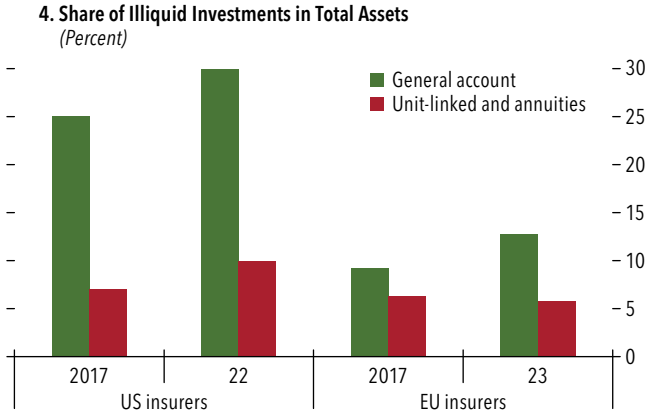

... and unit-linked insurance products has continued, but the rate of growth and the products' relative size differ significantly across countries.




Selected defined-contribution pension and superannuation funds are increasing their illiquid investments ...




... in a manner similar to US insurance annuities, but European unit-linked products have not seen an increase in their illiquid investments.




Sources: American Council of Life Insurers; Bank of England; European Insurance and Occupational Pensions Authority; Preqin; Thinking Ahead Institute; and IMF staff calculations.

Note: The calculations for defined-contribution pensions in panel 1 are based on data from the Thinking Ahead Institute. The calculations in panel 3 are based on the private equity and private credit investments of a sample consisting of 26 selected defined-contribution private pension and superannuation funds with $1.4 trillion in assets under management domiciled in Australia, Canada, Germany, Mexico, Sweden, Switzerland, the United Kingdom, and the United States. The defined-benefit calculations assume all public pension funds in the Preqin database are held in defined-benefit plans. The calculations for illiquid investments in panel 4 do not include the same items in the European Union and the United States and therefore are not directly comparable. The illiquid investments for US insurers are calculated as the sum of miscellaneous assets, mortgages, and real estate investments as of the end of 2022, according to the latest published factbook from the American Council of Life Insurers. The illiquid investments of EU insurers are calculated as the sum of investments in real estate funds, alternative funds, private equity funds, infrastructure funds, real estate structured notes, real estate collateralized securities, mortgages, loans, and property as defined by the European Insurance and Occupational Pensions Authority.

crowded and concentrated positions could exacerbate price movements across global indices, propagating the stress throughout the financial system. With limited transparency in the hedge fund industry, it might also be difficult for investors and supervisory authorities to gauge how much leverage is still in the system in real time and what might trigger another bout of hedge fund deleveraging.

## Illiquid Investments by Pensions and Insurance Raises Maturity Mismatch Vulnerabilities

The share of defined-contribution pensions and unit-linked insurance products has risen globally in recent years (Figure 1.31, panels 1 and 2). As clients holding these products bear any profits and losses of the underlying investments, providers of defined-contribution plans typically offer clients

frequent opportunities to enter or exit investment options. This flexibility may exacerbate liquidity mismatches between the underlying assets—especially illiquid assets, such as private equity and credit—and plan liabilities because the effective duration of the liabilities has been reduced. For example, Australian superannuation funds are required to allow clients to switch between different investment options generally within three business days, even though these funds hold, on average, illiquid exposures exceeding 20 percent of their total assets.[44] This liquidity mismatch could affect members' outcomes in a liquidity stress event. Furthermore, liquidity stress could spill over to financial markets, especially those markets in which pension funds and insurers have a large footprint, such as government bonds, equities, and corporate bonds.

There is some evidence that this type of liquidity mismatch is on the rise. Selected large private defined-contribution pension and superannuation funds have increased the amount of their assets allocated to illiquid private equity and credit in recent years (Figure 1.31, panel 3), and several countries have recently introduced initiatives to encourage further allocation to illiquid investments.[45] In the United States, annuities (a type of unit-linked insurance product) have also increased their allocations to illiquid investments, in a manner similarly to that observed in general accounts, which already hold a substantially higher proportion of illiquid assets (Figure 1.31, panel 4). However, European unit-linked insurance products do not appear to have increased the shares of illiquid investments in their portfolios, with exposures to assets such as real estate and private equity limited and materially smaller than those of European general account insurers (Figure 1.31, panel 4).

## Policy Recommendations

Inflation continues to moderate in many countries, and markets are pricing in multiple cuts in policy rates from major central banks. Yet economic uncertainty is elevated, and adverse surprises to either inflation or growth could drive financial market reactions that might complicate central banks' task. Although monetary policy should always be data dependent, clear communications from central banks that the path of policy rates should not react excessively to any individual data point would help ameliorate uncertainty by underpinning their commitment to achieving their objectives. Where growth and inflation momentum are set to continue to slow, central banks should gradually ease monetary policy toward a more neutral stance. Where inflation remains stubbornly above central banks' targets, central banks should push back against overly optimistic investor expectations for monetary policy easing.

The reduction of central banks' balance sheets has so far unfolded in an orderly fashion. But since more central banks are now engaging in quantitative tightening simultaneously, the decline of central bank reserves is global, requiring careful monitoring of and preparedness for the impact on funding markets. Central banks should monitor a broad spectrum of indicators encompassing both liquidity conditions and funding rates in money markets, and remain attuned to potential uneven distribution of liquidity and central bank reserves across banks, while standing ready to address market stresses. Policymakers should clearly communicate the objectives and steps for removing liquidity.

Many emerging markets have made notable progress on inflation, but central banks should continue to ensure inflation targets are met and preserve resilience against external pressures amid elevated economic uncertainty. Countries should integrate their policies, where applicable, using the IMF's Integrated Policy Framework. The use of foreign exchange interventions may be appropriate as conditions warrant and provided intervention does not impair the credibility of macroeconomic policies or substitute for their necessary adjustment. In the event of imminent crises, capital flows management measures may be an option for some countries as part of a broader policy package to

[44]Illiquid level 3 assets in five of the largest Australian superannuation funds, with assets under management exceeding $0.5 trillion, are estimated to account for almost one-quarter of total assets (Bradley 2023). Note that prudential regulations in Australia require super funds to determine sufficient liquidity levels within each investment option to manage client switching.

[45]The US Department of Labor has provided guidance on how US plan fiduciaries may offer certain private-asset investments without violating regulations associated with the Employee Retirement Income Security Act of 1974 (Pensions&Investments 2023). Former UK Chancellor of the Exchequer Jeremy Hunt has called on defined-contribution pension schemes to boost investment in unlisted UK equities (Hunt 2023). The European Union's Reformed European Long-Term Investment Fund (ELTIF 2.0) regulation, which has widened the scope of eligible assets and relaxed diversification and concentration rules, is seen as more friendly toward investment in illiquid assets (JPMorgan 2024).

lessen outflow pressures. Those measures should not substitute for warranted macroeconomic adjustments or policies that can help contain systemic risks from capital flows.

With levels of sovereign debt in many countries substantially above prepandemic levels, fiscal adjustments should primarily focus on credibly rebuilding buffers to keep external financing costs reasonable and to help anchor medium-term inflation expectations. For countries with less fiscal space, the credibility of fiscal plans is imperative to prevent cliff effects in ratings, which could adversely affect financing conditions. Countries near debt distress should enhance early contact with creditors. Bilateral and private sector creditors should find ways to coordinate preemptive and orderly restructuring to avert costly hard defaults and prolonged loss of market access. The Group of Twenty Common Framework should be used when applicable, and further efforts should be made to improve the forum's effectiveness. Continued use of enhanced collective-action clauses in international sovereign bonds and the development of majority voting provisions in syndicated loans would help facilitate future debt restructurings to be preemptive and orderly. Countries able to access funding should borrow prudently and avoid excessive debt issuance, which may compromise medium-term sustainability. Moreover, countries should foster economic growth to create space for financing development and climate-related spending while keeping debt on a sustainable path.

To durably improve confidence and alleviate disinflationary pressures, China still needs accommodative macroeconomic policies along with structural and promarket reforms to bolster near-term activity, mitigate risks, and ensure a smooth transition toward higher-quality and more balanced growth over the medium term. Property sector policies should prioritize the completion of presold unfinished housing and the restructuring troubled property developers in a timely manner. Additional easing of monetary policy, especially through lower interest rates, and reorientation of public expenditures toward households could bolster near-term recovery, and comprehensive fiscal reforms are needed to ensure the sustainability of local government finances. Policy response should balance the medium-term health of balance sheets in the financial sector amid slowing credit growth. For the banking sector, it is critical to enforce prudential policies strictly, by phasing out regulatory forbearance measures and maintaining adequate loss-absorbing buffers, among other measures, to strengthen efforts to restructure weak small- and medium-sized banks and safeguard risks to financial stability. The Chinese authorities have made progress in reducing risks in the nonbank financial sector, but additional regulatory measures to enhance management of liquidity and maturity risk, as well as to close regulatory and data gaps, could help contain future systemic risks.

Climate finance needs to be ramped up, including adaptation finance. Widespread consensus on the importance of adaptation has yet to catalyze meaningful private sector participation, as adaptation finance has so far solely relied on government expenditures. Creating investment opportunities attractive to private investors, especially in emerging market and developing economies, is the key challenge. To scale up adaptation finance, it is essential to align the interests and actions between the public and private sectors, improve the tracking and measurement of adaptation finance flows, provide investment guidance and adaptation taxonomies, and integrate adaptation considerations across asset classes. Continued support to low-income and vulnerable middle-income countries is imperative. Since its establishment in 2022, the Resilience and Sustainability Trust has been integrating adaptation support in its 18 programs, with country authorities emphasizing the importance of building economic resilience in the face of climate change risks.

Continued vigilance is warranted to monitor vulnerabilities in the CRE sector to minimize potential risks to financial stability. To ensure resilience in the banking system, authorities should collect detailed information on CRE exposures and conduct stress-testing exercises that incorporate scenarios involving large declines in CRE prices. The stress tests should include smaller banks with material exposure to CREs. Supervisors should also review banks' assumptions regarding CRE valuations and ensure that provisions are adequate.

With private credit playing an increasingly significant role in financial markets, it is imperative to enhance reporting requirements to improve monitoring and management of credit, liquidity, leverage, valuations, and risks related to interconnectedness. Given the potential macro criticality of private credit, coupled with its exponential growth and increasing retail participation, authorities may consider adopting a more intrusive supervisory and regulatory approach.

The buildup of debt amid elevated uncertainty underscores the need to strengthen the macroprudential policy framework to contain excessive risk taking in the nonbank financial sector and to ensure that capital and liquidity buffers in banking systems are adequate to support the provision of credit through periods of stress. Policymakers should tighten appropriate macroprudential tools to increase resilience against a range of shocks, as well as to forestall further increases in pockets of elevated vulnerabilities, while avoiding a destabilizing tightening of financial conditions.

The tail of weak banks in the global financial system and the risk of contagion to healthy institutions highlight the urgent need to enhance financial sector regulation and supervision. Despite repeated calls from the Group of Twenty, some major jurisdictions that are members of the Basel Committee have delayed implementing the remaining elements of Basel III or have introduced deviations from it, which could undermine the effectiveness of the standard-setting process and increase regulatory fragmentation. Full, timely, and consistent implementation of Basel III and other international standards remains an important step.

Authorities should prepare to deal with financial instability, including by ensuring that financial institutions are prepared to access central bank liquidity and by intervening early to address liquidity stress in the financial sector. All banks should be required to test their access to central bank instruments periodically. Central banks should set up their frameworks for emergency liquidity assistance in normal times, anticipating that they will have to intervene in a crisis. Central banks should be ready to provide liquidity against a broad universe of assets while abiding by the appropriate principles concerning solvency and viability, collateralization, and appropriate haircuts. Further progress on adopting and implementing frameworks for recovery and resolution is critical to proactively address the problems of weak or failing banks without undermining financial stability or risking public funds.

Market turmoil in early August is a reminder of how leveraged NBFIs can amplify stress. Even in the absence of defaults, which could give rise to counterparty risk and lead to contagion across financial institutions, rapid unwinding of leveraged positions can generate liquidity imbalances that amplify market disruptions. One of the challenges in addressing these issues is inadequate data, which hinder authorities' ability to assess the vulnerabilities associated with nonbank leverage and to identify large and concentrated positions. It is crucial to enhance reporting requirements for nonbank institutions and to strengthen policies that mitigate vulnerabilities and amplification mechanisms stemming from nonbank leverage, where judged to pose a threat to financial stability. In addition, the growth of bond funds highlights the need to reduce systemic risks by ensuring the effectiveness of tools for managing liquidity. Timely and consistent implementation of the Financial Stability Board's revised recommendations to address structural vulnerabilities from liquidity mismatches in open-ended funds is crucial.

Data gaps often hinder the monitoring of interconnectedness risks posed by pension funds and insurers. Supervisors should fill data gaps and cooperate with each other, including across borders, to ensure effective monitoring of these risks. Cross-border cooperation assumes importance in situations in which cross-border interconnections are significant and concentrated. International bodies, such as the Financial Stability Board, can aid in improving data gaps globally. In jurisdictions in which defined-contribution pensions and unit-linked insurance products are material, supervisors should closely monitor the share of illiquid investments held by these products. Liquidity stress tests that consider scenarios involving crises related to liquidity availability across the major asset classes are important. It is also paramount to ensure the compatibility between the liquidity of assets and notice periods required for clients to switch between different investment products.

## Box 1.1. Synthetic Risk Transfers: Managing Risks or Creating New Ones?

An increasing number of banks around the world have begun using synthetic risk transfers (SRTs) to manage credit risk and lower capital requirements. SRTs move the credit risks associated with a pool of assets from banks to investors through a financial guarantee or credit-linked notes while keeping the loans on banks' balance sheets. Through this credit protection, banks can effectively claim capital relief and reduce regulatory capital charges (Figure 1.1.1, panel 1). However, the transactions can generate risks to financial stability that need to be assessed and monitored.

Globally, more than $1.1 trillion in assets have been synthetically securitized since 2016, of which almost two-thirds were in Europe (Figure 1.1.1, panel 2). In the United States, activity picked up in 2023 and is expected to accelerate further because the regulatory landscape has become clearer. In Europe, corporate and small- and medium-enterprise lending, a well-known and stable loan category for investors, backs up most of the issuance; recent transactions in the United States have centered on retail loans, particularly automobile loans. In Europe, issuers of SRTs include global systemically important banks and large banks, whereas in the United States, regional banks issue SRTs as well. Private credit funds are the dominant buyers, with a market share exceeding 60 percent, followed by pension funds, with close to 20 percent (Gonzalez and

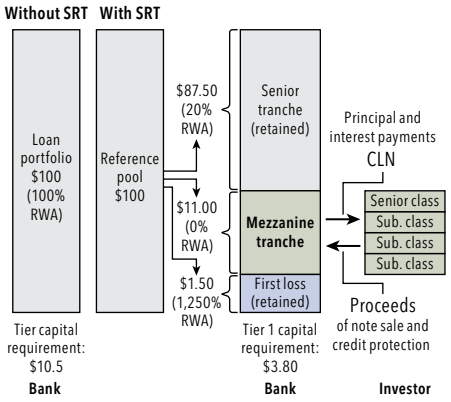
### Figure 1.1.1. Selected Information for SRT Structures, Issuance, and Returns

Banks use SRTs to offload risk and claim capital relief.

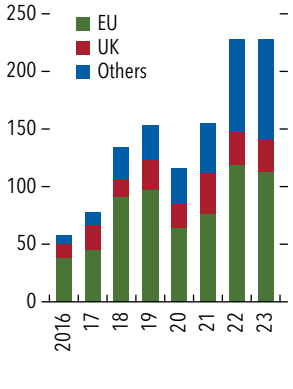
Synthetic securitization volumes have grown in recent years.

Credit risk indices suggest asset quality in SRT reference pools is starting to deteriorate, particularly for SMEs.

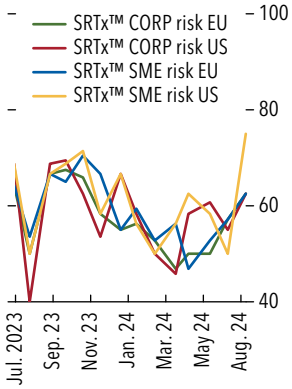
**1. Stylized Example of a Direct Bank-Issued CLN Structure**




**2. Underlying Pool Size of Synthetic Securitization at Inception by Region**
*(Billions of US dollars)*




**3. Synthetic Risk Transfers: SRTx™ Credit Risk Indices**
*(Indices)*




Sources: Bloomberg Finance L.P.; International Association of Credit Portfolio Managers; Structured Credit Investor; and IMF staff calculations.

Note: Panel 1 shows a bank-issued CLN in which the bank buys protection for the mezzanine tranche by issuing CLNs to investors for cash up front and retains the first-loss and senior tranches. Under securitization treatment, the senior tranche carries 20 percent in RWA, and the first-loss tranche carries 1,250 percent in RWA. The RWA for the mezzanine tranche becomes zero because the bank is no longer exposed to the losses from this tranche. In panel 3, each SRTx™ Credit Risk Index is compiled from contributor survey responses and measures market sentiment regarding the direction of the SRT reference pool credit risk over the near term. The index scale ranges from 0 to 100, with levels above 50 indicating a higher proportion of respondents estimating that credit risk is worsening. CLN = credit-linked note; RWA = risk-weighted assets; SMEs = small and medium enterprises; SRT = synthetic risk transfer; SRTx™ CORP EU = credit risk index for large firms in the European Union; SRTx™ CORP US = credit risk index for large firms in the United States; SRTx™ SME EU = credit risk index for small and medium enterprises in the European Union; SRTx™ SME US = credit risk index for small and medium enterprises in the United States; sub. = subordinate.

This box was prepared by Gonzalo Fernandez Dionis, Yiran Li, and Silvia L. Ramirez.

## Box 1.1 *(continued)*

Triandafil 2023). Industry estimates expect issuance of SRTs to remain above $200 billion in Europe and to more than triple in the United States to surpass $50 billion in 2024 (Alloway 2024).

The amount of capital relief varies by transaction. In Europe and the United States, the lack of data on private transactions makes an aggregate calculation of capital relief for banks challenging. Proceeds from capital relief can be used to originate more loans, fund stock repurchases, or pay dividends. If interest rates fall, certain motivations behind SRTs become less relevant. In addition, SRTs allow banks to limit loan book concentration, reduce counterparty risk, and, for some US banks, avoid realizing potential mark-to-market losses linked to gyrations in interest rates compared with an outright sale of the loans. Investors purchase SRTs to access loan categories that may not be easily accessible through public markets or direct lending to earn attractive returns (8–12 percent) compared with those from other asset classes as well as to meet mandates to allocate capital in private credit.

However, certain SRT characteristics could increase risks to financial stability. First, SRTs may elevate interconnectedness and create negative feedback loops during stress. For instance, there is anecdotal evidence that banks are providing leverage for credit funds to buy credit-linked notes issued by other banks. From a financial system perspective, such structures retain substantial risk within the banking system but with lower capital coverage. The magnitude of the interconnections is difficult to assess because the market remains opaque, with only a fraction of deals being made public and no centralized repository for data on SRTs. Second, SRTs may mask banks' degree of resilience because they may increase a bank's regulatory capital ratio while its overall capital level remains unchanged. Increased use of SRTs may reflect inability to build capital organically because of weaker fundamentals and profitability performance. Furthermore, overreliance on SRTs exposes banks to business challenges should liquidity from the SRT market dry up. Currently, the asset pools being securitized seem to be of higher quality; however, there are signs of increased concerns regarding deterioration of asset quality (Figure 1.1.1, panel 3). Financial innovation may lead to securitization of riskier asset pools, challenging banks with less sophisticated tools for risk management, because some more complex products make the identity of the ultimate risk holder less clear. Finally, although lower capital charges at a bank level are reasonable, given the risk transfer, cross-sector regulatory arbitrage may reduce capital buffers in the broad financial system while overall risks remain largely unchanged. Financial sector supervisors need to closely monitor these risks and ensure the necessary transparency regarding the SRTs and their impact on banks' regulatory capital.

## Box 1.2. Interconnectedness Through Tokenization

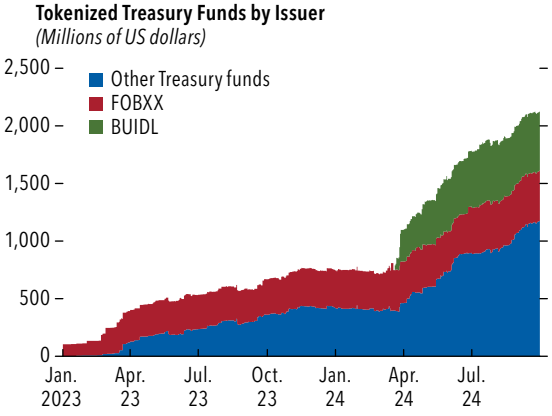
Tokenization of real-world assets involves creating a digital representation of these assets on a blockchain.[1] Although it is not a new phenomenon, its adoption in certain financial markets by large players could lead to increased interconnectedness between the traditional financial markets and crypto markets. In recent years, tokenization of money market funds' shares, repos, and Treasuries has gained popularity because high interest rates have allowed these products to offer high yields, particularly in comparison to stablecoins (see Figure 1.2.1). In addition, there are expectations that tokenization may generate benefits such as potential immediate trade settlement, lower costs related to ownership, fractional use of safe and liquid collateral for management of liquidity, and timely receipt of asset yields or coupons.[2] In regard to repos specifically, investors reportedly seek the immediacy and cost-efficiency of blockchain-based transactions to manage intraday liquidity, which helps mitigate mishaps that might otherwise result in costly intraday repos with central banks.[3]

Traditional finance institutions have shown interest in participating in the tokenization wave. BlackRock and Franklin Templeton have launched tokenized Treasury funds, the BlackRock USD Institutional Digital Liquidity Fund and Franklin OnChain US Government Money Fund, respectively. Major banks such as JPMorgan, UBS, and DBS are using systems such as Onyx and Broadridge's Distributed Ledger Repo to tokenize shares of money market funds for use as collateral and to execute intraday repos. Performance of tokenized money market funds has been at par with that of traditional money market funds; for example, the Franklin OnChain US Government Money Fund's average annual return through the end of July 2024 was 5.3 percent, compared with 5.0 for Federated Hermes' Treasury Obligations Fund.

Concerns regarding financial stability stemming from the tokenization of real-world assets are limited at present, given its still-small scale. Over the medium term, tokenization deepens the nexus between the ecosystem of crypto assets and the traditional financial system. If more real-world assets become tokenized, the resulting increased interconnectedness can transmit shocks or volatility from crypto markets to the real-world markets of the underlying assets, or vice versa. Volatility might arise, for example, if investors become uncertain about the value of a token or the possibility of redeeming it, or if a shock occurs during a weekend, when the underlying real-world assets cannot be traded or funded as opposed to tokenized

### Figure 1.2.1. Interconnectedness Through Tokenization

Tokenization of money market funds has gained momentum, though it remains at a nascent stage, as key traditional finance players have entered the market.




Sources: Bloomberg Finance L.P.; RWA.xyz; and IMF staff estimates.

Note: BUIDL = BlackRock USD Institutional Digital Liquidity Fund; FOBXX = Franklin OnChain US Government Money Fund.

This box was prepared by Gonzalo Fernandez Dionis and Kleopatra Nikolaou.

[1]Digital tokens are assets issued on electronic ledgers that are shared, trusted, and programmable (Agur and others, forthcoming).

[2]Fractional ownership involves digitizing real-world assets and representing them on a blockchain as tokens. Each token represents a fraction of the asset's total value. Investors can purchase these tokens and use them as collateral for loans.

Tokenized money market funds are digital representations of shares in traditional money market funds on a blockchain. Tokenized repo is a type of short-term borrowing in fixed income through the exchange of cash for tokenized collateral. Tokenized Treasuries are digital representations of US Treasury securities in the form of tradable tokens on the blockchain. In practice, however, tokenized Treasuries often refer to tokenized fund shares, with Treasuries as the underlying collateral. Tokenized Treasuries allow investors engaging in blockchain trading to receive interest payments and principal repayments according to the Treasuries' schedules and rates.

[3]For a quantitative assessment of the benefits from financial asset tokenization, please refer to Box 2 in Agur and others (forthcoming).

## Box 1.2 *(continued)*

funds, which allow 24/7 trading (see Carapella and others 2023). Concerns may also arise as a result of technology risks and increased use of leverage through tokenization. Finally, a rise in tokenized safe and liquid assets, such as tokenized Treasuries, can interact with the rise of stablecoins, especially considering that many stablecoins do not offer returns. The growth of this new form of financial intermediation will depend also on regulatory developments, which can be complex and evolve slowly. Supervisors in the financial sector should continue to monitor risks related to interconnectedness within the crypto markets and between those markets and traditional capital markets for potential increases in vulnerabilities.

## Box 1.3. Summertime Blues: The Carry Trade Unwind and VIX Surge of August 2024

Carry trades involve borrowing money in currencies with low funding costs and investing in assets in currencies with higher returns, allowing investors to earn the spread, or "carry," of relative returns.[1] Carry trades have been popular for many decades, and recently, the divergence of monetary policies worldwide provided investors with opportunities to increase exposures to them. Various funding currencies have been used for these trades over time. Over the past several years, the relatively low interest rates in Japan vis-à-vis in other advanced economies have driven the yen as the preferred funding currency over others. Although it is difficult to estimate the overall size of carry trade positions (see BIS 2024), the amount of Japanese yen borrowed by nonresidents, who do not naturally need Japanese yen, could serve as one guide to an upper bound of the estimate (Figure 1.3.1, panel 1). Many investors have reportedly used the Japanese yen as a funding currency to invest in Brazilian and Mexican government bonds, Indian equities and corporate bonds, and US technology stocks in artificial intelligence. Absent any significant changes in the exchange rate or relative interest rates, this type of trade can generate large profits over time. However, carry trades are inherently unstable: When currency and interest rate volatilities surge, the carry may no longer be there, and profits from the carry trade can be quickly wiped out.[2] Carry trades therefore tend to accumulate gradually during periods of sustained low volatility, when leverage and risk taking accumulate—for example, borrowing yen to invest in Mexican pesos—but can unwind rapidly and in large volumes when conditions turn adverse, potentially destabilizing markets.

Worse-than-expected labor market data in the United States following the Bank of Japan's monetary policy decision in July meant that carry trades were no longer profitable, and their unwinding led to spikes in stock and currency volatility in early August. The interest rate differential between the dollar and yen narrowed, and the yen appreciated in a speed-up of trends that began in July (Figure 1.3.1, panel 2). High-yielding currencies that were targets of carry trades depreciated (Figure 1.3.1, panel 3). At the same time, the Nikkei index experienced a collapse of 12.4 percent on August 5, its largest one-day move since 1987. In the United States, the Chicago Board Options Exchange Volatility Index (VIX) surged from 16 to more than 65, before lowering to 37 by the end of the day. Other major indices such as the S&P 500 (–3 percent) and the STOXX Europe 600 (–2 percent) also lost ground, as few stocks were spared. Anecdotally, along with the unwind of carry trades by nonbank financial intermediaries like hedge funds, momentum and algorithmic traders also fed into the sell-off, guided by their trend-following algorithms, as did broker–dealers who were selling stocks to hedge risks created by selling large amounts of options to their clients.

This period of high volatility was ultimately short-lived and risk assets regained most of the losses in subsequent days, indicating that traders did not see the declines to be justified by macroeconomic fundamentals. The massive move in the VIX did not trigger a more widespread US sell-off, as the signal of excessive volatility it was conveying largely reflected issues related to the index's construction, rather than actual market transactions (possibly because out-of-the-money options currently play a much larger role than they did in previous years).[3] Front-end VIX futures saw much smaller moves on August 5 than the index itself (Figure 1.3.1, panel 4). In contrast, during past episodes such as the COVID-19 pandemic

This box was prepared by Deepali Gautam, Sanjay Hazarika, Harrison Kraus, Mustafa Oguz Caylan, and Aki Yokoyama. The box provides an update on market developments since the April 2024 *Global Financial Stability Report*.

[1]Carry trade refers to borrowing at a low interest rate and investing in a high-return asset but is best known for those conducted between currencies. Many are executed via off-balance-sheet derivatives that are partially reflected in on-balance-sheet statistics. For example, foreign exchange swaps typically exchange the notional amount in two different currencies for each party requiring financing. Meanwhile, currency options may not be fully reflected.

[2]While the difference in interest rates between two currencies, or "carry" earned over the course of a year, is only single-digit percentage, exchange rates can move more than 10 percent once they start to move, and the capital loss from a market move in an unwanted direction can easily exceed the carry earned over time.

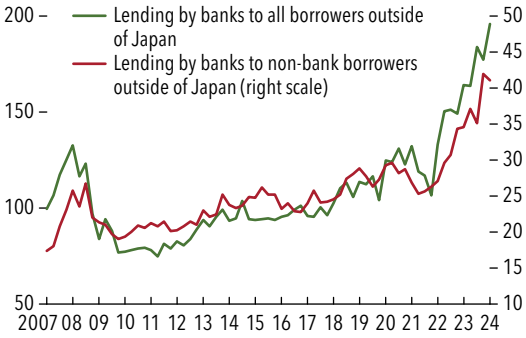
[3]The VIX is effectively a weighted average of the midpoints of the bid and ask prices of multiple option contracts; the weight used is proportional to 1 divided by the strike price squared (CBOE 2022). By construction, the weight of the far-out-of-the-money put option with a lower strike price is more significant, and illiquid market conditions easily lead to higher midpoint prices as sellers pull back their ask prices. Front VIX futures expire on August 21, and, therefore, the much lower levels of futures prices relative to the VIX indicate that traders did not view the high VIX level to be sustained for more than two weeks.

## Box 1.3 *(continued)*

### Figure 1.3.1. Unwinding of Carry Trades in Early August

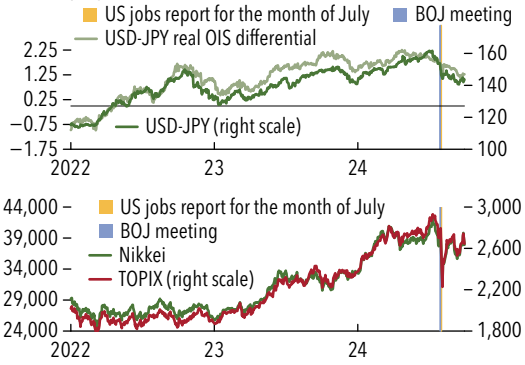
Cross-border borrowing in yen has risen sharply in recent years.

**1. International Bank Claims Denominated in Japanese Yen**
*(Trillions of Japanese yen)*



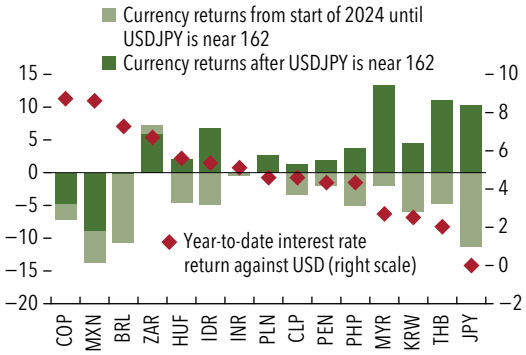

The Bank of Japan's monetary policy decision and a weaker-than-expected US jobs report was followed by the unwinding of carry trades.

**2. US-Dollar-to-Japanese-Yen Spot Rate versus Rate Differential and Major Japanese Equity Indices**
*(Percentage points, top left scale; yen per dollar, top right scale; index, bottom scales)*



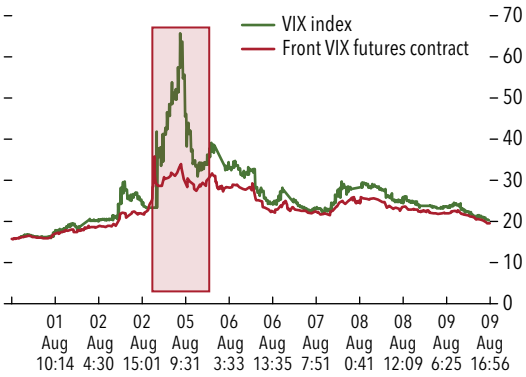

Unwinding of carry trades led to depreciation of high-yielding currencies and appreciation of low-yielding ones.

**3. Currency Returns**
*(Percentage points)*




Traders did not believe the spike in the VIX was sustainable.

**4. Intraday VIX versus Front VIX Futures Contract**
*(Percent, intraday moves on August 5, 2024)*




Sources: Bank for International Settlements; Bloomberg Finance L.P.; and Haver Analytics.

Note: In panel 4, the front VIX futures contract is a generic first future of the VIX, which has a one-month maturity. BOJ = Bank of Japan; BRL = Brazilian real; CLP = Chilean peso; COP = Colombian peso; CPI = consumer price index; HUF = Hungarian forint; IDR = Indonesian rupiah; INR = Indian rupee; JPY = Japanese yen; KRW = Korean won; MXN = Mexican peso; MYR = Malaysian ringgit; OIS = overnight index swap; PEN = Peruvian sol; PHP = Philippine peso; PLN = Polish zloty; THB = Thai baht; TOPIX = Tokyo Stock Price Index; USD = US dollar; VIX = Chicago Board Options Exchange Volatility Index; ZAR = South African rand.

and the 2015 China devaluation, the VIX and VIX futures surged in tandem. The episode highlights the potentially destabilizing role that leveraged strategies such as carry trades can play in global markets, underscoring the need for more regulatory scrutiny, especially in regard to nonbank financial intermediaries. It is also a reminder that the disconnect between heightened uncertainty and low market volatility may abruptly close, with adverse consequences for asset prices. Carry trades have thrived in various forms as a result of the prolonged low-yield and low-volatility environment in the past, and it remains to be seen how large the unwinding of these positions could be in the future.

## Box 1.4. Domestic Investors in Local Bond Markets: A Stabilizing Force?

Local bond markets in emerging markets have been growing over the years. Alongside banks, nonbank financial intermediaries—especially pension and insurance funds—are playing an increasingly important role in markets for local currency government bonds (LCGBs). Total assets under management in nonbank financial intermediaries have grown since 2002 to reach 25 percent of GDP in the median emerging market from less than 10 percent as recently as 2003. The importance of these funds has grown since the end of the pandemic, as the role of foreign investors has declined and domestic banks have shed some of their holdings of domestic government bonds acquired during the early stages of the pandemic. The recent increase of the share of holdings by nonbank financial intermediaries has varied across countries, with pension funds playing an increasing role, as various countries have recently either instituted or proposed new rules that could significantly increase the amount of assets these funds hold.

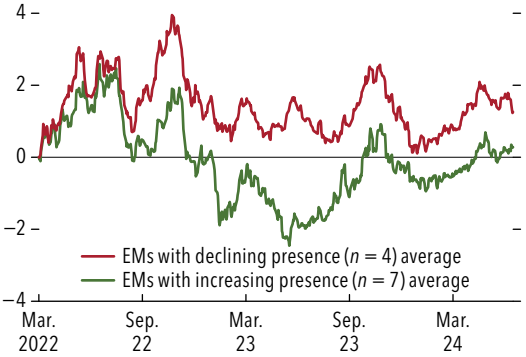
Long-term domestic institutional investor funds tend to focus their investments in LCGBs, providing governments with a stable source of funding as other asset classes such as domestic corporate bonds and equities are comparatively less developed. The rise of this investor base has reduced reliance on foreign capital, mitigating risks of capital outflows; enhanced market depth and liquidity; and reduced volatility. Countries in which the share of domestic government bonds held by pension and insurance companies has increased have experienced less volatility in term premiums, whereas those in which the share has declined have seen term premiums rise (Figure 1.4.1, panel 1). In addition, a sizable domestic investor base with a long-term investment horizon could mitigate a rise of a sovereign-bank nexus, such as the one that occurred during the pandemic (see Chapter 2 of the April 2022 *Global Financial Stability Report*).

The greater presence of long-term domestic institutional investors could have important implications for

### Figure 1.4.1. NBFIs Play an Important Role in NBFI Markets

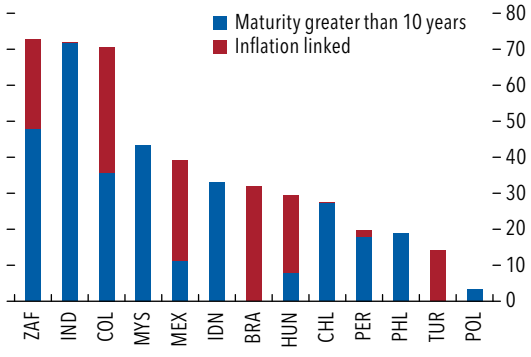
Countries with a rising share of holdings among pension and insurance funds broadly experienced less pressure on term premiums.

**1. Change in Term Premiums for Local Currency 10-Year Government Bonds, March 2022 to June 2024**
*(Cumulative change to z-scores on domestic term premiums since the onset of the Federal Reserve's hiking cycle)*




The availability of long-dated and inflation-linked assets varies significantly across jurisdictions.

**2. Local Government Bonds That Have Remaining Maturities of at Least 10 Years or Are Linked to Inflation**
*(Percent)*




Sources: Arslanalp and Tsuda 2014; Bank for International Settlements; Bloomberg Finance L.P.; Financial Stability Board; and IMF staff calculations.

Note: In panel 1, the sample includes 11 major emerging markets. Local currency government bond holdings by pension and insurance funds are assessed from December 2021 to December 2023. Term premiums are on the 10-year yield and follow the methodology in Adrian, Crump, and Moench (2013). Data labels in the figure use International Organization for Standardization (ISO) country codes. EMs = emerging markets.

This box was prepared by Jeffrey Williams.

## Box 1.4 *(continued)*

decisions by government agencies charged with debt management. These funds tend to prefer longer-dated securities, as well as inflation-linked assets, to better match their liability structures. Such instruments are already a large fraction of LCGBs outstanding in several countries (Figure 1.4.1, panel 2), and in others, this growing asset class could present an opportunity to extend the domestic yield curve. Although the growth of this investor base could present a stabilizing force for LCGB markets, it also presents risks. With limited alternative options for domestic investment, funds may become overly concentrated in LCGB, leaving them vulnerable to large losses should interest rates rise precipitously, the yield curve steepen sharply, or inflation surge. Additionally, from the government's point of view, an unexpected increase in redemptions from these funds could drive a sudden rise in the cost of domestic funding.

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CHAPTER 2

# MACROFINANCIAL STABILITY AMID HIGH GLOBAL ECONOMIC UNCERTAINTY

## Chapter 2 at a Glance

- Uncertainty regarding global economic outcomes and policies has been higher since the COVID-19 pandemic amid inflation shocks and rising geopolitical tensions.
- High macroeconomic uncertainty can profoundly affect macrofinancial stability by exacerbating downside market tail risks, delaying consumption and investment decisions, and reducing credit supply.
- As financial indicators may not fully capture macroeconomic uncertainty, particularly in economies with less-developed financial systems, there is merit in considering measures of macroeconomic uncertainty in systemic risk assessment frameworks such as the growth-at-risk framework.
- An increase in macroeconomic uncertainty equivalent to its rise during the global financial crisis reduces the downside outcome (the 10th percentile) of one-year-ahead real GDP growth by, on average, 1.2 percentage points in advanced and emerging market economies.
- Macroeconomic uncertainty also tends to amplify the effect of prevailing macrofinancial vulnerabilities, such as excessive leverage in the private and public sectors, on downside risks to future output growth.
- A significant easing of financial conditions amid high macroeconomic uncertainty can exacerbate downside risks to future output growth, particularly during periods of low financial market volatility (that is, during "macro-market disconnects"). An adequate macroprudential policy response can, however, mitigate this effect.
- The effects of macroeconomic uncertainty can spill over across borders through trade and financial interlinkages, increasing the risk of contagion in the face of adverse shocks.

**Policy Recommendations**

- Reduce domestic macroeconomic uncertainty by strengthening the credibility and transparency of frameworks for monetary, fiscal, and financial sector policies and through effective communication strategies.
- Implement adequate fiscal and macroprudential policies to contain macrofinancial vulnerabilities and build resilience against adverse shocks, particularly when macroeconomic uncertainty is high.
- Build adequate international reserve buffers and allow exchange rate flexibility to help cushion the adverse spillover effects of an increase in foreign macroeconomic uncertainty.
- Devote resources to quantifying, managing, and mitigating the risks from rising geopolitical uncertainty on macrofinancial stability.

## Introduction

A high level of uncertainty has characterized the global macroeconomic landscape since the COVID-19 pandemic. Uncertainty about economic outcomes and policies spiked during the COVID-19 pandemic and has remained high since then, compared with levels in earlier years, amid inflation shocks, escalating geopolitical tensions, rapidly emerging new technologies, and increasing climate-related risks.[1] Different measures of macroeconomic uncertainty make this evident (Figure 2.1).[2]

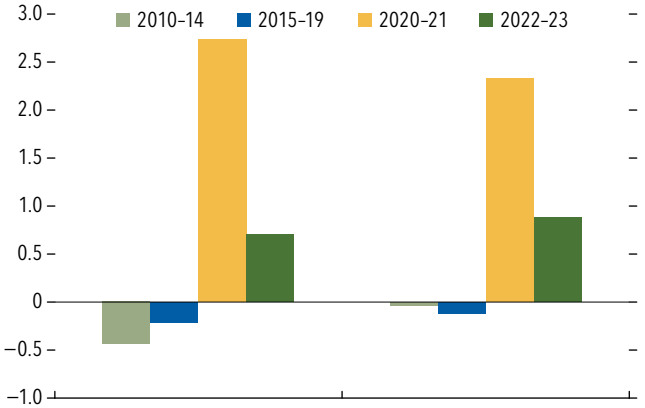
This chapter was prepared by Rafael Barbosa, Yuhua Cai, Mario Catalán (co-lead), Andrea Deghi (co-lead), Li Lin, Tatsushi Okuda, Mustafa Yenice, and Aleksandr Zotov, under the guidance of Mahvash Qureshi. Ian Dew-Becker and Stefano Giglio served as external advisors.

[1]In economics, uncertainty refers to situations in which future outcomes are difficult to predict (Knight 1921).

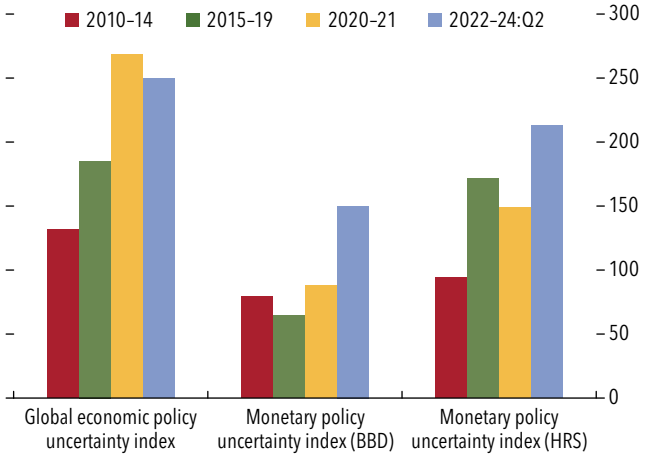
[2]Measures of macroeconomic uncertainty tend to be volatile but on average have stayed elevated since the pandemic. Some measures, such as global economy policy uncertainty of Baker, Bloom, and Davis (2016), declined in the first quarter of 2024 but rose again in the second quarter amid electoral uncertainty in some major economies (Online Annex Figure 2.1.1).

## Figure 2.1. Economic and Policy Uncertainty

Uncertainty around the macroeconomic outlook has increased ...




... along with policy uncertainty.




Sources: Baker, Bloom, and Davis 2016; Husted, Rogers, and Sun 2020; IMF, Global Data Source and International Financial Statistics databases; Organisation for Economic Cooperation and Development, Main Economic Indicators database; and IMF staff calculations.

Note: Panel 1 shows values on a real economic uncertainty index for the United States and other economies based on the approach in Ludvigson, Ma, and Ng (2021). The index is standardized over its historical mean (January 1990 through September 2023) and averaged across different periods. Non-US real economic uncertainty index is a GDP-weighted average across non-US economies. In panel 2, "Global economic policy uncertainty index" is a GDP-weighted index from Baker, Bloom, and Davis (2016) averaged over the indicated time period. For additional details on the data sources, see Online Annex 2.1. The monetary policy uncertainty indices pertain to the United States and are compiled by Baker, Bloom, and Davis (BBD, 2016) and Husted, Rogers, and Sun (HRS, 2020), respectively.

Increased macroeconomic uncertainty can profoundly affect macrofinancial stability. High macroeconomic uncertainty can potentially affect macrofinancial stability—or systemic risk—through three key channels.[3] First, it can exacerbate downside market tail risks in the event of an adverse shock (the market channel). Second, it can delay private sector consumption and investment decisions, slowing economic activity and raising credit risks for financial institutions that can in turn trigger an adverse macrofinancial feedback loop (the real channel). And third, it can reduce the supply of domestic credit by financial institutions by exacerbating challenges in determining the creditworthiness of new borrowers (the credit channel). These three channels can interact and mutually reinforce each other, amplifying the effect of macroeconomic uncertainty on macrofinancial stability.[4]

Macroeconomic uncertainty can interact with potential vulnerabilities in the real and financial sectors to magnify the effects of adverse shocks. For example, in the presence of high levels of public debt relative to GDP, investors may react more strongly to an expansionary fiscal shock when uncertainty regarding the economic outlook is high instead of low, leading to a sharp increase in sovereign bond yields (see the October 2024 *Fiscal Monitor*). Periods of high macroeconomic uncertainty may also make the corporate debt market more vulnerable to adverse shocks, particularly when leverage in the corporate sector is high or credit spreads are perceived by investors to be overly compressed. Equity markets are also likely to experience larger price corrections in the face of adverse shocks when uncertainty about the macroeconomic outlook is high and valuations are stretched relative to fundamentals.[5] These considerations may be particularly pertinent at the current juncture as, along with macroeconomic uncertainty, macrofinancial vulnerabilities remain elevated (Online Annex Figure 2.1.1).

The effect of macroeconomic uncertainty can spill over across borders. Global financial and real

[3]Macrofinancial stability is defined in terms of systemic risk, that is, the risk of disruption to the financial system that can have serious negative consequences for the real economy, and is measured by downside tail risks to future real GDP growth.

[4]While studies using well-known measures of macroeconomic uncertainty generally find it to be negatively associated with asset returns and volatility (Asgharian, Christiansen, and Hou 2015; Bali, Brown, and Tang 2017), the effect could also be positive. For example, high-tech revolutions promising future productivity gains can be a source of positive or "good" uncertainty, while geopolitical conflicts can be considered as a source of negative or "bad" uncertainty (Bloom 2014; Segal, Shaliastovich, and Yaron 2015; Dew-Becker and Giglio 2023).

[5]The set of shocks can include shocks to uncertainty itself that drive aggregate fluctuations (Bloom 2009; Bloom and others 2018).

interconnectedness implies that increased macroeconomic uncertainty can have cross-border implications through the aforementioned channels. For example, an increase in macroeconomic uncertainty that imposes losses on investors in a particular region may force them to sell assets in other countries, leading to large asset price declines and triggering international financial contagion.[6] Similarly, by reducing domestic consumption and investment, macroeconomic uncertainty can weaken the demand for imports, raising downside risks to economic activity in trading partner countries.

Financial variables may not fully span macroeconomic uncertainty. Existing approaches to assess macrofinancial stability typically consider selected financial indicators, including those related to financial market uncertainty (for example, the Chicago Board Options Exchange Volatility Index [VIX]), as relevant variables in frameworks to assess systemic risk (Adrian, Boyarchenko, and Giannone 2019; Adrian and others 2019). However, financial indicators may not fully reflect macroeconomic uncertainty, making it useful to consider it in frameworks to assess systemic risk and predict tail risks to markets and economic activity.[7] This may be particularly relevant for countries with less developed financial markets or during episodes of "macro-market disconnect"—that is, when macroeconomic uncertainty is high and financial market volatility (realized and implied) is low.[8]

Against this background, this chapter examines risks to macrofinancial stability posed by macroeconomic uncertainty. The chapter first lays out a simple conceptual framework for discussing the main channels through which macroeconomic uncertainty can undermine macrofinancial stability, measured by downside risks to real GDP. It then uses panel data from a sample of 43 advanced and emerging market economies since 1990 (or the earliest year for which data are available) to empirically address three key questions.[9] First, does macroeconomic uncertainty help predict downside risks to output? Second, how does macroeconomic uncertainty interact with macrofinancial vulnerabilities to affect downside risks to output? Third, does the effect of macroeconomic uncertainty spill over across borders to affect downside risks to economic activity in a country's major financial and trading partners? The chapter then discusses policy options to mitigate the risks posed by high macroeconomic uncertainty.

To assess the downside risk to future economic activity from macroeconomic uncertainty, the chapter extends the growth-at-risk (GaR) framework. Since the global financial crisis, significant progress has been made in systemic risk analytics. The GaR framework (Adrian, Boyarchenko, and Giannone 2019) has become an operational cornerstone in this regard, providing a quantitative tool to assess the effect of financial conditions on downside tail risks to real GDP growth.[10] The chapter builds on this framework in two dimensions. First, it augments the GaR model with measures of macroeconomic uncertainty to examine if these are associated with downside tail risks to real GDP growth. In this context, the chapter considers three types of commonly used macroeconomic uncertainty measures—those based on (1) the accuracy and dispersion of forecasts for key macroeconomic variables, (2) domestic policies, and (3) geopolitical tensions. Second, the chapter implements the augmented GaR framework using machine learning tools, in addition to the standard panel quantile regressions, to exploit their advantages in prediction and improve the forecasting of downside tail risks to future GDP growth.[11]

[6]Bond and stock market volatility tend to be positively correlated across major economies, and this correlation seems to have increased since the pandemic (Online Annex 2.1), suggesting that stress in asset markets can spread quickly across the financial system.

[7]See, for example, Valkanov and Zhang (2018) and Dew-Becker and Giglio (2023). Online Annex 2.2 shows that financial variables explain about 80 percent of the variation in commonly used measures of macroeconomic uncertainty for advanced economies like the United States, and 40 to 50 percent of the variation in those for major emerging markets such as Brazil. This is because available financial instruments may not fully hedge important risks facing households and firms—for example, those related to housing markets (Shiller 2003, 2013; Benford, Ostry, and Shiller 2018).

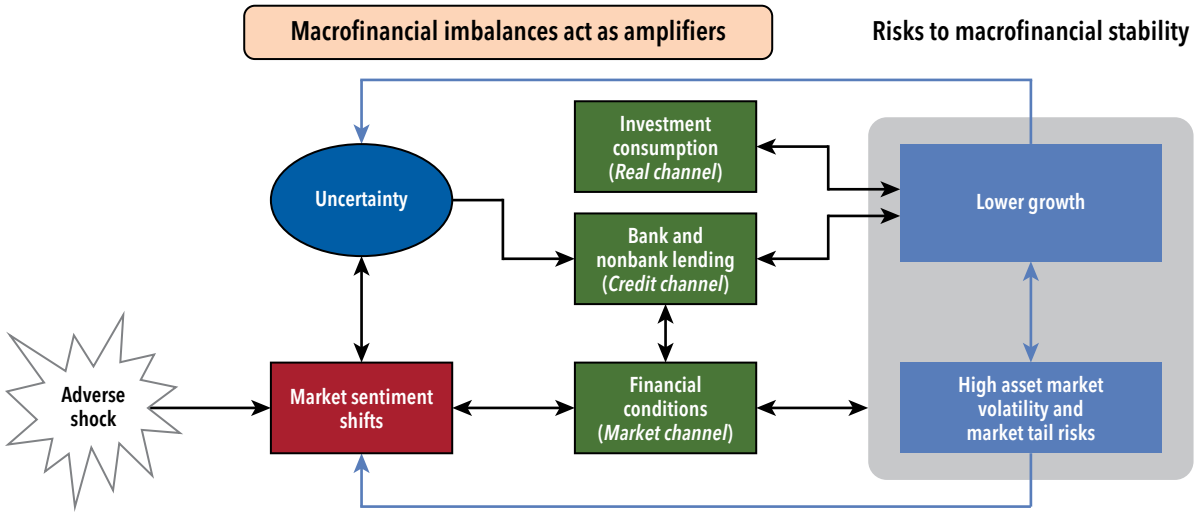
[8]Several factors can drive macro-market disconnects, including investor perception that future policy reactions will protect against downside market risks. Bialkowski, Dang, and Wei (2022) show that low-quality political signals, higher divergence in opinions among investors, and strong equity market performance drive disconnects between the VIX and US economic policy uncertainty. Todorov and Vilkov (2024) note the role played by hedging of covered calls in keeping the VIX at a low level in recent years.

[9]The cross-country sample coverage varies across exercises depending on data availability. See Online Annex 2.1 for information on countries included in the sample and the data sources.

[10]Downside risks to future GDP growth are typically captured by the 5th or 10th percentile of the distribution, while financial conditions are proxied by a composite indicator of risky asset prices (such as equity and corporate bond returns, real house price growth, etc.) and measures of financial uncertainty (such as the VIX).

[11]Machine learning models have gained popularity for forecasting economic and financial variables as they can accommodate many predictors and complex, nonlinear relations between variables (Gu, Kelly, and Xiu 2020; Coulombe and others 2022; Lenza, Moutachaker, and Paredes 2023).

**Figure 2.2. Macroeconomic Uncertainty and Macrofinancial Stability: Channels of Transmission**




Source: IMF staff elaboration.

## Macroeconomic Uncertainty and Financial Stability: A Conceptual Framework

Macroeconomic uncertainty can affect macrofinancial stability through three key channels. First, it can affect macrofinancial stability through a *market channel*, whereby macroeconomic uncertainty can amplify the impact of adverse shocks on investor sentiment, raising downside market tail risk—that is, the risk of large negative realized future asset returns (Figure 2.2) (Baker and Wurgler 2006; Birru and Young 2022). The realization of market tail risks could be transmitted to the broader economy through balance sheet and financial acceleration effects, raising downside risks to output (Adrian and others 2019). Second, macroeconomic uncertainty can affect macrofinancial stability through a *real channel*, whereby in response to higher macroeconomic uncertainty, firms and consumers may adopt a wait-and-see attitude and delay investment and consumption. This would slow economic activity, raising credit risks for financial institutions that could trigger an adverse macrofinancial feedback loop.[12] Third, macroeconomic uncertainty can affect macrofinancial stability through a *credit channel*. This channel may arise because of reduced credit supplied by financial intermediaries as they face greater challenges in determining the creditworthiness of new borrowers when the macroeconomic outlook is more uncertain.[13] These three channels can potentially interact and mutually reinforce each other, amplifying the effect of macroeconomic uncertainty on macrofinancial stability.[14]

Recent technological innovations and social media could aggravate uncertainty as well as its effect on market tail risks. Over the past few years, investors and depositors have been more attentive to surprises in data and news disseminated through social media, affecting their relationship with financial institutions and intensifying stress episodes (see Online Annex Figure 2.1.3). At the same time, fintech has made

[12]This channel originates from the "real options" literature, where the option value of deferring decisions rises with uncertainty (Bernanke 1983). Gilchrist, Sim, and Zakrajšek (2014), however, find that uncertainty mainly affects investment by causing financial distortions rather than through wait-and-see attitudes.

[13]See, for example, Valencia (2017); Buch, Buchholz, and Tonzer (2015); Wu and Suardi (2021); and Berger and others (2022).

[14]The literature has considered the effect of uncertainty both as a shock and as a type of vulnerability that can amplify the effects of other shocks. For example, Arellano, Bai, and Kehoe (2010); Christiano, Motto, and Rostagno (2014); and Gilchrist, Sim, and Zakrajšek (2014) analyze how increasing risk premiums can transmit uncertainty shocks to economic outcomes, while He and Krishnamurthy (2013) examine how high borrowing costs from higher uncertainty can undermine firms' profitability and solvency, making them more vulnerable to financial shocks. Alfaro, Bloom, and Lin (2022) show that uncertainty shocks and financial shocks to firms can amplify each other.

conducting transactions faster and easier, exacerbating funding and market liquidity risks (see the April 2022 *Global Financial Stability Report*). In addition, artificial intelligence (AI) is penetrating deeply into the financial sector, with institutional investors' use of AI-based algorithmic trading strategies further raising market volatility risks because of a potential increase in herding behavior among investors using similar AI models (see Chapter 3). Although these innovations have benefits, they also create systemic complexities that can accelerate the transmission of shocks and amplify the effect of macroeconomic uncertainty on financial stability.

## The Global Landscape of Macroeconomic Uncertainty

Macroeconomic uncertainty can stem from different sources. These include (1) innovations affecting the real sector of the economy such as output, product prices, factor costs, and firms' profitability; (2) monetary, fiscal, trade, and regulatory policies; and (3) geopolitical tensions, for example, conflicts or policy-driven decisions to impose barriers on cross-border trade and capital flows.[15] To quantify macroeconomic uncertainty from these sources, the chapter considers different measures. For example, real sector uncertainty is proxied by two indicators: the real economic uncertainty index (REU) of Jurado, Ludvigson, and Ng (2015) and Ludvigson, Ma, and Ng (2021), which reflects the accuracy of forecasts for a large set of key macroeconomic variables, and by the dispersion in real GDP forecasts based on Consensus Economics' survey of professional forecasters. Uncertainty pertaining to domestic macroeconomic and regulatory policies is captured by the text-based economic policy uncertainty index of Baker, Bloom, and Davis (2016), as well as by the world uncertainty index of Ahir, Bloom, and Furceri (2022). Finally, geopolitical uncertainty is measured by the text-based geopolitical risk index of Caldara and Iacoviello (2022).[16]

The different measures of macroeconomic uncertainty tend to be positively but not strongly correlated. The degree to which the macroeconomic uncertainty measures correlate with each other varies considerably but is generally modest (Figure 2.3, panel 1). This suggests that the different measures capture some idiosyncratic phenomena in addition to common shocks, making it important to individually assess their association with tail risks to economic activity.[17] The REU is of particular interest because it exhibits the strongest correlation with other measures of macroeconomic uncertainty, possibly because real sector outcomes may capture uncertainty from different sources including policies and geopolitics.

Measures of macroeconomic and financial uncertainty may contain complementary information but do not always fluctuate in tandem. The correlations of macroeconomic uncertainty measures with commonly used measures of financial uncertainty—such as that based on Ludvigson, Ma, and Ng (2021), which captures the precision of forecasts for different financial market variables, or the VIX—are generally positive but also modest (Figure 2.3, panel 1). Looking at the evolution of different measures of macroeconomic and financial uncertainty for the United States, for example, makes evident that in some major crises, such as the global financial crisis or the COVID-19 pandemic, all measures spiked in tandem (Figure 2.3, panel 2). However, for many economic and political events, only some of the measures have shown a significant response while other measures have remained muted. The US dot-com bubble of the late 1990s is one such case that is only captured by measures of financial uncertainty (VIX), while the intensification of trade tensions between China and the United States that started around 2018 is largely captured by an increase in the economic policy uncertainty index.

[15]Several other factors could also influence macroeconomic uncertainty such as climate change, climate policy, and technological innovation. These are not explicitly analyzed in the chapter because of limited data availability. However, some of the measures of macroeconomic uncertainty used in the chapter may at least partly capture the effects of these sources as well. There may also be some overlap between the different sources of macroeconomic uncertainty—for example, that stemming from geopolitical tensions could affect both real outcomes and policies.

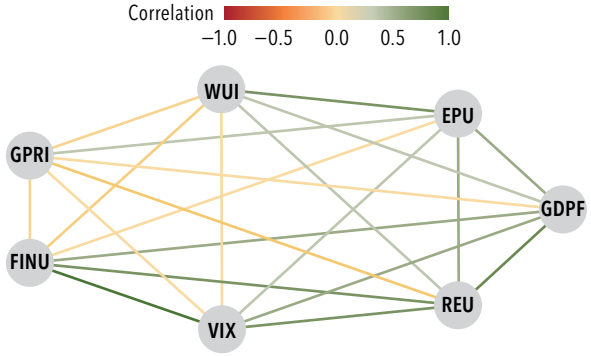
[16]See Online Annex 2.2 for further details on the various measures of uncertainty.

[17]Correlation among measures of uncertainty has increased over time (Online Annex Figure 2.1.4). Kozeniauskas, Orlik, and Veldkamp (2018) show that measures of economic uncertainty are statistically distinct and can covary positively or negatively depending on the type of shock. Nevertheless, these measures tend to have some common fluctuations beyond the business cycle effect, which is driven by changes to macroeconomic volatility.

## Figure 2.3. Measures of Macroeconomic and Financial Uncertainty

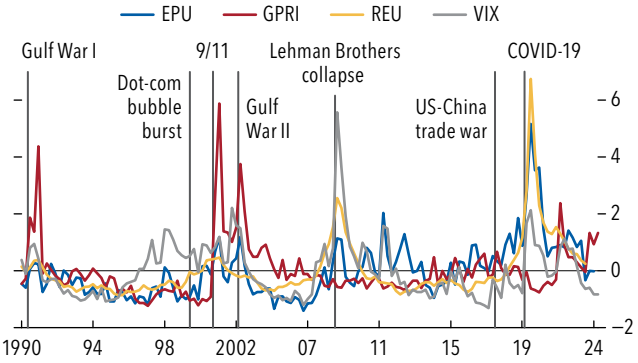
Measures of uncertainty are not perfectly correlated ...

**1. Correlations between Selected Measures of Macroeconomic and Financial Uncertainty, 1990–2023**
*(Correlation coefficient)*



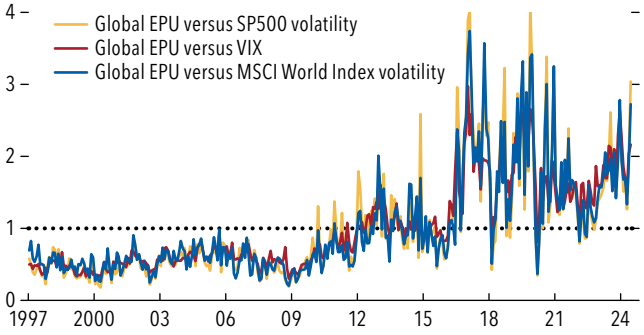

... and may increase idiosyncratically around certain events.

**2. Selected Measures of Macroeconomic and Financial Uncertainty for the United States, 1990–2024**
*(Standardized values)*



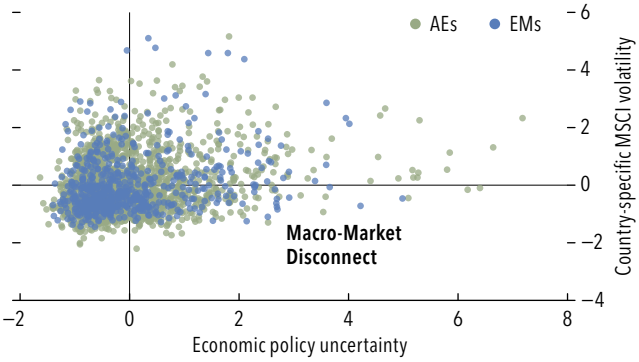

A disconnect between the level of macroeconomic and financial uncertainty can arise ...

**3. Global Economic Policy Uncertainty Relative to Realized and Implied Stock Market Volatility, 1997–2024**
*(Ratio, normalized)*




... and is often observed in both advanced and emerging market economies.

**4. Realized Stock Market Volatility and Economic Policy Uncertainty across Economies, 1990–2024**
*(Standardized values)*




Sources: See Online Annex 2.1; and IMF staff calculations.

Note: Panel 1 shows the correlation between several macroeconomic and financial uncertainty measures from 1990 to 2023. Panel 2 depicts standardized measures of uncertainty for the United States. Panel 3 shows the monthly ratios of the global economic policy uncertainty index to the realized S&P 500 volatility, to the VIX, and to the MSCI World Index volatility, with the ratios normalized to have a mean of one over 1997:M1–2024:M2. Panel 4 shows a scatterplot of standardized country-specific economic policy uncertainty against MSCI country-specific realized stock market volatility. Realized stock market volatility is computed as the within-quarter volatility of daily returns. The fourth quadrant of the panel (with above average macroeconomic uncertainty and below average stock market volatility) indicates observations of a macro-market disconnect across countries. AEs = advanced economies; EMs = emerging markets; EPU = economic policy uncertainty index; FINU = financial uncertainty measure; GDPF = real GDP forecast dispersion; GPRI = geopolitical risk index; REU = real economic uncertainty index; SP500 = S&P 500; VIX = Chicago Board Options Exchange Volatility Index; WUI = world uncertainty index.

Measures of macroeconomic and financial uncertainty can remain disconnected for a period of time. Commonly used measures of financial uncertainty are limited in scope and generally restricted to certain time horizons. For example, measures of option-implied market volatility, such as the VIX, capture risk related to stock market returns—that is, the performance of publicly traded firms as perceived by investors—at short time horizons. In contrast, the information embedded in measures of macroeconomic uncertainty such as policy uncertainty can be relevant for assessing the outlook of an economy over much longer horizons, for example, when it pertains to geopolitical shocks or to electoral cycles.[18] This may at least partly explain why at times financial market volatility (realized and

[18]Policy uncertainty can increase because of electoral uncertainty when candidates' policy proposals diverge significantly, or there is less clarity on the proposals. Goodell, McGee, and McGroarty (2020) show that changes in the incumbent party's probability of reelection drive key changes to policy uncertainty.

implied) may be low while macroeconomic uncertainty is high—that is, there is a "macro-market disconnect"—which may remain persistent (Figure 2.3, panels 3 and 4).[19]

## Macroeconomic Uncertainty and Downside Risk to Output

To assess the association of macroeconomic uncertainty with downside risks to future output, the chapter estimates an augmented GaR model.[20] The analysis looks at the full distribution of future GDP growth at different horizons, with a focus on the left tail (the 10th percentile) as a measure of downside tail risk.

The results show that an increase in macroeconomic uncertainty is associated with a significant rise in downside risk to future GDP growth. A one-standard-deviation increase in measures of macroeconomic uncertainty reduces one-quarter-ahead real GDP growth (annualized) by 0.5 to 2.0 percentage points (Figure 2.4, panel 1).[21] Measures of macroeconomic uncertainty based on real outcomes such as the REU and dispersion of GDP forecasts have quantitatively the largest effect, but the association of all measures with downside risks to future output is statistically significant. Moreover, the impact of macroeconomic uncertainty persists up to about seven quarters after the shock (Figure 2.4, panel 2). In cumulative terms, an increase in the REU equivalent to that observed on average across countries during the global financial crisis translates into a decline in one-year-ahead GaR of about 1.2 percentage points.[22]

Increased uncertainty has an asymmetric association with the distribution of future GDP growth, affecting downside ("bad") tail risks more strongly than upside ("good") tail risks. Macroeconomic uncertainty has a negligible effect on the median of the distribution of future real GDP growth but a large and statistically significant effect on the lower and upper quantiles (Figure 2.4, panel 3).[23] Overall, however, an increase in uncertainty exerts a stronger effect on downside tail risks to future GDP growth (at the 5th or 10th percentiles) than on upside tail risks (at the 90th or 95th percentiles). Additional analysis presented in Online Annex 2.2 suggests that some technological revolutions (for example, the 1990s dot-com bubble in the United States and the mobile phone revolution in Finland), postcrisis reforms (for example, those in Korea after the Asian financial crisis), and major political shifts (for example, the reunification of East and West Germany in the late 1980s) could be considered as examples of "good" uncertainty that raised upside tail risks to future growth. By contrast, increased macroeconomic uncertainty at the onset of the global financial crisis or the COVID-19 pandemic are examples of "bad" uncertainty.[24]

Machine learning models can improve predictions of downside risk to GDP growth, particularly when measures of macroeconomic uncertainty are added as predictors. Applying machine learning models—such as panel quantile random forest and panel quantile neural network—to the GaR framework (ML-GaR)

[19]For example, while the 2016 US presidential election was associated with significant uncertainty about its effect on the country's long-term policies, volatility in stock markets remained low. Similarly, Brexit caused considerable uncertainty about UK trade, growth, and immigration policies, yet it had less of an impact on short-term stock market volatility. Aït-Sahalia and others (2024) show that macroeconomic uncertainty and stock return volatility could be disconnected. In particular, the relationship between macroeconomic uncertainty and volatility could vary over time depending on the precision of political signals, even though (a priori) they are expected to be positively correlated (Pástor and Veronesi 2013).

[20]The analysis extends the baseline GaR model of Adrian, Boyarchenko, and Giannone (2019) to include measures of macroeconomic and financial uncertainty, while controlling for current GDP growth, financial conditions, and country fixed effects. Estimations are carried out using panel quantile regressions for different time horizons. While the focus of the analysis is on predicting downside risks to future output, and not on identifying the causal effects of uncertainty on future output, potential endogeneity concerns are addressed in robustness exercises. See Online Annex 2.3 for more details on the estimation methodology, results, and robustness analysis.

[21]These estimates are quantitatively significant, considering that the annual output decline in the bottom 10th percentile of the historical GDP growth distribution for the full sample, across advanced and emerging market economies, is 1.2 percent.

[22]Note that an increase in the financial uncertainty measure also raises downside risks to real GDP growth beyond the effect of the financial conditions index included in the model. These estimates are based on panel data, capturing the cross-country average effects. The effects of macroeconomic and financial uncertainty variables for individual countries may be larger or smaller.

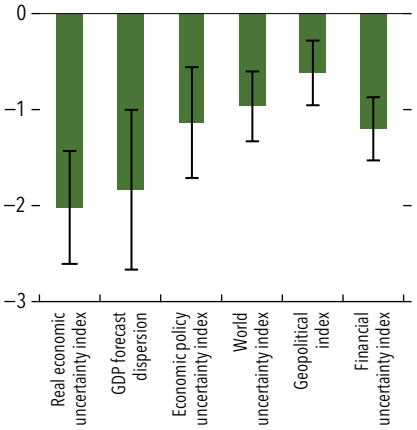
[23]The macroeconomic uncertainty measures are significantly associated with the mean of one-quarter-ahead GDP growth when the financial conditions indicator is not included in the model, but they are not significant otherwise.

[24]Episodes of "bad" and "good" uncertainty are distinguished by following the approach of Segal, Shaliastovich, and Yaron (2015) (see Online Annex 2.2 for details). Intuitively, uncertainty marked by positive shocks like technological advancements or unexpected market opportunities can potentially be "good" because businesses and investors, perceiving future gains, may increase investment and expand operations, driving economic growth and higher asset prices. By contrast, "bad" uncertainty, related to negative shocks to macroeconomic variables, would lower prices and reduce investment.

## Figure 2.4. Uncertainty and Downside Risks to Output: Results from Panel Quantile GaR Model

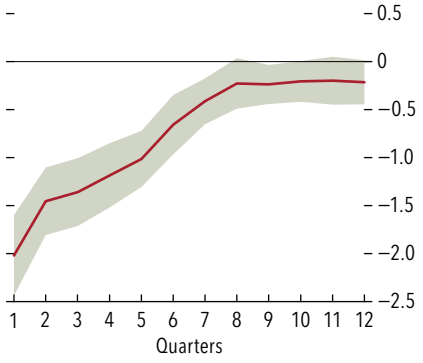
Measures of macroeconomic uncertainty have a strong impact on downside risks to output ...

**1. Effect of Measures of Uncertainty on Growth-at-Risk, One Quarter Ahead**
*(Percentage points, annualized)*



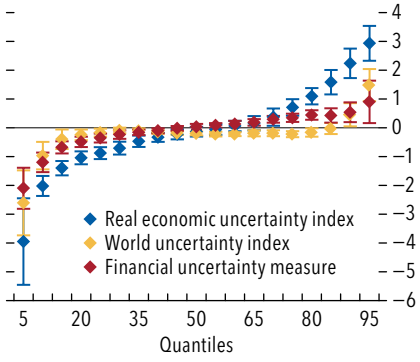

... and effects are persistent up to about seven quarters ahead.

**2. Effect of Real Economic Uncertainty on Growth-at-Risk at Different Horizons**
*(Percentage points, annualized)*




A rise in uncertainty has asymmetric effects on the distribution of future GDP growth.

**3. Effect of Uncertainty on Growth-at-Risk, One Quarter Ahead**
*(Percentage points, annualized)*




Sources: Ahir, Bloom, and Furceri 2022; Baker, Bloom, and Davis 2016; EUROPACE AG/Haver Analytics; IMF, Global Data Source and International Financial Statistics databases; LSEG Datastream; Organisation for Economic Co-operation and Development, Main Economic Indicators database; and IMF staff calculations.

Note: Panel 1 illustrates the impact of a one-standard-deviation increase in various measures of uncertainty individually on the 10th percentile of the one-quarter-ahead real GDP growth distribution, with current real GDP growth, financial conditions, and country fixed effects controlled for. Panel 2 shows the impact of a one-standard-deviation increase in the real economic uncertainty index used in the chapter, based on Ludvigson, Ma, and Ng (2021), on the 10th percentile of the average future real GDP growth distribution at different time horizons. The solid line shows estimated coefficients; shaded areas around estimated coefficients correspond to 90 percent confidence intervals. Panel 3 depicts the effect of various measures of uncertainty on the full distribution of one-quarter-ahead real GDP growth. All estimations are carried out using panel quantile regressions across the economies considered in the sample. Error bars indicate 90 percent confidence intervals. For more details on variables, estimations, and data sources, see Online Annexes 2.1, 2.2, and 2.3. GaR = growth-at-risk.

improves out-of-sample prediction accuracy compared to the standard benchmark GaR model based on linear quantile regressions. Specifically, out-of-sample prediction accuracy for advanced and emerging market economies improves by up to 7 percent at different horizons (Figure 2.5, panels 1 and 2, green bars).[25] Adding measures of macroeconomic uncertainty (such as the REU) as predictors further improves the out-of-sample forecast performance of ML-GaR models by 5 to 13 percent relative to the standard GaR models that exclude uncertainty (Figure 2.5, panels 1 and 2, red bars).[26]

ML-GaR models also show that macroeconomic uncertainty contributes at least as much as the financial conditions index to predicting downside risk to real GDP growth. For both one- and four-quarter-ahead forecasts of downside risks to output growth in advanced and emerging market economies, the REU on average contributes more to predictions than the financial conditions index typically included in GaR models (Figure 2.5, panels 3 and 4).[27]

Market and credit channels play an important role in transmitting the effect of macroeconomic uncertainty on future output growth. An increase in macroeconomic uncertainty is associated with a greater likelihood of large negative realizations of stock market returns, as well as of spikes in sovereign bond spreads (Box 2.1). Furthermore, macroeconomic uncertainty influences tail risks to future bank lending, particularly in countries where banking exposure to sovereign debt is high.

[25]The benchmark quantile regression GaR model and the machine learning models are estimated on the same panel of economies and predict the 10th percentile of the one- or four-quarter-ahead GDP growth distribution. See Online Annex 2.3 for further details.

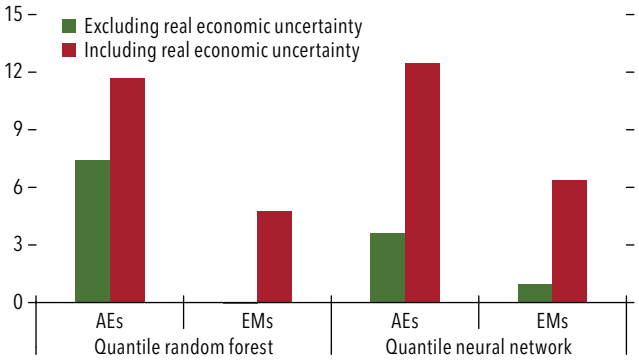
[26]These results are qualitatively robust to the use of alternative measures of macroeconomic uncertainty and training samples that exclude major crises such as the global financial crisis and the COVID-19 pandemic (see Online Annex 2.3 for details).

[27]Contributions for each variable to the forecast are calculated as average absolute Shapley values in panel quantile random forest and quantile neural network models. These contributions may vary across countries and over time. For example, the financial conditions index may play a more important role than the REU during periods of financial stress in advanced economies. On average, the contribution of the REU is higher when the quantile neural network models, which provide more flexibility to capture complex nonlinearities between uncertainty and other predictors, are used.

## Figure 2.5. Improvement in Predictive Accuracy from Applying Machine Learning GaR Models

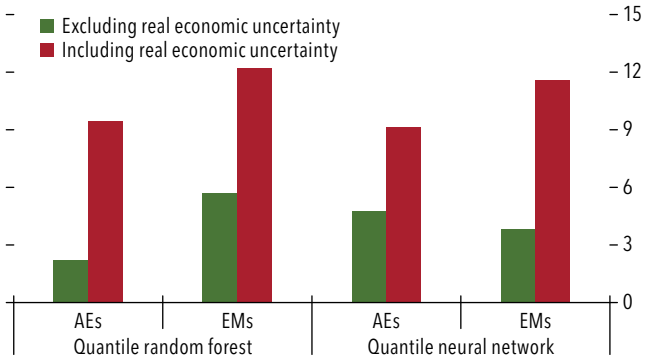
Machine learning tools increase the predictive power of growth-at-risk models, especially when macroeconomic uncertainty is considered ...

**1. Machine Learning GaR: One-Quarter-Ahead Out-of-Sample Growth-at-Risk Forecasts**
*(Accuracy change relative to benchmark model, percent)*



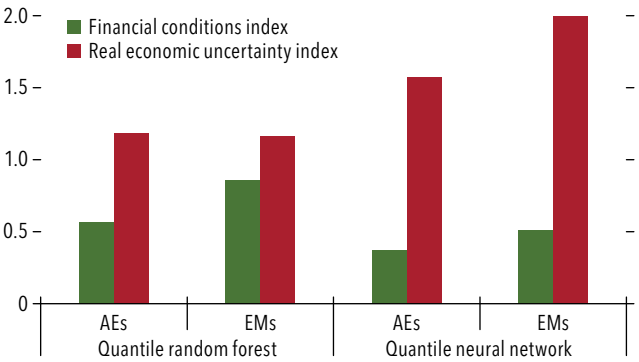

... and this holds for different time horizons.

**2. Machine Learning GaR: Four-Quarters-Ahead Out-of-Sample Growth-at-Risk Forecasts**
*(Accuracy change relative to benchmark model, percent)*



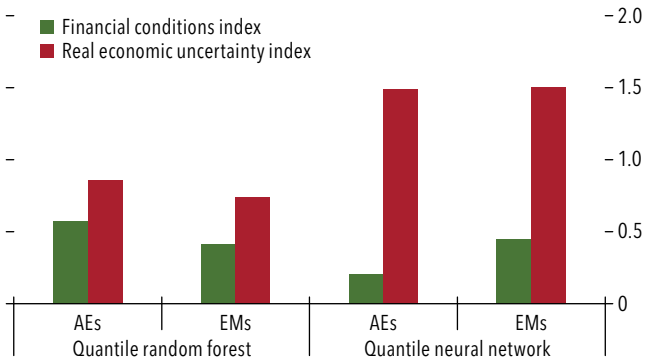

Macroeconomic uncertainty is an important predictor ...

**3. Predictive Importance of Macroeconomic Uncertainty and Financial Conditions, One-Quarter-Ahead Out-of-Sample Growth-at-Risk Forecasts**
*(Average absolute Shapley value, percent)*




... particularly in emerging markets.

**4. Predictive Importance of Macroeconomic Uncertainty and Financial Conditions, Four-Quarters-Ahead Out-of-Sample Growth-at-Risk Forecasts**
*(Average absolute Shapley value, percent)*




Sources: EUROPACE AG/Haver Analytics; IMF, Global Data Source and International Financial Statistics databases; Organisation for Economic Cooperation and Development, Main Economic Indicators database; LSEG Datastream; and IMF staff calculations.

Note: Panels 1 and 2 compare the predictive accuracy of alternative ML-GaR models (quantile random forest and quantile neural network) against a benchmark GaR model estimated using panel quantile regressions for one- and four-quarter-ahead output growth (at the 10th percentile), respectively, for a sample of advanced and emerging market economies. The benchmark GaR model includes current real GDP growth, the financial conditions index used in the chapter, and country fixed effects as predictors. The comparator ML models include the same variables for results presented in green bars and additionally include the real economic uncertainty index for results presented in red bars. The predictive accuracy improvement is defined as one minus the percentage change in realized quantile loss for the 10th percentile when moving from benchmark GaR to ML-GaR predictions for out-of-sample forecasts. Panels 3 and 4 display the average absolute Shapley values for the real economic uncertainty index and the financial conditions index to assess the importance of each variable for one- and four-quarter-ahead predictions of GaR (10th percentile of output growth). For additional details, see Online Annex 2.3. AEs = advanced economies; EMs = emerging markets; GaR = growth-at-risk; ML = machine learning.

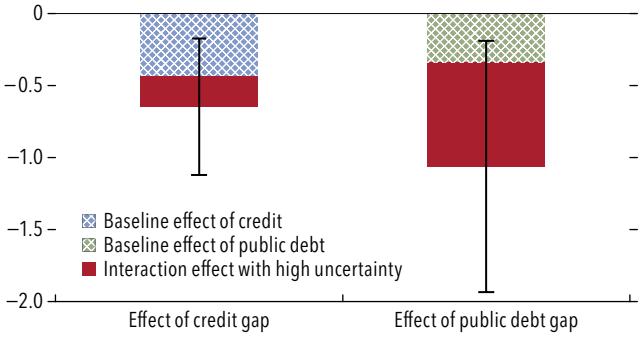
## Macroeconomic Uncertainty Amplifies the Impact of Macrofinancial Vulnerabilities

Macroeconomic uncertainty interacts with debt vulnerabilities to exacerbate downside tail risks to GDP growth. High real economic uncertainty combined with excessive domestic credit (measured as the deviation of the credit to the private-sector-to-GDP ratio from its long-term trend) reduces one-quarter-ahead downside tail risk to GDP growth (that is, the 10th percentile of the distribution of future GDP growth) by 0.6 percentage points (Figure 2.6, panel 1). Similarly, high public debt levels (captured by the deviation of the public-debt-to-GDP ratio from its long-term trend) significantly increase downside risks to GDP growth, particularly when real economic

## Figure 2.6. Macroeconomic Uncertainty and Macrofinancial Vulnerabilities

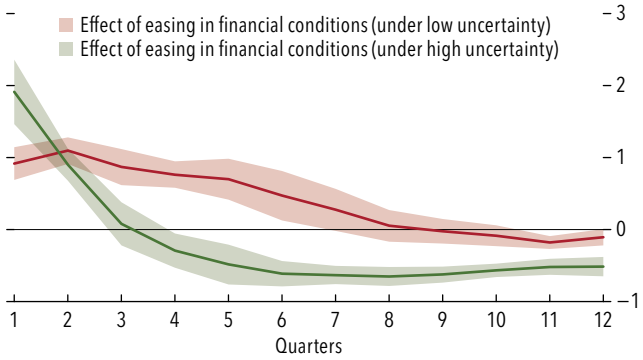
High macroeconomic uncertainty amplifies the effects of macrofinancial vulnerabilities on downside risks to future GDP growth ...

**1. Effect on GaR of Interaction between Real Economic Uncertainty and Public and Private Sector Leverage**
*(Percentage points, one quarter ahead)*



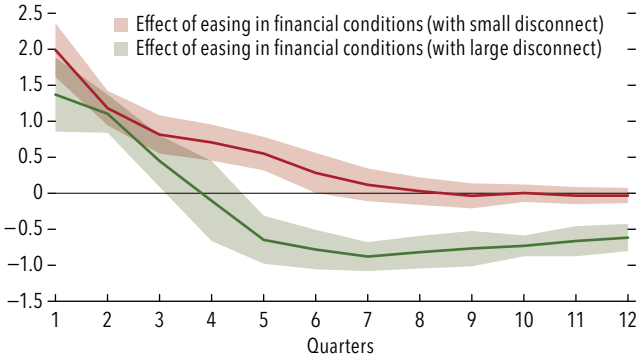

... as well as the intertemporal trade-off posed by easy financial conditions on growth-at-risk ...

**2. Effect of Easing in Financial Conditions on GaR amid High and Low Real Economic Uncertainty**
*(Percentage points)*



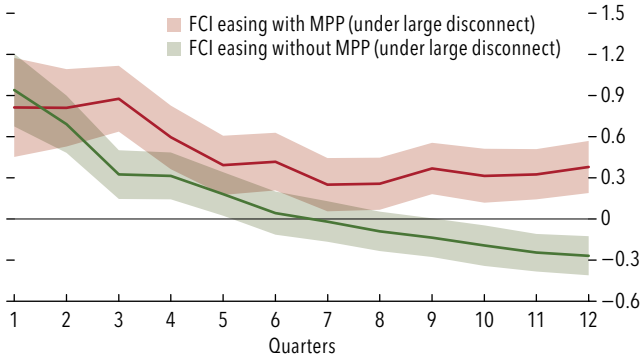

... particularly when uncertainty in the macroeconomy becomes substantially disconnected from that in financial markets.

**3. Effect of Easing in Financial Conditions on GaR amid High and Low Macro-Market Disconnect**
*(Percentage points)*




Macroprudential policies can help mitigate the intertemporal trade-off and maintain financial stability.

**4. Effect of Easing in Financial Conditions on GaR with and without Macroprudential Policies**
*(Percentage points)*




Sources: EUROPACE AG/Haver Analytics; IMF, Global Data Source, Integrated Macroprudential Policy, and International Financial Statistics databases; LSEG Datastream; Organisation for Economic Co-operation and Development, Main Economic Indicators database; and IMF staff calculations.

Note: Panel 1 shows the impact of private credit-to-GDP gap and public debt-to-GDP gap on GaR (10th percentile of the distribution of one-quarter-ahead output, annualized) amid high real economic uncertainty. The analysis extends the baseline GaR model of Adrian, Boyarchenko, and Giannone (2019) by adding variables relating to the gaps in private credit and public debt, a dummy variable indicating periods of high uncertainty, and their respective interaction terms. Periods of high (low) uncertainty are defined as those with values above (below) the median. The credit-to-GDP gap and total public debt-to-GDP gap are measured by the deviations of the variables from a one-sided Hodrick-Prescott filter. Estimations are conducted using panel quantile regressions for the countries in the sample, depending on data availability. Error bars (solid color) indicate 90 percent confidence intervals for the sum of the coefficients on vulnerabilities and their interaction with the uncertainty dummy variable. Panels 2 and 3 present the impact of a one-standard-deviation easing in financial conditions on the term structure of GaR amid high (low) real economic uncertainty and amid high (low) macro-market disconnect, respectively. High (low) macro-market disconnect is defined as the ratio of real economic uncertainty to realized market volatility that is above (below) the mean. Panel 4 illustrates the impact of a one-standard-deviation easing in financial conditions during a period of macroprudential tightening, using a methodology similar to that in Chapter 2 of the April 2021 *Global Financial Stability Report*. The macroprudential tightening regime refers to quarters in the preceding year with net macroprudential tightening. See Online Annexes 2.1 and 2.4 for further details on estimations. Solid lines show estimated coefficients; shaded areas around estimated coefficients correspond to 90 percent confidence intervals. FCI = financial condition index; GaR = growth-at-risk; MPP = macroprudential policies.

uncertainty is high instead of low—possibly through the effects of increased public debt on borrowing costs, and thereby on investment and consumption.[28]

More generally, high macroeconomic uncertainty can exacerbate macrofinancial stability risks associated with loose financial conditions. In the standard GaR framework, changes in financial conditions lead to intertemporal trade-offs. In the short term, an easing of financial conditions that is typically associated with rising asset valuations and a compression of credit spreads and stock market volatility reduces downside tail risks to GDP growth. Easy financial conditions, however, also encourage a buildup of debt vulnerabilities which exacerbate downside tail risks to GDP growth in the medium term. This intertemporal trade-off has relevance for monetary and macroprudential policy making because tighter policies can help weaken it (Adrian and Liang 2018). An increase in macroeconomic uncertainty can, however, amplify the trade-off, particularly when it is not synced with financial market volatility—that is, when there is a macro-market disconnect. This is because such a disconnect increases the possibility of sudden jumps in financial market volatility and market crashes in the face of adverse shocks as investors realign their expectations, with broader implications for financial stability.[29]

The analysis suggests that macroeconomic uncertainty significantly influences the intertemporal trade-off. Estimates of the GaR model augmented with the REU show that under high macroeconomic uncertainty, looser financial conditions exacerbate downside tail risks to GDP growth in the medium term (Figure 2.6, panel 2). The impact of looser financial conditions is even more pronounced when there is a large macro-market disconnect, confirming that compressed market volatility may reverse quickly in the face of a shock when real economic uncertainty is high (Figure 2.6, panel 3).

Macroprudential policies can help mitigate the intertemporal trade-off. Further analysis suggests that a net tightening of macroprudential policies can help offset the rise in medium-term downside risks that accompany easy financial conditions, especially when there is a macro-market disconnect.[30] Specifically, when the macro-market disconnect is large, a loosening of financial conditions coupled with a net tightening of macroprudential policies is associated with a reduction in downside risks to GDP growth of 0.3 to 0.6 percentage points in the medium to long terms, compared with a scenario in which no macroprudential measures are put in place (Figure 2.6, panel 4). These findings suggest that policymakers may need to be more proactive in deploying policies aimed at preserving financial stability in periods when macroeconomic uncertainty is high relative to market volatility. More generally, credible policy frameworks may also help reduce macroeconomic uncertainty and its impact on downside risks to output (Box 2.2).

## The Downside Risks of Macroeconomic Uncertainty and Cross-Border Spillovers

The downside risks from macroeconomic uncertainty can spill over across borders through trade and financial linkages. An increase in macroeconomic uncertainty in a country's major trading and financial partners can raise domestic downside risks through the real channel (as the demand for the country's exports dwindles) as well as through the market and credit channels (by limiting foreign capital flows).[31] To investigate these possible cross-border spillover

[28]For example, uncertainty about future economic policies can prompt investors to demand higher risk premiums, thereby increasing government borrowing costs and making debt servicing more expensive. Machine learning models further expose the nonlinear relationship between public and private debt and downside risks to GDP growth, conditional on the level of real economic uncertainty (Online Annex Figure 2.4.1).

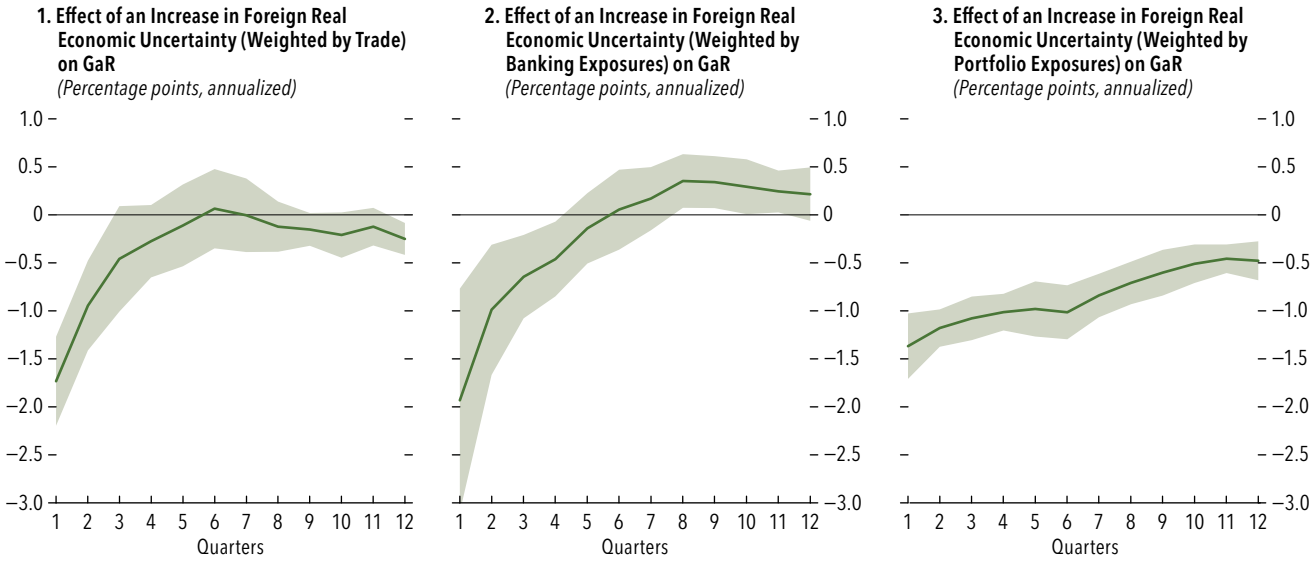
[29]Periods of compressed risk premiums may be associated with overexuberant sentiment and are often followed by a reversal in valuations (Greenwood and Hanson 2013). Extending the GaR model with a variable for a large macro-market disconnect—defined as the ratio of real economic uncertainty to realized stock market volatility that is above its mean level—confirms that such a disconnect is associated with an increase in downside tail risks to future output growth (see Online Annex 2.4).

[30]This result complements the findings in Chapter 2 of the April 2021 *Global Financial Stability Report*, which show that macroprudential policy can temper buildups in private sector leverage, reducing downside risks to growth in the medium term. The analysis here considers the presence of all types of macroprudential measures, focusing on the frequency of tightening episodes rather than on their intensity (for details, see Online Annex 2.5).

[31]A large body of literature examines the cross-border spillover effects of global financial uncertainty (proxied by the VIX) on asset prices, capital flows, domestic credit growth, and output, documenting strong effects (for example, Rey 2013; Obstfeld, Ostry, and Qureshi 2019; Bhattarai, Chatterjee, and Park 2020). Biljanovska, Grigoli, and Hengge (2021) show that an increase in economic policy uncertainty in China, Europe, and the United States reduces economic activity in the rest of the world, and Londono, Ma, and Wilson (2024) find that foreign uncertainty negatively affects domestic economic outcomes. These studies, however, mostly focus on the mean spillover effects of uncertainty and not on tail risks to output.

### Figure 2.7. Cross-Border Spillover Effects of Foreign Uncertainty

An increase in real economic uncertainty in a country's major trade and financial partners can raise downside risks to domestic output.




Sources: EUROPACE AG/Haver Analytics; IMF, Global Data Source and International Financial Statistics databases; LSEG Datastream; Organisation for Economic Co-operation and Development, Main Economic Indicators database; and IMF staff calculations.

Note: The figure shows the effect of a one-standard-deviation increase in various measures of foreign uncertainty on the 10th percentile of future quarterly domestic real GDP growth (annualized) over time. In panel 1, the measure of foreign uncertainty is calculated as a weighted average of the chapter's real economic uncertainty index in a country's trading partners, with weights computed as the sum of the ratios of bilateral exports and imports to domestic GDP. In panel 2 (3), the measure of foreign uncertainty is calculated as a weighted average of the chapter's real economic uncertainty index in a country's financial partners, with weights computed as the sum of the ratios of bilateral banking (portfolio) assets and liabilities to domestic GDP. The model controls for current GDP growth, the domestic financial conditions index, measures of domestic real economic and financial uncertainty (based on Ludvigson, Ma, and Ng 2021), global real GDP growth, the global financial conditions index, a dummy variable for the global financial crisis and country fixed effects. Estimations are conducted using a panel quantile regression framework for the full sample of advanced and emerging market economies. For more details on computations and data sources, see Online Annex 2.6. Graph lines represent estimated coefficients; shaded areas around estimated coefficients correspond to 90 percent confidence intervals. GaR = growth-at-risk.

effects, the chapter constructs measures of "foreign uncertainty" as a weighted average of measures of macroeconomic uncertainty in each country's major trading and financial partners—with weights based on the intensity of trade (export and import) or banking and portfolio investment exposures between the domestic and partner economy. The foreign uncertainty measures are included in the GaR model, along with measures of domestic uncertainty and other relevant control variables, and the model is estimated for the full sample of advanced and emerging market economies.[32]

The findings show that foreign macroeconomic uncertainty can exacerbate downside tail risks to domestic GDP growth through both trade and financial linkages. The 10th percentile of the one-quarter-ahead distribution of GDP growth declines by 1.7 percentage points following a one-standard-deviation increase in the trade-weighted foreign macroeconomic uncertainty measures (based on the REU) (Figure 2.7, panel 1). The effect is, however, less persistent than that resulting from a similar increase in domestic macroeconomic uncertainty (Figure 2.3, panel 2) and peters out in about three quarters. Similar results are obtained for an increase in the REU in partner countries with which a country has strong banking relationships (Figure 2.7, panel 2) or cross-border portfolio investment exposures (Figure 2.7, panel 3).[33] In the latter case, the effect is notably more persistent, suggesting that nonbank financial intermediaries can potentially play an important role in transmitting

[32]See Online Annex 2.6 for methodological details and detailed results of the cross-border spillover analysis.

[33]These results are robust to other measures of macroeconomic uncertainty. For uncertainty related to foreign economic policy, the impact on domestic downside risks to output is found to be more persistent, lasting up to six quarters.

macroeconomic uncertainty across borders through the market channel.[34]

International reserve buffers and exchange rate flexibility can help mitigate the adverse implications of foreign uncertainty. While macroeconomic uncertainty can be a potential source of international financial contagion, additional analysis shows that downside risks arising from a rise in foreign macroeconomic uncertainty could be mitigated by building adequate international reserve buffers, or through greater exchange rate flexibility (Online Annex 2.6).

## Conclusion and Policy Recommendations

Macroeconomic uncertainty remains elevated globally since the COVID-19 pandemic. This chapter shows that high uncertainty about economic fundamentals and policies increases downside risks to future real GDP growth, stock and bond market returns, and bank lending. Macrofinancial vulnerabilities, such as high ratios of public and private sector debt to GDP, can interact with high macroeconomic uncertainty to amplify the effects of adverse shocks on future output growth. Moreover, high macroeconomic uncertainty worsens the intertemporal trade-off posed by an easing of financial conditions for downside risk to medium-term output growth, particularly when accompanied by low financial market volatility (a macro-market disconnect). The impact of macroeconomic uncertainty tends to spill over across borders through trade and financial linkages, raising the risk of international contagion in the face of large adverse shocks. The chapter also presents evidence that macroprudential policies, larger buffers of international reserves, and enhanced exchange rate flexibility can help mitigate the domestic and cross-border effects of macroeconomic uncertainty.

The findings also show that machine learning models can improve the forecasting capacity of systemic risk assessment frameworks such as the GaR framework. Regulatory and policy institutions can enhance their systemic risk monitoring frameworks by explicitly considering the role of macroeconomic uncertainty as a key determinant of systemic risk while also exploiting the advantages of AI tools such as machine learning models for predicting downside tail risks to output and financial markets. Other AI tools (such as natural language models) can be used to extract useful and high-frequency information from a range of text-based sources (including firms' earning call reports, social media, and local and global news) to enhance real-time monitoring of systemic risk.[35]

Policy actions should focus on reducing macroeconomic uncertainty as well as on mitigating its adverse effects by strengthening resilience and containing macrofinancial vulnerabilities.

### Reducing Policy Uncertainty

Credible monetary and fiscal policy frameworks and improved communication can reduce macroeconomic uncertainty and its adverse effects on the economy. Enhancing the credibility of policy frameworks through, for example, the adoption of fiscal and monetary policy rules supported by strong institutions can reduce policy uncertainty (Box 2.2). Credible policy frameworks can also offer policymakers more room to cope with large adverse shocks, thereby mitigating the effects of increases in macroeconomic uncertainty on downside risks to output growth. In addition, improved transparency and well-designed policy communication frameworks can steer market expectations and make policy decisions more predictable and less uncertain.[36]

A stable financial regulatory framework is important to help mitigate policy uncertainty. In the financial sector, constant innovations open new loopholes and sources of complexity, which can threaten financial stability and require a regulatory response without delay. To prevent these reforms from generating unnecessary policy uncertainty among market participants and financial institutions, they should be announced and implemented with clear communication strategies, robust calibration, phase-in periods as necessary, and clear and practical use of supervisory discretion and enforcement.

[34]Studies note that nonbank financial intermediaries are more sensitive to changes in drivers of global liquidity flows than banks (Buch and Goldberg 2024) and that nonbanks' large-scale selling during uncertain times can amplify global market disruptions (Ma, Xiao, and Zeng 2022).

[35]Although machine learning methods are well suited for improving systemic risk surveillance, their application entails conceptual and practical challenges. First, data requirements and technological know-how for applying machine learning tools are significant, which may pose challenges for many emerging market and developing economies with data, skill, and technological constraints. Second, weak signal-to-noise ratios of financial variables can lead large and sophisticated models to perform poorly out of sample. Finally, machine learning methods often suffer from poor transparency and interpretability. Online Annexes 2.3 and 2.4 discuss how these shortcomings have been addressed in the chapter using cross-validation methods for model selection and overfit mitigation, as well as by numerical simulations and analysis of variable importance.

[36]For example, Blinder and others (2008) show that increased transparency and improved policy communication among central banks in major economies has increased the predictability of central banks' interest rate decisions, reducing their impact on market volatility.

## Mitigating the Financial Stability Risks Associated with Macroeconomic Uncertainty

Policymakers should deploy adequate macroprudential and fiscal policies to contain financial stability risks arising from elevated macrofinancial vulnerabilities amid high macroeconomic uncertainty. As high uncertainty can exacerbate the adverse effects of macrofinancial vulnerabilities such as excessive private sector leverage on the real economy, policymakers should remain vigilant and proactively deploy macroprudential policies to limit these vulnerabilities. This is particularly relevant when financial conditions are loose and seemingly disconnected from the elevated uncertainty prevailing in the broader economy.[37] In such cases, the response could include not only tighter macroprudential policies but also a tighter monetary policy stance by the central bank if that is aligned with its goal of maintaining price stability (Adrian 2020).[38]

[37]The specific type of macroprudential policy to be deployed would depend on prevailing circumstances and vulnerabilities. Policies to build resilience against turns in the financial and credit cycle, such as countercyclical capital buffers, could be relevant. Borrower-based measures could also be activated, for example, if lax financial conditions amid high uncertainty (a macro-market disconnect) encourage excessive borrowing for investment in real estate.

[38]Higher uncertainty tends to shorten the horizons at which the intertemporal trade-off becomes unfavorable for financial stability (that is, the horizons at which downside risks to future growth rise in response to an easing of current financial conditions), as Figure 2.6 illustrates. Because monetary and macroprudential policies can have very different implementation and transmission lags, the level of macroeconomic uncertainty and its disconnect from financial market volatility can inform policymakers' decisions regarding policy instruments and the magnitude of the response.

In addition, fiscal policies should prioritize debt sustainability to contain the adverse effects of elevated public debt levels on borrowing costs that risk undermining macrofinancial stability (see the October 2024 *Fiscal Monitor*).

Prudential regulators and supervisors should ensure that bank and nonbank financial institutions assess their vulnerabilities to cross-border spillovers of spikes in foreign macroeconomic uncertainty. At the country level, given the cross-border spillovers of macroeconomic uncertainty, adequate reserve buffers and greater exchange rate flexibility can help countries cushion the potential adverse impacts of foreign uncertainty shocks.

Amid rising geopolitical uncertainty, governments should build adequate safety nets to mitigate macrofinancial stability risks. As uncertainty related to geopolitical developments can exacerbate tail risks to domestic markets, credit, and output, governments should make utmost efforts to reduce geopolitical tensions through diplomacy and multilateral cooperation. To the extent that such cooperation remains elusive, policymakers should devote resources to identifying, quantifying, managing, and mitigating financial stability risks associated with increases in geopolitical tensions and uncertainty (see Chapter 3 of the April 2023 *Global Financial Stability Report*). In this context, policymakers should ensure an adequate level of international reserves as well as of capital and liquidity buffers at financial institutions to mitigate the adverse consequences of increasing geopolitical risks.

## Box 2.1. Market and Credit Channels Are Important in Transmitting the Effect of Macroeconomic Uncertainty on Output

Dynamics originating in the financial sector amid high macroeconomic uncertainty can play a crucial role in generating risks to macrofinancial stability through the market and credit channels (Figure 2.2). This box examines whether different measures of macroeconomic uncertainty can help explain downside tail risks to future asset (stock and sovereign bond) returns as well as to bank lending by using a panel quantile regression framework.[1]

### *Market Channel*

The results indicate that macroeconomic uncertainty raises the likelihood of future spikes in sovereign bond yields. A one-standard-deviation increase in the real economic uncertainty index (REU) is, on average, associated with an increase of 150 basis points in upside tail risks to sovereign bond spreads (defined as the 90th percentile of the distribution of sovereign bond spreads) in emerging market economies at a six-month horizon (Figure 2.1.1, panel 1). By contrast, for the average advanced economy, a shock of a similar magnitude to the REU increases upside tail risks by about 25 basis points.[2]

In addition, the impact of macroeconomic uncertainty on sovereign bond spreads is more pronounced when fiscal vulnerabilities such as public debt service and banks' exposure to public debt are high rather than low in emerging market economies (Figure 2.1.1, panel 2).[3] In turn, a widening of sovereign bond spreads is more likely to have an adverse impact on public debt dynamics and macrofinancial stability (through the sovereign–financial sector nexus) when public debt or debt service as a share of GDP is already high (see Chapter 2 of the April 2022 *Global Financial Stability Report*). Thus, amid elevated public debt vulnerabilities and macroeconomic uncertainty, a sharp widening of spreads becomes more likely as well as more damaging to the economy (Figure 2.6, panel 1).

Analysis for stock market returns suggests that increased macroeconomic uncertainty can also exacerbate the risk of stock market crashes. A one-standard-deviation increase in the REU can raise downside tail risks to stock market returns (the 10th percentile of the distribution of stock market returns) by about 30 percentage points, one year after the shock in advanced and emerging market economies (Figure 2.1.1, panel 3).

### *Credit Channel*

To examine the relevance of the bank lending channel, the analysis estimates the effect of macroeconomic uncertainty on tail risks to bank lending, defined as the 10th percentile of future bank lending distribution. Macroeconomic uncertainty is measured using the various indicators discussed earlier as well as a new text-based measure developed from transcripts of individual banks' earnings calls.[4] The bank-level measure is intended to capture more directly the level of uncertainty banks perceive, which can influence their lending decisions.

The results indicate a strong relationship between macroeconomic uncertainty and tail risks to future bank lending. For example, a one-standard-deviation increase in the REU is associated with a decline of about 1 percentage point (annualized) in the 10th percentile of the distribution of one-quarter-ahead real credit growth (Figure 2.1.2, panel 1).[5] This effect persists through about seven quarters, although it becomes smaller over time. These findings are qualitatively robust across the

[1]See Online Annex 2.5 for methodological details and regression results for the analysis presented in this box.

[2]These findings complement the analysis in Chapter 1 of the October 2024 *Fiscal Monitor*, which shows that higher global policy uncertainty and geopolitical risk raise sovereign yield volatility across countries.

[3]For advanced economies, fiscal vulnerabilities do not appear to play a statistically significant role in amplifying the effect of macroeconomic uncertainty on sovereign bond spreads (Box Figure 2.1.1, panel 2). This could be because spikes in macroeconomic uncertainty may trigger flight to quality effects, whereby investors reallocate investments from equity or corporate bonds with low credit ratings to sovereign bonds. In addition, in response to increased macroeconomic uncertainty, central banks in advanced economies are more likely to intervene in sovereign bond markets (purchasing bonds to lower yields) when fiscal vulnerabilities and yields are already elevated—reinforcing the role of such bonds as a "safe haven" for investors.

[4]Following the approach of Soto (2021), the bank-level uncertainty measure is constructed by calculating the percentage of sentences including words related to uncertainty in the earnings call transcripts of specific banks, using definitions from the February 2024 update of the Loughran-McDonald Master Dictionary (https://sraf.nd.edu/loughranmcdonald-master-dictionary/). These percentages are then averaged across banks in a specific country to arrive at a country-level indicator. As Online Annex 2.5 shows, the bank-level text-based measure generally exhibits a low degree of correlation with the other measures of uncertainty.

[5]The estimates are based on panel quantile regressions for a sample of 18 advanced and 13 emerging market economies using data from 2001 to 2023. The model controls for lagged credit growth dynamics, output growth, financial conditions, and financial vulnerabilities. The last of these are measured by the position in the credit cycle and banking sector fundamentals such as capital adequacy, asset quality, profitability, and exposure to sovereign risk. The model also includes country and time fixed effects. See Online Annex 2.5 for more details on the methodology and estimation results.

## Box 2.1 *(continued)*

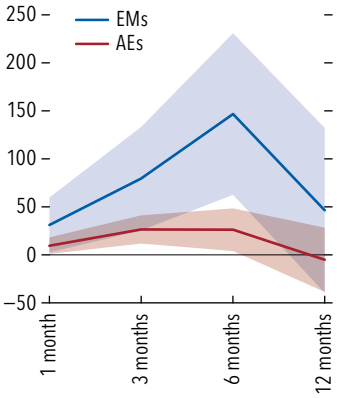
### Figure 2.1.1. Macroeconomic Uncertainty and Tail Risks in Financial Markets

Macroeconomic uncertainty raises upside tail risks of sovereign bond spreads ...

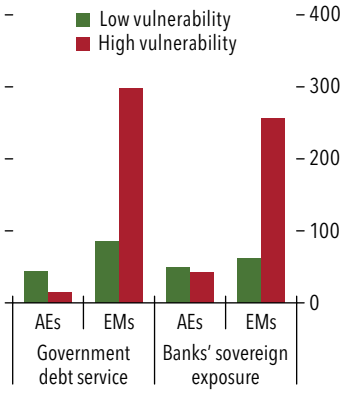
... particularly amid elevated fiscal vulnerabilities ...

... while raising downside tail risks to stock market returns.

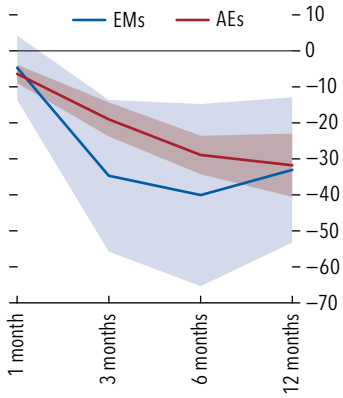
**1. Real Economic Uncertainty and Upside Tail Risk to Sovereign Spreads**
*(Basis points)*




**2. Real Economic Uncertainty, Fiscal Vulnerabilities, and Upside Tail Risk to Sovereign Spreads, Three Months Ahead**
*(Basis points)*




**3. Real Economic Uncertainty and Downside Tail Risk to Stock Market Returns**
*(Percentage points, returns)*




Sources: EUROPACE AG/Haver Analytics; Federal Reserve Bank of St. Louis, Federal Reserve Economic Data; ICE Bank of America; IMF, Global Data Source and International Financial Statistics databases; LSEG Datastream; Organisation for Economic Co-operation and Development, Main Economic Indicators database; and IMF staff calculations.

Note: Panel 1 shows the effects of a one-standard-deviation increase in the real economic uncertainty index at time *t* on upside tail risks to sovereign bond spreads (that is, the 90th percentile of the distribution of changes to sovereign bond spreads between time *t* and time *t* + *h*) at different horizons (*h* = 1, 3, 6, and 12 months), estimated using panel quantile regressions with country fixed effects. The sample consists of monthly data for 20 advanced and 9 emerging market economies from 1990:M1 to 2023:M12. The underlying regressions include relevant controls for the sovereign bond market at the country and global levels, following Gilchrist and others (2022), as well as the lagged dependent variable. Spreads for each country are calculated relative to a benchmark economy (Germany for Euro area countries and the United States for all others) using only debt denominated in the same currency as that of the benchmark economy. Panel 2 illustrates the effect of a one-standard-deviation increase in the real economic uncertainty index on upside tail risks to sovereign bond spreads at a three-month horizon conditional on high and low levels of government debt service (as a percentage of GDP) and domestic banks' exposure to sovereign risk (measured by domestic banks' holdings of sovereign bonds as a share of their total assets). Low and high levels of government debt service and banks' sovereign exposure are defined as the 25th percentile (green bars) and the 75th percentile (red bars) of the respective distributions. Note that the difference between green and red bars (that is, low and high fiscal vulnerabilities) is not statistically significant for advanced economies in the analysis. Panel 3 presents the effect of a one-standard-deviation increase in the real economic uncertainty index in month t on the 10th percentile of the distribution of the overall stock market return at different horizons (*t* + 1, 3, 6, and 12 months), estimated using panel quantile regressions with country fixed effects. The sample consists of monthly data for 21 advanced economies and 19 emerging markets from 1990:M1 to 2023:M12. The panel quantile regressions include as explanatory variables country fixed effects, lagged returns, and relevant controls at the country level, following Schmeling (2009) and Goyal and Welch (2008). Solid lines show estimated effects; shaded areas represent 95 percent confidence intervals. See Online Annex 2.5 for further details. AEs = advanced economies; EMs = emerging markets.

various measures of uncertainty, including the bank-level text-based measure (Figure 2.1.2, panel 2), and also hold for the subsamples of advanced and emerging market economies.[6]

[6]Although the bank-level text-based measure of uncertainty has a somewhat smaller impact on future tail risks to bank lending than the REU, it remains statistically significant when all other measures of uncertainty are included in the regression. This suggests that the measure captures aspects of uncertainty that may not be captured by other broad-based indicators.

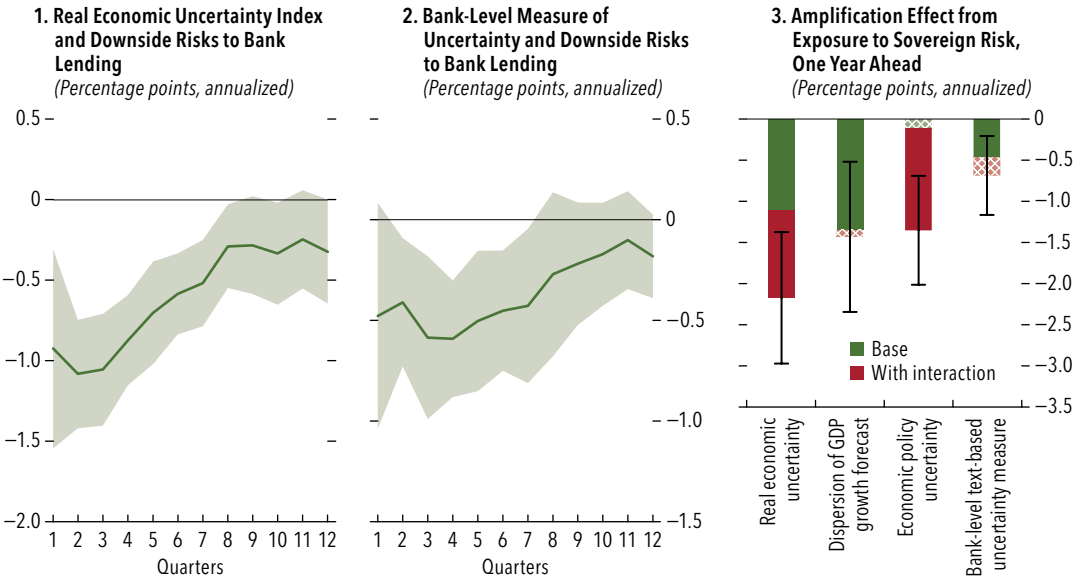
Existing financial vulnerabilities can amplify the effects of higher uncertainty on downside risks to bank lending. Extending the model to include interaction terms of the macroeconomic uncertainty measure with financial vulnerabilities such as banks' exposure to sovereign debt shows that countries with a higher bank exposure to sovereign risk exhibit a greater likelihood of a sharp decline in future bank loan growth when macroeconomic uncertainty rises (Figure 2.1.2, panel 3). For instance, a one-standard-deviation

## Box 2.1 *(continued)*

### Figure 2.1.2. Macroeconomic Uncertainty and Tail Risks to Bank Loan Growth

Higher macroeconomic uncertainty is associated with larger downside risks to future credit growth ...

... and its impact increases when financial vulnerabilities are high.




Sources: Bank for International Settlements; Fitch Analytics; IMF, Global Data Source and International Financial Statistics databases; Organisation for Economic Co-operation and Development, Main Economic Indicators database; and IMF staff calculations.

Note: Panels 1 and 2 show the effects of a one-standard-deviation increase in the real economic uncertainty index and the bank-level text-based uncertainty measure, respectively, on the 10th percentile of the distribution of future aggregate real credit growth at different time horizons. For each horizon, the growth rate indicates the average quarterly rate (annualized). Results are obtained from a panel quantile regression using country-level data for both advanced and emerging market economies. Graph lines show estimated effects; shaded areas represent 90 percent confidence interval. Panel 3 shows the effect of a one-standard-deviation increase in four types of measures of uncertainty on the 10th percentile of the distribution of one-year-ahead real credit growth interacted with banks' exposure to sovereign debt (defined as the share of banks' holdings of sovereign debt in an economy as a share of banks' total assets). The "Base" effect (green bars) shows the coefficient for the measure of uncertainty, and "With interaction" (red bar) shows the effect of uncertainty when banks' exposure to sovereign debt is one standard deviation above the mean. The measures of uncertainty and sovereign exposure variable are standardized. Estimated coefficients (solid bars) are statistically significant at the 10 percent level. The error bars represent the 90 percent confidence intervals for the sum of the coefficients, including both the base effect and the interaction effect. See Online Annex 2.5 for further details.

increase in the REU is associated with an increase in the one-year-ahead downside risk to lending (10th percentile of the real credit growth distribution) of about 1 percentage point when domestic banks' exposure to sovereign risk is high (one standard deviation above the mean) compared to at the mean level.

## Box 2.2. Macroeconomic Uncertainty and Policy Credibility

Many factors, including policy uncertainty, can drive macroeconomic uncertainty (Bloom 2009). Several studies document that monetary and fiscal policy uncertainty can have contractionary effects (Fernández-Villaverde and others 2015; Husted, Rogers, and Sun 2020; Beckmann and Czudaj 2021; Mumtaz and Ruch 2023). This box examines whether rules-based frameworks, or strengthening of policy frameworks more generally, can reduce policy uncertainty.

### *Monetary Policy*

Early proponents of monetary policy rules (Henry Simons, Lloyd Mints, Milton Friedman) argued that reducing policy uncertainty and its adverse effects on the real economy (inefficiencies) was the main benefit of such rules. In their view, inflation expectations were stabilized through reduced policy uncertainty (Dellas and Tavlas 2022).[1] Empirical evidence shows that enhanced monetary policy credibility can help stabilize an economy by more firmly anchoring inflation expectations to target levels (Park 2023; Beckmann and Czudaj 2024) and that policy rules can play an important role in reducing uncertainty (Cochrane, Taylor, and Wieland 2020, and references therein).[2]

More generally, the degree of soundness of monetary policy frameworks (regardless of whether they are strictly rules based) may reduce monetary policy uncertainty and its effect on downside risk to GDP growth. Figure 2.2.1, panel 1, shows that countries where inflation expectations deviate more from the policy (inflation) targets experience higher levels of economic policy uncertainty. This result suggests that a weaker policy framework or impaired policy credibility can amplify economic policy uncertainty. In addition, in the context of the growth-at-risk framework, Figure 2.2.1, panel 2, shows that increased macroeconomic uncertainty (real or policy related) has a larger effect on downside risk to one-quarter-ahead GDP growth when policy targets were missed by wider margins over the preceding three years (that is, when monetary policy frameworks were weaker). These results support the view that enhanced credibility and reliance on stronger monetary policy frameworks can mitigate the adverse implications of increased uncertainty for macrofinancial stability.

### *Fiscal Policy*

Similar arguments in favor of fiscal rules and their impact on macroeconomic uncertainty apply to fiscal policy. Several studies have analyzed the effects of fiscal policy rules on policy variables (such as budget balances or debt levels), market variables (interest rates and sovereign risk premiums), and output cyclicality, concluding that fiscal rules can reduce fiscal policy uncertainty, fiscal procyclicality, and market volatility and enhance fiscal sustainability (Reuter 2015). Fatas and Mihov (2006), Badinger and Reuter (2017), and Arroyo Marioli, Fatas, and Vasishtha (2024) document that more stringent fiscal rules can reduce overall macroeconomic volatility (and hence real economic uncertainty).[3,4]

[1]The modern (that is, since the late 1970s) literature on rules versus discretion proves theoretically that discretion can generate inefficiencies even if it does not increase policy uncertainty. Although this literature places less emphasis on uncertainty, it does not provide evidence regarding, or argue against, the connection between policy rules and uncertainty; it establishes that weaker theoretical conditions are needed to favor rules over discretion (Dellas and Tavlas 2022).

[2]Policy uncertainty can also increase when the effectiveness of policies comes into question (Carney 2016). Available evidence indicates that high uncertainty can weaken monetary policy transmission (Castelnuovo and Pellegrino 2018; Lakdawala and Moreland 2024). A more uncertain response of the economy to policy stimulus, in turn, exacerbates policy uncertainty, increasing uncertainty surrounding the extent to which policy instruments will need to be adjusted to achieve policy goals.

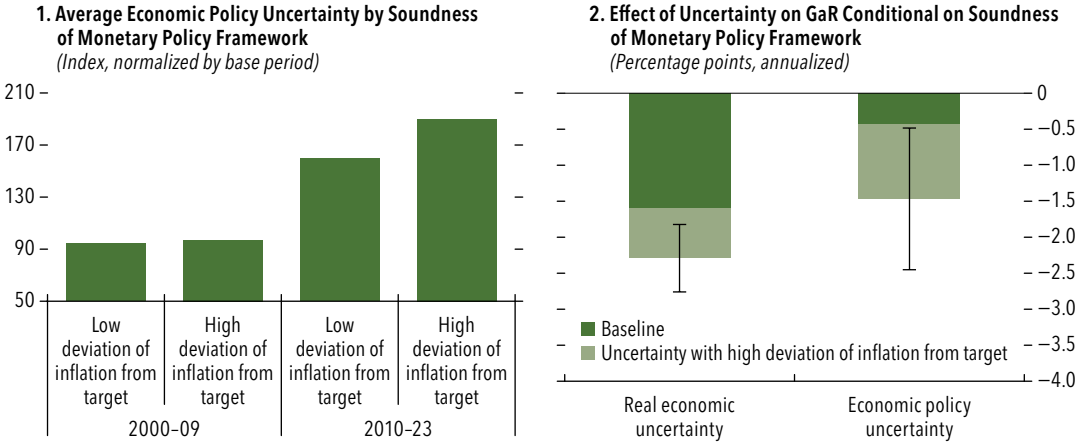
[3]Discretionary fiscal policy is prone to deficit bias due to political incentives to delay austerity, leading to excessive deficits and debt (Alesina and Drazen 1991). Fiscal rules can help offset this bias by acting as a commitment device to limiting the government's incentives to exert discretion (Alesina and Tabellini 1990).

[4]There is also evidence that increased uncertainty can impair the effectiveness of fiscal policy (Jerow and Wolff 2022; Liu 2023), suggesting that policy responses themselves could become more uncertain, potentially magnifying macroeconomic uncertainty.

## Box 2.2 *(continued)*

### Figure 2.2.1. Soundness of Monetary Policy Framework and Effect of Uncertainty on Future GDP

Credible policy frameworks tend to help reduce economic policy uncertainty and its impact on downside risks to output.




Sources: Online Annex 2.1; and IMF staff calculations.

Note: In panel 1, high deviation is based on the sample median of the deviation of inflation expectations from the policy inflation target (absolute value summed over preceding three years). The "high deviation" regime acts as a proxy for the effectiveness of monetary policy framework across countries, indicating less effective frameworks. Panel 2 shows the effect of a one-standard-deviation increase in measures of real and economic policy uncertainty on the 10th percentile of the distribution of one-quarter-ahead real GDP growth without (baseline, dark green bar) and with (interaction term, light green bar) sound monetary policy frameworks. Whiskers (solid bars) indicate 90 percent confidence intervals (significance). GaR = growth-at-risk.

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CHAPTER 3

# ADVANCES IN ARTIFICIAL INTELLIGENCE: IMPLICATIONS FOR CAPITAL MARKET ACTIVITIES

## Chapter 3 at a Glance

- Generative artificial intelligence and related breakthroughs have the potential to dramatically increase the efficiency of capital markets—trading, investment, and asset allocation—through artificial intelligence–assisted process automation and analysis of complex unstructured data, and evidence suggests these effects are already beginning to be felt.
- New evidence from labor markets and patent filings suggests that the adoption of artificial intelligence (AI) in capital markets is likely to increase significantly in the near future, and analyses of pricing patterns and trading dynamics already show changes in some markets consistent with the adoption of these new technologies.
- In addition, AI could cause large changes in market structure through the greater and more powerful use of algorithmic trading and novel trading and investment strategies, which in turn may increase turnover and asset correlations and drive prices to reflect new information at an ever-increasing speed.
- However, based on outreach conducted with both market participants and regulators, most current use of AI appears to be an extension of existing trends in the use of machine learning and other advanced analytical tools; more significant changes are a medium- to long-term concern.
- AI may actually reduce financial stability risks by enabling superior risk management, deepening market liquidity, and improving market monitoring by both participants and regulators. At the same time, new risks may arise:
  - Increased market speed and volatility under stress, especially if trading strategies of AI models all respond to a shock in a similar manner or shut down in response to an unforeseen event.
  - More opacity and monitoring challenges, as AI spurs further migration of market-making and investment activities to hedge funds, proprietary trading firms, and other nonbank financial intermediaries and creates uncertainty about how AI models used by different investors and traders could interact.
  - Increased operational risks as a result of reliance on a few key third-party AI service providers that dominate computational power and large language model services.
  - Increased cyber and market manipulation risks, particularly in generating fraud and social media disinformation.
- Many of these risks are addressed by existing regulatory frameworks, but important new and unforeseen developments may arise. To ensure relevant authorities are prepared for these potentially transformative changes, they should consider additional policy responses:
  - Undertake the calibration of circuit breakers and a review of margining practices in light of potentially rapid AI-driven price moves.
  - Enhance monitoring and data collection of the activity of large traders, including nonbank financial intermediaries.
  - Address dependency on data, models, and technological infrastructure by requesting a risk mapping from regulated entities (that is, data on the internal and external interconnections and interdependencies that are necessary to deliver the institutions' critical services).
  - Adopt a coordinated approach for the definition of critical AI third-party service providers and continue to strive for resilience in capital markets by enhancing cyberattack protocols.
  - Adopt measures that ensure continued market integrity, efficiency, and resilience of over-the-counter markets when AI use proliferates.

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## Introduction

Artificial intelligence (AI) has the potential to reshape the world and transform industries, including financial services. This chapter focuses on the use of AI and GenAI[1] in capital markets, which may see deep changes in market structure changes from network effects and increased speed of market functioning. Financial services are well poised to take advantage of recent advances in AI given the industry's long-standing focus on data collection and analysis and early adoption of techniques such as machine learning (ML). Recent surveys of financial institutions reported that a vast majority of respondents expect a significant expansion of the use of GenAI-driven models (IIF and Ernst & Young 2023), and more than half of investment managers said that they planned to use GenAI in the future (Mercer Investments 2024). Hence, it is important to understand the potential financial stability implications of these developments and to ensure regulators are ready for these changes.

Further adoption of AI may contribute positively to financial stability, and can provide clear benefits to financial institutions, such as efficiency improvements and higher productivity (Boukherouaa and others 2021), refined portfolio investing frameworks (Park and others 2023), improved return forecasting (Chen, Kelly, and Xiu 2023), and quantification of crash risks (Swinkels and Hoogteijling 2022). There are also AI applications benefiting SupTech and RegTech.[2]

However, AI could also introduce new forms of financial stability risks and accelerate well-established financial stability concerns such as leverage, liquidity strains, and interconnectedness. This chapter considers and finds indicative evidence for four broad categories of potential risks, which could transmit stress to the real economy through loss of market confidence, higher borrowing costs, and potentially significant financial system outages:

- **Increased market speed and volatility under stress**, especially if AI trading strategies become highly correlated
- **Opacity and monitoring challenges** as extreme behaviour of AI systems becomes increasingly difficult to anticipate and AI activities also migrate to nonbank financial intermediaries (NBFIs)
- **Increased operational risks** as a result of reliance on a few key third-party AI service providers
- **Increased cyber and market manipulation risks**, particularly through fraud and disinformation

GenAI is already seeing widespread "evolutionary" adoption—use cases that build upon existing analytical methods and investment strategies—across the financial sector. As in other industries, GenAI is increasing efficiency across a host of tasks: helping analysts write code, improving customer-facing activities, and generating new investment ideas. Large language models are being used as inputs into existing analytical models to improve the forecasting power of textual analysis, likely improving the predictive power of quantitative investment strategies. It could also lower barriers to entry for quantitative investors into less liquid asset classes (such as corporate or sovereign bonds) that require extensive analysis of indentures and other legal documents. GenAI is also likely to increase the speed of market reactions to new information through the real-time processing of unstructured data, such as textual central bank announcements. Numerous other use cases in asset allocation, trading, and risk management have been noted by market participants (Figure 3.1).

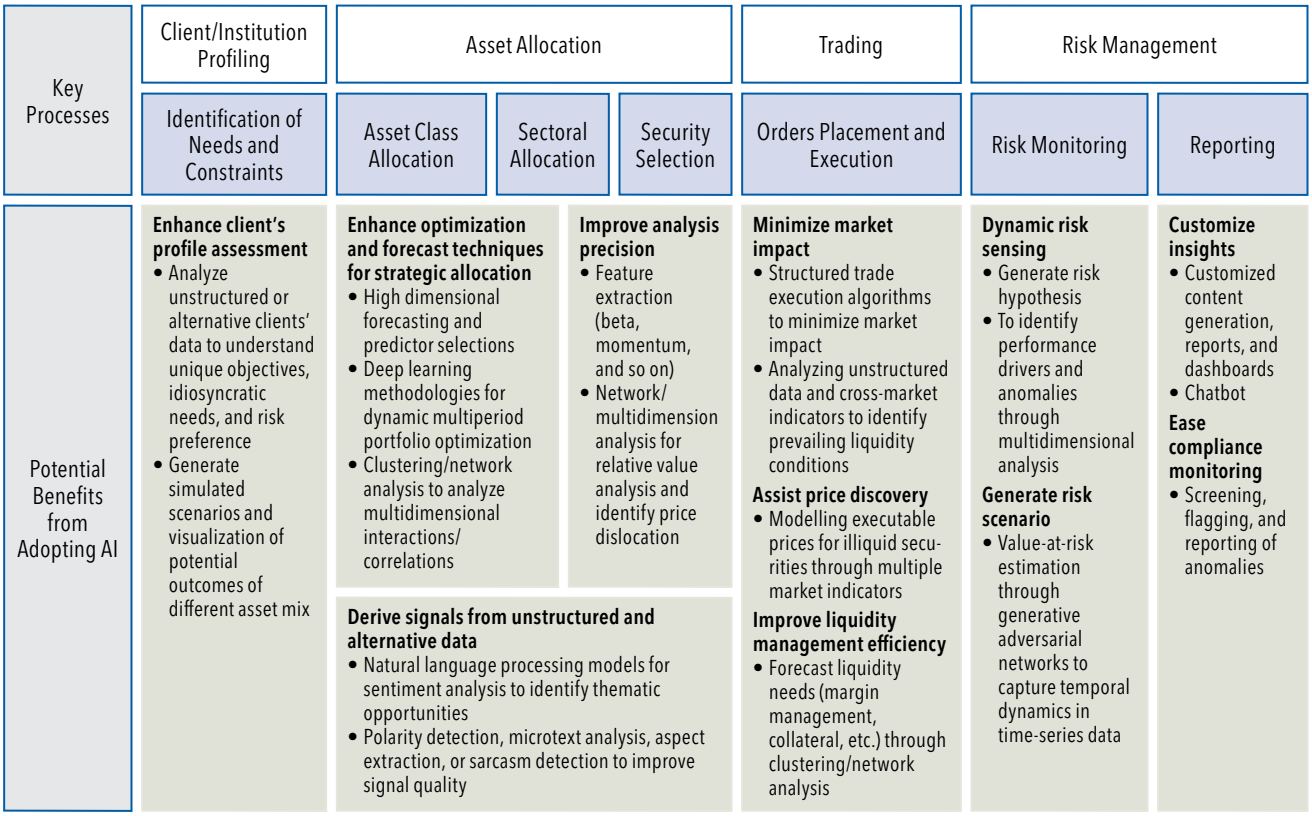
The more "revolutionary" uses of GenAI—radically new investment strategies and processes using cutting-edge AI technology—remain mostly speculative. Although many observers envision scenarios involving autonomous AI generating and executing trades without human oversight, most market participants that responded to IMF outreach are quite uncomfortable with this idea (Box 3.1). They view AI-generated strategies that are not understood by humans as a nonstarter. In addition, for regulatory, risk management, liability, and ethical reasons, most participants view having a "human in the loop" as an essential part of any AI-based strategy.

[1]For the purpose of this chapter, AI or "machine learning (ML) models" (AI/ML) refers to well-established predictive analytics, including shallow neural networks, clustering algorithms, textual analysis tools natural language processing, decision trees, and so on; and "sophisticated AI models" refers to their move recent and advanced counterparts, such as deep neural network architectures addressing reinforcement learning, and natural language processing (large language models). This includes GenAI models capable of generating text, codes, images, and other content.

[2]SupTech and RegTech are advanced financial technology applications used by supervisors and regulated institutions.

### Figure 3.1. Recent and Potential Use Cases for Artificial Intelligence and Machine Learning in Capital Market Activities: Investment Decisions, Trade Execution, and Monitoring Processes

Potential benefits include enhanced accuracy, efficiency, and market insights through multidimensional analysis from unstructured data sources, delivering customized, and actionable outputs.




Sources: Academic studies; IMF outreach discussions (see Box 3.1); prospectus from third-party services; and IMF staff compilations.

Note: The figure presents recent and potential artificial intelligence (AI) and machine learning (ML) use cases across investment decision, execution, and monitoring processes. The information may not be exhaustive of all possible AI/ML use cases, as adoption continues to evolve.

For emerging markets, AI is widely seen as a positive development, although it may create fragmentation risks. The IMF's outreach effort found that market participants widely viewed GenAI as a tool to enable technological leapfrogging and increase financial development and inclusion for many emerging market and developing economies through increased access to credit and a deepening of local financial markets. However, if high fixed costs lead to different speeds of adoption across regions, emerging market and developing economies may be less able to benefit from the migration to AI-driven activities than advanced economies.

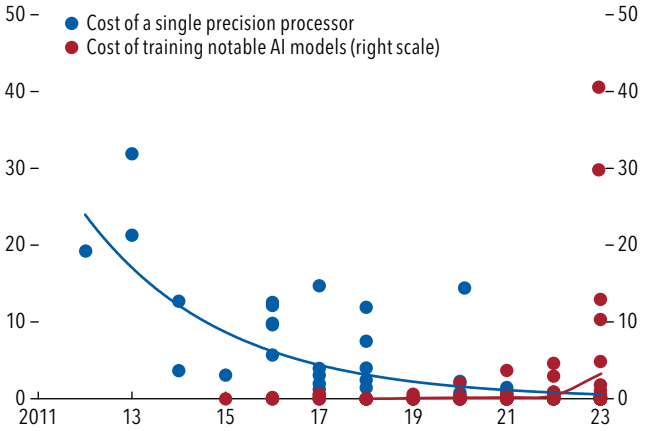
As adoption is still at a relatively early stage, this chapter gives a forward-looking assessment of the impact of AI (and GenAI specifically) on capital markets. To compensate for the lack of readily available data in this area, the chapter draws on a combination of extensive IMF staff market outreach (Box 3.1) and analytical work that leverages novel data sources. By understanding the current levels and speed of adoption of AI, the chapter posits where and how AI-related risks may arise. It analyzes how AI is transforming market structures and dynamics and examines the financial stability implications for liquidity, leverage, and interconnectedness as well as other potential novel risks. The chapter concludes by offering policy recommendations that focus on monitoring and the sufficiency of current or forthcoming guidelines.

**Figure 3.2. The Cost of Compute and the Artificial Intelligence Market Structure**

Cost per unit of calculation has declined but models are increasingly complicated ...

**1. Cost of a Single Precision Processor and the Cost of Training Notable AI Models**

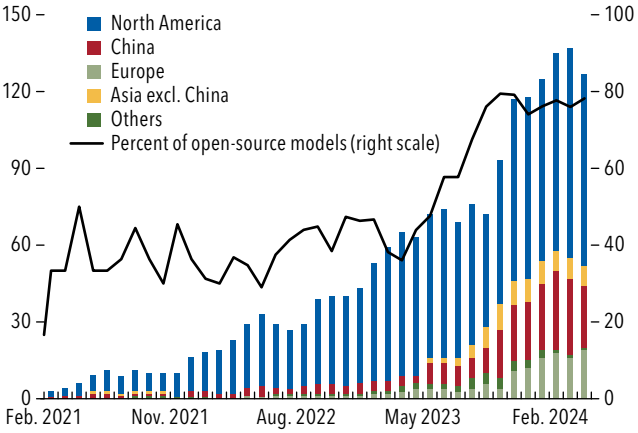
*(Inflation-adjusted 2023 US dollars per exa floating point operation; millions of inflation-adjusted 2023 US dollars, right scale)*




... but most large, foundation models are being developed by a concentrated number of countries.

**2. National Affiliation of Foundation Models and Access Type**

*(Trailing six-month count of published models; trailing six-month percentage of open-source models, right scale)*




Sources: Epoch AI; Stanford University's Ecosystem Graphs; and IMF staff calculations.

Note: Training compute is measured using floating-point operations. Estimated costs for panel 1 were derived from Epoch AI's data sets and the methodology to estimate costs of training notable artificial intelligence models and graphics processing unit price-performance data. Foundation models are artificial intelligence/machine learning models developed that can be used for various applications. Exa denotes a factor of $10^{18}$. The blue and red lines in panel 1 are best-fit lines. AI = artificial intelligence.

## Current and Future Adoption of Artificial Intelligence in Capital Market Activities

Mainstream use of GenAI only dates back a few years, but financial institutions have been actively using ML and other AI-related computation methods for approximately 20 years, and these methods are now well integrated into their investment processes. Robo-advising, AI-based exchange-traded funds (ETFs), and applications related to GenAI are only in their infancy, but labor market data, patent filings, and investor outreach all suggest that institutions are rapidly gearing up for significant integration of these technologies.

### Technological Change and the Rise of Artificial Intelligence

Although the unit cost of training AI models has dropped dramatically as a result of recent advancements in algorithmic efficiency and computation hardware, "notable" models of the type used in leading GenAI applications have simultaneously become much more complex, leading to much higher overall costs (Figure 3.2, panel 1).[3] The high fixed costs of the infrastructures and talent enabling development and distribution of sophisticated AI systems may exacerbate market concentration, whereby the few private sector developers with existing commercialization channels could continue to dominate the space (noting that the growing number of open source models may challenge this paradigm). Concentration often arise also because of data monopolies, whereby some players have access to superior nonpublic data, which would allow them to train more effective models or have the capacity to process huge volumes of data. This is especially pertinent in the financial sector, where some players have vast amounts of trading and client data. Development of foundation models has predominantly been based in the United States (Figure 3.2, panel 2).

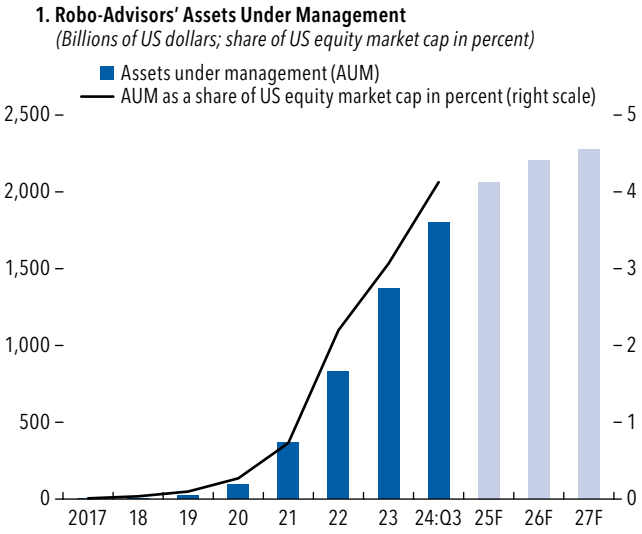
### Current Adoption: Evidence from the IMF's Market Outreach

From a capital market perspective, the expansion and considerable scale of robo-advising highlights a move toward automation by the investment industry (Figure 3.3, panel 1). However, genuinely AI-driven strategies are still in their early stages. For instance, AI-powered ETFs—where AI is used to construct and adjust an ETF's portfolio—still account for a very small share of the market, with less than $1 billion in assets under management (Figure 3.3, panel 2). This indicates that

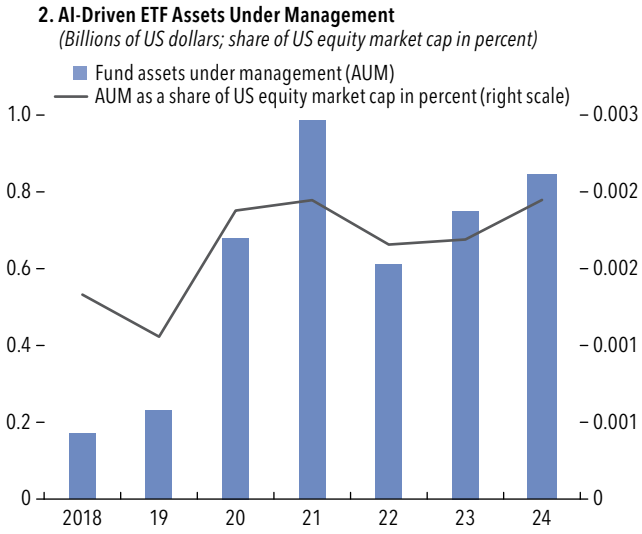
[3]Notable models are models in the running for the top 10 largest training compute, expressed in terms of required floating-point operations (FLOP) (Epoch AI 2024).

## Figure 3.3. Investment Strategies Driven by Artificial Intelligence

Robo-advisor assets under management have grown explosively and are projected to grow further.




AI-driven exchange-traded fund (ETF) investment has grown, but it remains tiny compared to the market's size.




Sources: Bloomberg Finance L.P.; Statista Digital Market Insights; and IMF staff calculations.

Note: In panel 1, the light blue bars are the forecasts for 2025, 2026, and 2027. The share of assets under management as a percentage of the US equity market capitalization is based on the MSCI US Equity Index market capitalization. AI = artificial intelligence; ETF = exchange-traded fund.

although technology has begun to alter the landscape of investment management, the penetration of advanced AI applications is relatively modest.

To complement the analytical work based on an extensive literature of review and data collection, IMF staff conducted a qualitative assessment with main players in the industry directly involved in AI-related strategy to further assess how AI advances have been adopted and are transforming capital markets. The IMF staff outreach aimed to shed light on how financial institutions—both buy-side and sell-side firms—are harnessing AI technologies. While acknowledging that AI is not a new phenomenon, all market participants highlighted the accelerating pace of AI adoption in various areas, mainly driven by the proliferation of GenAI tools (Box 3.1).

Prospects for creating value through AI appear to be most promising in publicly traded liquid asset classes (Figure 3.4, panel 1).[4] Equities, government bonds, and listed derivatives offer a wealth of real-time data and transparency. The high volume of transactions and the dynamic nature of these markets enable AI systems to continuously learn and adapt, potentially offering more accurate and timely insights. Results from the IMF's outreach to stakeholders point to equities and derivatives as being the most likely areas where AI will be adopted in the investment process, followed by fixed income and foreign exchange (which are primarily traded in over-the-counter markets) (Figure 3.4, panel 2). However, some market participants also highlighted that advances in AI and its unprecedented processing capabilities could benefit less-liquid markets such as private credit and some emerging markets segments.

The IMF's outreach also reveals a number of AI use cases in the investment process. For instance, AI is used in the incorporation of alternative data sets,[5] the development of forward-looking indicators, and market analysis.[6] More specifically, buy-side firms employ AI/ML for productivity enhancement, including exploration of new asset classes,[7] extraction of signals from data to support their investment decisions, and

[4]For a thorough description of capital market structure (for example, type of instruments, actors, trading venues, and central counterparties), see US Securities and Exchange Commission (2020).

[5]Alternative data sets include content from social media platforms and other public forums where market participants share their opinions and engage in discourse. Sentiment analyses, although various natural language processing methodologies, are also conducted on regulatory filings or relevant public statements.

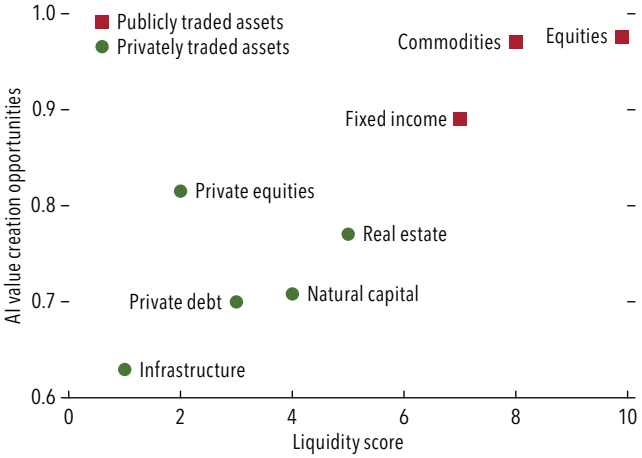
[6]Some market participants also employ AI techniques on price movements from other asset classes or instruments to estimate valuation and executable prices for some illiquid instruments.

[7]AI is primarily adopted for asset-class research, focusing on summarizing research documents from various sources and extracting key information relevant to assessing risk and return profiles or requirements that are unique to individual investors.

## Figure 3.4. Opportunities for Artificial Intelligence to Create Value: Asset Classes

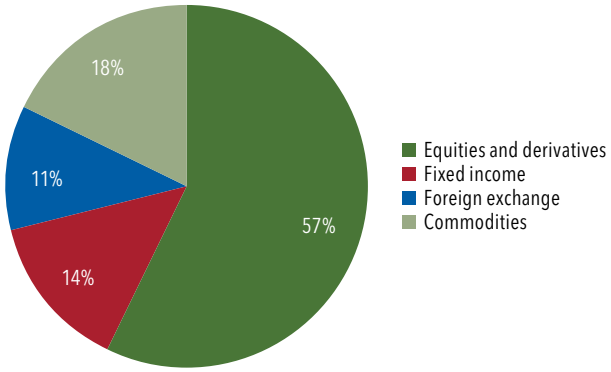
There is a strong correlation between market liquidity and current adoption of AI by investment managers.

**1. AI Opportunities and Asset Class Liquidity**
*(Value creation opportunity index; liquidity score)*




The IMF's outreach to stakeholders suggests equity markets as most likely to see AI implementation.

**2. Which Markets Are Incorporating Machine Learning and Generative AI?**
*(Percent of participants' scores)*




Sources: IMF, October 2024 *Global Financial Stability Report* market intelligence; Mercer Investments (2024); and IMF staff analysis.

Note: In panel 1, the liquidity score is assigned by asking a large language model to assign a liquidity score between 1 and 10 to each asset class, whereby the model is prompted to assign an ordinal score, distinct for each asset class, reflecting the liquidity of the given asset classes, and 1 reflects the least liquid asset class and 10 the most liquid. The AI value creation opportunities score is a ratio based on survey responses, whereby the numerator is equal to difference between the respondents that do see value creation opportunities and those that do not; the denominator is equal to the number of respondents that expressed a view. Details on the market intelligence outreach in panel 2 can be found in Box 3.1. AI = artificial intelligence.

portfolio optimization and allocation, as well as for back-office activities. Meanwhile, sell-side institutions use AI/ML for risk assessment, pricing and forecasting, and customer service and to improve trading automation. Market infrastructure providers and academia note that AI/ML models, including sophisticated AI models, are aiding the democratization of techniques such as code writing and prototyping as well as information extraction and summarization.

Participants in the IMF's outreach to stakeholders widely observed that recent breakthroughs, particularly in GenAI, are catalyzing broader AI/ML adoption across capital markets. Within a three- to five-year horizon, participants expect greater integration of sophisticated AI in investment and trading decisions. One use case gaining traction in asset management is the AI-powered exploration of alternative and text data to uncover causal relationships in markets that are previously unknown, which could lead to new investment strategies. Another would be the adoption of traditional AI/ML applications to increase the robustness and accuracy of existing models, especially in terms of forecasting. A recent survey by Mercer Investments (2024) shows that the adoption of AI in core investment processes such as trading and the execution of investment decisions is still nascent (Figure 3.5, panel 1). Concentrating on the more specialized area of algorithmic trading, evidence is mixed. Survey data among participants of a major energy market (The Netherlands) suggest that more autonomous algorithms may still be based on simpler methods (Figure 3.5, panel 2).[8]

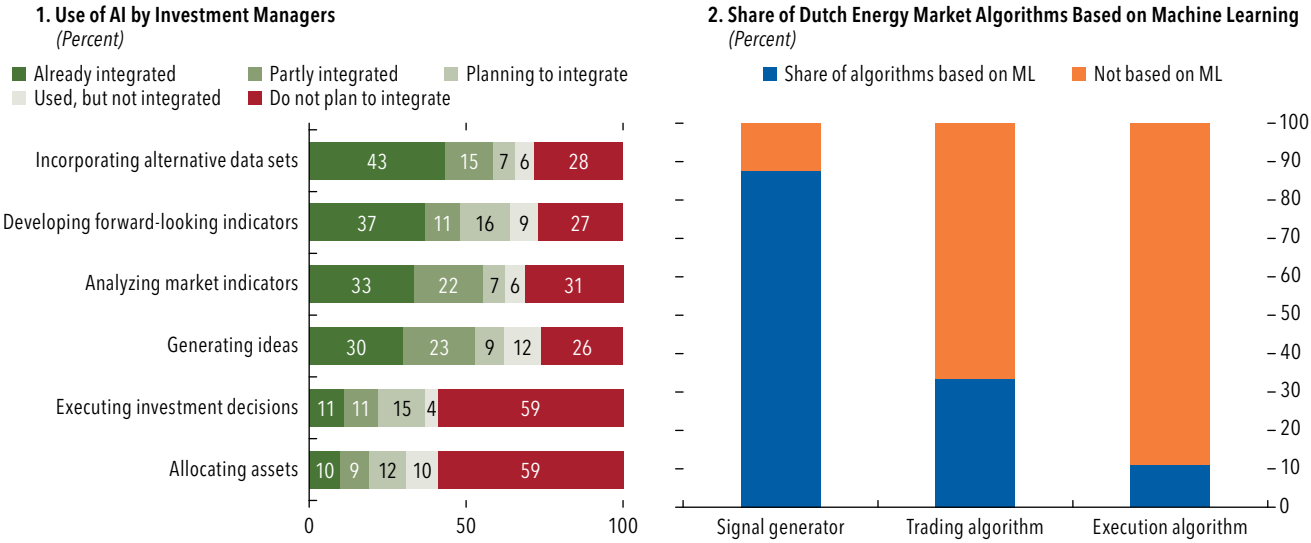
Meanwhile, there is evidence that sophisticated AI has not yet been implemented widely to build autonomous AI trading agents (Authority for Consumers and Markets 2024, p. 18). It is instead more frequently used to generate a signal that is then used as an input in an existing analytical system where a human trader may ultimately make the trading decision. There was a consensus among the IMF outreach participants on the increasing benefits of AI/ML, including improved efficiency and productivity, cost savings in designing

[8]The Dutch Authority for the Financial Markets found that on the Euronext exchange, "trading firms tell the Authority for the Financial Markets that machine learning is implicitly or explicitly used in 80 to 100 percent of their trading algorithms." It should be noted however, that "explicit" use cases may include applications that are not autonomous, such as signal generators (Authority for the Financial Markets 2023).

## Figure 3.5. Artificial Intelligence Advances: Use Cases and Adoption in Investment Processes

Adoption of AI in trading and investment decision making is still nascent.

Adoption of machine learning has not yet penetrated autonomous trading processes.




Sources: Authority for Consumers and Markets; IMF, Mercer Investments (2024); and IMF staff analysis.

Note: Panel 2, statistics are derived from survey responses regarding algorithms that are already in use; survey responses regarding planned use cases are not included. AI = artificial intelligence; ML = machine learning.

trading algorithms, better processing of unstructured data, and more compressed bid-ask spreads.

Financial supervisors included in the IMF's staff outreach indicated that they were beginning to reap the benefits of AI. They use AI-driven SupTech tools to monitor financial markets and institutions, including ones that detect anomalies in large data sets to identify risks early, and other tools that can help check regulatory compliance of supervised entities. For their part, banks have used RegTech tools to manage regulatory compliance and to enhance and boost efficiency of their "anti-money laundering/know your customer" process by, for instance, automating some tasks to ensure higher accuracy in clients' data, monitor transactions, and detect fraud.

Looking ahead, market participants expect a rise in the use of AI in trading and investment, and a higher degree of autonomy of AI-based decisions, especially in the equity market, where high-frequency, AI-driven trading is expected to account for a more substantial share. However, all participants in the IMF's outreach expected a "human in the loop" approach to persist in the near term (three to five years), especially for large capital allocation decisions. Although the trend is toward less human interaction, complete autonomy is not anticipated soon, and models will continue to operate within predefined rules. Some participants mentioned the potential for agent-to-agent trading and the development of complete AI-driven workflows in trading.

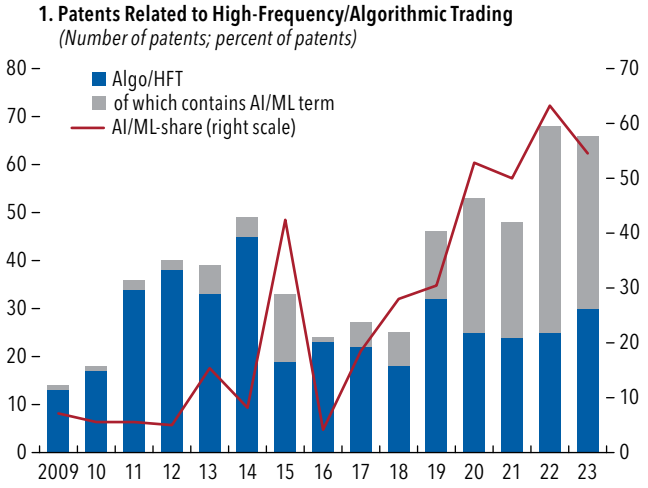
## Future Adoption: Evidence from Patent Filings and Labor Markets

The relationship between financial innovation and patents has been an area of growing interest in the literature (Lerner and others 2024). Financial innovations have become more significant and economically impactful, with a notable increase in patent grants today compared to the 1990s. This trend provides valuable insights into the evolving nature of financial innovation. In this regard, the evolution of AI patent filings may serve as an indicator of AI adoption in capital market activities, providing insights into future trends.

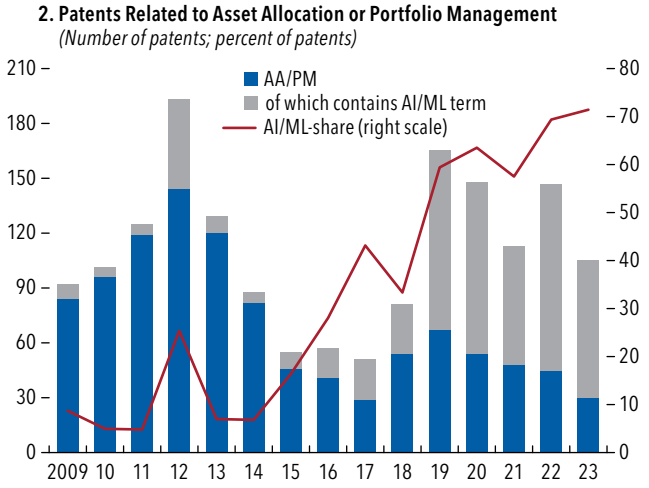
The number of filings that reference AI/ML terminologies in the context of high-frequency or algorithmic trading has increased (Figure 3.6, panel 1). Over the past year, filings lean toward improving operational efficiency of brokerage or trading platforms and on developing systems that compute trading signals with low latency and high throughput. AI/ML-related filings have also driven a surge in patents in the area of asset management (Figure 3.6, panel 2). Filings related to

**Figure 3.6. Artificial Intelligence/Machine Learning Innovations: Evidence from Patent Applications**

Filings relating to high-frequency or algorithmic trading incorporating AI/ML are increasing ...




... with a similar trend observed for applications relating to broader asset management practices.




Sources: World Intellectual Property Organization, PATENTSCOPE; and IMF staff calculations.

Note: Aggregated values are limited to filings with specific mention of financial or capital markets and the relevant terminologies. Aggregate patents may not be unique patents, as some patents may be filed in multiple jurisdictions. Aggregate patents may not be exhaustive of all patents filed with respective national authorities and are limited to those available in the PATENTSCOPE database. These filings may or may not translate to actual patents granted by national authorities, and the review process may take time depending on the complexity of the invention. In panel 2, asset management practices also include asset allocation and portfolio management applications. AA = asset allocation; AI = artificial intelligence; HFT = high-frequency trading; ML = machine learning; PM = portfolio management.

asset management detail the use of ML techniques to enhance the efficiency of cash flow and liquidity management, automate asset class rebalancing, improve valuation and forecasting methods, and determine capital requirements tailored to individual needs. Several innovations focus on interpreting unstructured data and designing systems to process information from alternative data sources. In addition, some filings incorporate techniques to access and manage alternative asset classes, such as methodologies for trading emissions and managing digital assets, as well as evaluation methods for validating cryptographically signed transactions.

Although only a small share of workers claims to have AI skills (Figure 3.7, panel 1), the talent pool, specifically within the financial services industry, appears to be growing. Quantitative researchers and analyst profiles in the US financial industry increasingly feature AI skills. ML, natural language processing, and deep learning are among the top 30 competencies listed in their profiles.[9] Demand for AI skills is on the rise and, according to the IMF's outreach, competition to attract talent is one of the most important challenges that could limit the acceleration of developments in AI. The incorporation of AI skills in job postings for typical front office roles with direct influence on investment decision making or responsible for financial market transactions has been increasing,[10] and the share of job postings for these front office roles and the financial services industry requiring AI skills has outpaced the overall share of AI-related job postings for the broader US economy (Figure 3.7, panel 2). Unsurprisingly, AI talent concentration[11] within the US financial services industry also exceeds the broader economy.

According to participants in the IMF's outreach, AI could bring greater financial opportunities in emerging markets and developing economies. Cited key benefits include improvements in access to financial services, credit scoring, loan origination, robo-advising, and

[9]Ranking is based on LinkedIn's statistical measure using Term Frequency-Inverse Document Frequency, a natural language processing algorithm that evaluates how representative a word/terminology is. Specifically, ML ranks among the top five skills in this cohort, highlighting the industry's expanding focus on AI/ML applications.

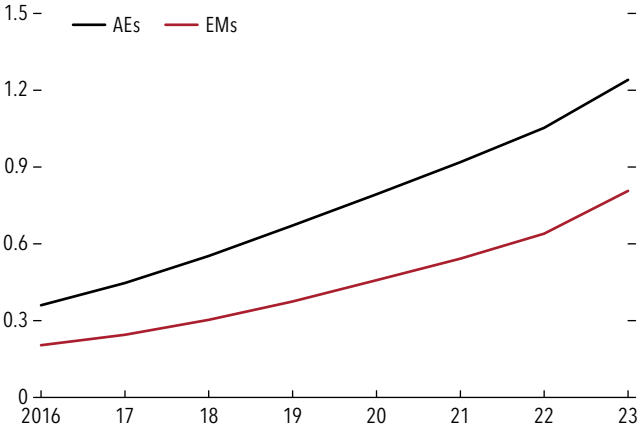
[10]Also known as "front office" roles, including traders, portfolio managers, portfolio strategist, asset allocation analysts, and programmatic traders. Job postings containing AI terminology for these roles rose from a monthly average of 4.5 percent of front office roles in 2019 to 4.9 percent in 2023 and a peak of 6.6 percent in 2022.

[11]A LinkedIn member is considered AI talent if they have explicitly added AI skills to their profile and/or they are occupied in an AI occupation representative, which requires AI skills to perform the job.

**Figure 3.7. Adoption of Artificial Intelligence: Evidence from Candidate Profiles and Job Vacancies**

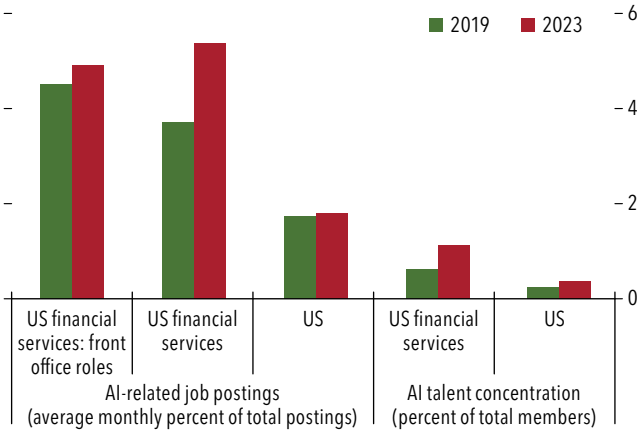
While the existing workforce in the broader industry is steadily adopting AI skillsets ...

**1. Concentration of LinkedIn Members in the Financial Services Industry with AI Skills**
*(Average percent of aggregated country profiles)*




... demand for these skills, particularly in the financial services sector, has increased in recent years and appears to outpace job postings of the broader US economy.

**2. Job Postings Containing AI Skills and the Share of AI Talent**
*(Average monthly percent of total job postings, percent of total members)*




Sources: Indeed Hiring Lab; LinkedIn Economic Graph; and IMF staff calculations.

Note: Financial services include entities that make financial transactions (creation, liquidation, or change in ownership of financial assets) and/or that facilitate financial transactions across 30 advanced economies and 14 emerging markets. Data from Indeed and LinkedIn were obtained through the Development Data Partnership (https://datapartnership.org/), a collaboration between international organizations and private sector companies to facilitate the efficient and responsible use of third-party data in international development. AEs = advanced economies; AI = artificial intelligence; EMs = emerging markets.

portfolio construction. GenAI-enabled parsing of fragmented and unstructured data could reduce investment barriers in these countries and improve the liquidity of some emerging market assets. Synthetic (AI-generated) data may also be helpful in training investment models where data are scarce, bearing in mind the caveats around the use of this technology. Overall, the combination of better liquidity and enhanced market efficiency could make some emerging markets more attractive to global investors and potentially lead to larger capital flows.

The use of a new generation of models should help address data gaps, thanks to the use of synthetic data in less-efficient markets, in turn enhancing market liquidity and lowering barriers to entry. Indeed, synthetic data being real data-like and generated by algorithms, can indeed offer valuable opportunities for training and testing AI. However, reliance on generated data should account for two key issues. First, the unintended over- or under-representation of certain values of real-world data distribution, undermining extreme event performance of AI systems. Second, potential biases perpetuated by synthetic data when the generation process fails to account for specificities and requirements of second-order applications.

Other market participants indicate possible differentiation between large and less-significant emerging markets, based on the extent to which AI technologies will be implemented. The risk of fragmentation between advanced economies and emerging market and developing economies seems to be limited, and some market participants reported that advances in AI could instead support greater financial inclusion. AI-driven financial services may facilitate access to credit using new data sets where traditional metrics are less developed, and robo-advising should reduce barriers to entry in investing, deepening local capital markets. However, others pointed to the risk of automation affecting lower-skilled jobs in some countries.

## The Artificial Intelligence Transformation: Implications for Market Structures and Dynamics

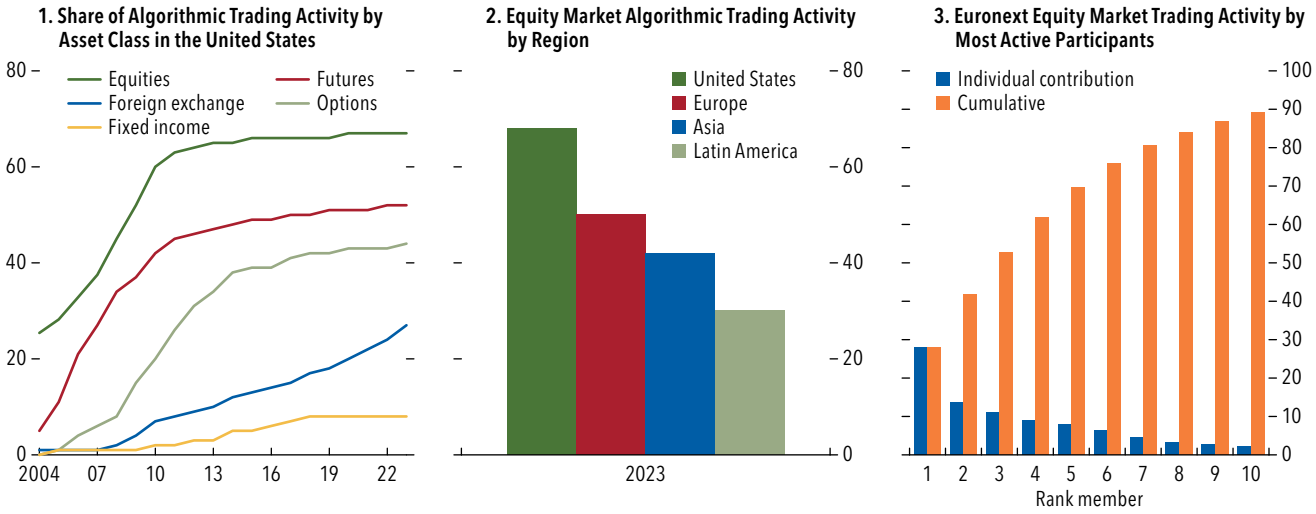
The adoption of AI in capital market activities has the potential to change the structure and dynamics of markets. Some of these changes are more evolutionary, whereby existing trends may be amplified. Other impacts could be more revolutionary: For example, the

**Figure 3.8. Algorithmic Trading Activity and Concentration in Equity Markets**
*(Percent)*

Algorithmic trading has expanded across asset classes.

The US equity market, being the largest and most liquid market, has seen the most aggressive adoption of algorithmic trading.

Activity in markets dominated by algorithmic trading tends to be dominated by a few players.




Sources: Authority for Consumers and Markets; Bank for International Settlements; Datos Insights; and IMF staff calculations.
Note: In panel 1, "equities" refers to US equities. In panel 3, statistics show trading activity by most active market participants on Euronext.

prospect of a market with competing and self-learning algorithms opens up a range of possible new market structure outcomes. This section first explores how AI could amplify existing trends and then turns to more revolutionary aspects.

## A Larger Role for Nonbank Financial Institutions and More Algorithmic Trading

With the help of AI models, NBFIs may grow even more important, and the largest ones more important still. NBFIs now hold over half of all financial market assets globally. They are generally more agile and subject to fewer constraints with regard to the adoption of AI. By contrast, some of the larger banks may suffer from legacy infrastructure and may be subject to more stringent requirements in terms of model governance and accountability, and model explainability.

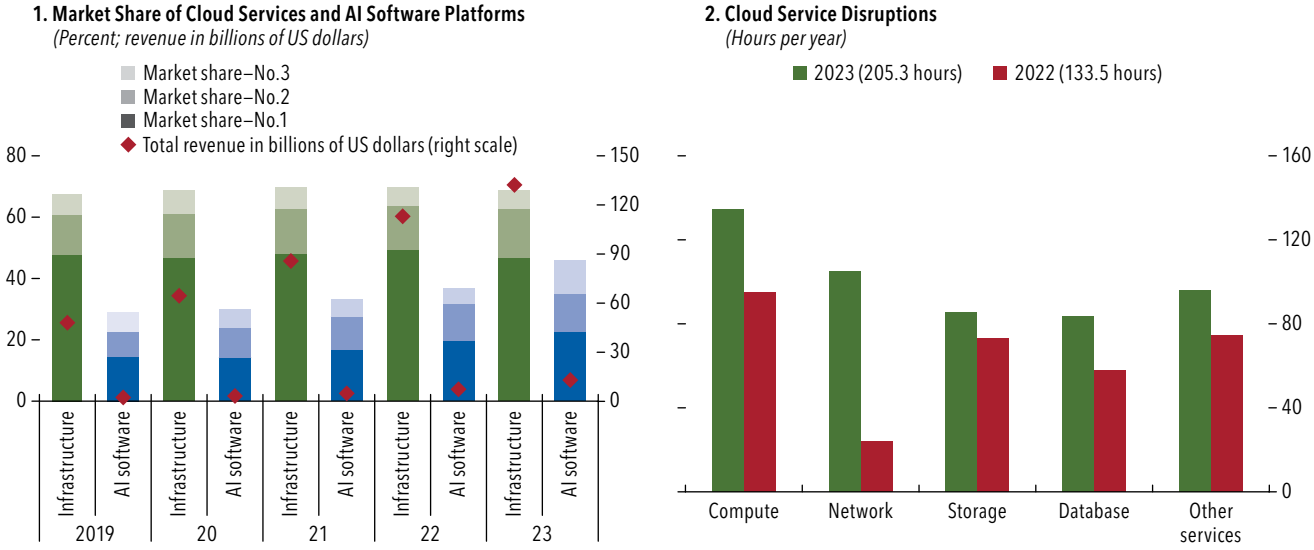
Over the past two decades, financial markets in advanced economies have experienced a significant transformation with the growth of algorithmic trading, with NBFIs rising to newfound importance. In the United States, algorithmic trading now constitutes about 70 percent of equities trading and more than half of futures trading (Figure 3.8, panel 1). Other jurisdictions are lagging behind in the share of algorithmic equities trading, but they could catch up briskly (Figure 3.8, panel 2). Increasing returns to scale seem to have resulted in those markets with a relatively high share of algorithmic trading activity also tending to see a concentration of activity among a limited number of players (Figure 3.8, panel 3). The high fixed costs associated with internal development or deployment of sophisticated AI let larger trading firms benefit from AI, while they could lead smaller players to resort to critical third-party service providers of cloud and AI software services, further amplifying outsourcing, market concentration and vendor lock-in risks (Figure 3.9).

Algorithmic trading now occupies a key role in many capital markets, and its evolution is likely to be driven by advances in AI. Strategies have already evolved from relatively simple trading rules to more complex algorithms and are now poised to use more sophisticated AI. This will provide new competitive advantages, primarily through the ability of AI to process large amounts of high-frequency and unstructured data in short amounts of time and to extract more value from it enabling automation of trading decisions. Algorithmic trading has already fundamentally altered the nature of capital markets, and the

## Figure 3.9. The Risks of Artificial Intelligence: Dependence on Third-Party Providers

IT infrastructure remains strongly concentrated, and the AI software services market is becoming more concentrated.

There was longer outage time for IT infrastructure in 2023 than in 2022.




Sources: Bloomberg Intelligence; Parametrix Insurance; and IMF staff calculations.

Note: In panel 1, infrastructure is represented by the aggregated revenue for the Infrastructure-as-a-Service segment, while AI software is represented by AI and predictive analytics Platforms-as-a-Service segment. In panel 2, disruption events only include critical events as defined by Parametrix and cover total outage, severe performance degradation, or other critical issues that require immediate action. As multiple groups may be affected by the same event simultaneously, the sum of the duration from each subcomponent is not equal to the total number of downtime hours. AI = artificial intelligence; IT = information technology.

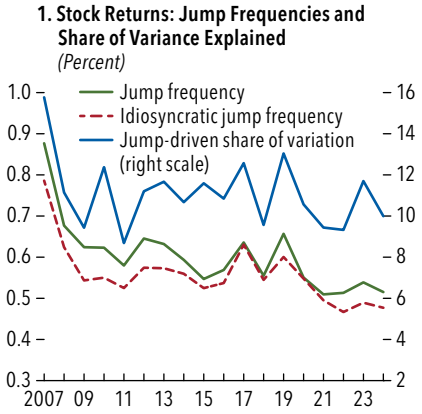
finance literature has connected its history to provide valuable insights into the potential changes to come:

- Algorithmic trading is largely assessed to have a positive impact on market liquidity and efficiency, but there may also be some negative impacts, especially under stressed conditions. Research suggests that algorithmic trading enhances liquidity and informational efficiency, albeit at the cost of increased short-term volatility (Hendershott, Jones, and Menkveld 2011; Hendershott and Riordan 2012; Boehmer, Fong, and Wu 2021). However, algorithmic trading can also increase volatility following macroeconomic news and can disincentivize informed traders from participating in the market, potentially even harming market efficiency (Scholtus, van Dijk, and Frijns 2014; Yadav 2015). In the US Treasury market, one of the deepest and largest markets in the world, digitalization has dramatically improved liquidity on aggregate, but this may have come at the cost of rare but extreme bouts of illiquidity under stress (Bouveret and others 2015). Adrian, Fleming, and Vogt (2017) find that market liquidity is affected by the extent to which high-frequency traders are present in the market. This is relevant from a systemic perspective because most bonds are traded over the counter rather than on centralized exchanges where banks and securities dealers facilitate transactions.
- Algorithmic trading could minimize price swings that are not driven by new information (Chaboud and others 2014). A decomposition of high-frequency US stock returns into continuous and "jump" components (Online Annex 3.1) shows that idiosyncratic jumps in individual stock returns—which could be evidence of a reduced level of intermediation and lower liquidity—are less and less frequent (Figure 3.10, panel 1).[12] Further analysis suggests that idiosyncratic jumps are more frequent when liquidity conditions are poor (Figure 3.10, panel 2). This substantiates the notion

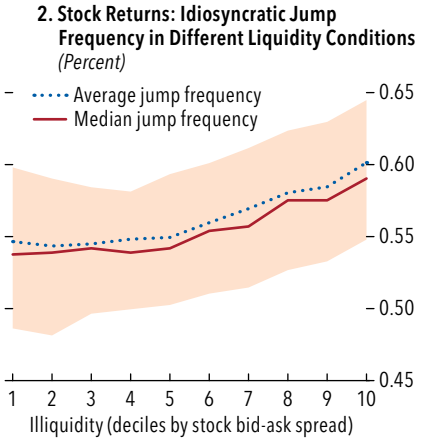
[12]See Box 1.4 in the October 2018 *Global Financial Stability Report*. Idiosyncratic jumps are identified by considering jumps in individual stocks that do not coincide with jumps in large and liquid passive ETFs that track the S&P 500 index (SPDR S&P 500 ETF Trust—SPY). The robustness of this identification is tested by also performing a jump decomposition of the residual stock returns, after regressing out the index return.

**Figure 3.10. Algorithmic Trading and Market Efficiency**

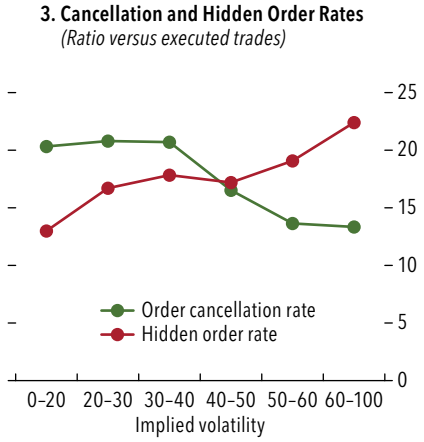
Markets have become less "jumpy" over the past two decades ...




... whereby idiosyncratic jumps are associated with illiquidity.




Liquidity and algorithmic trading may be "flighty" under stress.




Sources: Bloomberg Finance L.P.; US Securities and Exchange Commission, Market Information Data Analytics System; and IMF staff calculations.

Note: In panel 1, the now-standard thresholding approach and time of the day indicator in Bollerslev, Todorov, and Li (2013) are used to identify jumps. Data consist of five-minute trading hour intraday data covering a balanced panel of 235 stocks between 2007 and 2024. In panel 2, the idiosyncratic jumps frequencies are computed per stock-specific deciles of the daily bid-ask spreads. Higher deciles correspond to higher illiquidity. See Online Annex 3.1 for further details.

that algorithmic trading may have helped reduce idiosyncratic jumps through its positive effect on liquidity and market efficiency. AI-driven algorithms could further facilitate this positive effect on market stability.

- Algorithmic risk limits may contribute to market destabilization under stress. Algorithmic trading strategies are often programmed to de-risk or even shut down during periods of high volatility, particularly when faced with price signals that have not occurred previously.[13] These measures are intended to protect individual trading firms from significant losses. However, under certain conditions they could contribute to market destabilization through a cascading and simultaneous triggering of limits, feedback loops, and the sudden evaporation of liquidity provided by algorithmic trading. These AI-driven strategies may then be "switched off." Data from US equity markets provide some evidence for the notion that liquidity provided by algorithmic trading diminishes under stress. High-frequency traders often make use of order cancellations (Weller 2017), but order cancellation rates drop significantly as implied volatility increases (Figure 3.10, panel 3). Simultaneously, hidden order rates increase. Hidden orders are typically used by large institutional investors to minimize the market impact of their trades when liquidity is limited. Both observations are consistent with the concept of "flighty liquidity-under-stress." Based on feedback received during the IMF outreach, AI-driven algorithmic trading strategies are also subject to the same measures under stressed conditions, especially when regular and predictable market patterns break down.
- GenAI could facilitate the proliferation of algorithmic trading across new asset classes, trading venues, and geographic regions.[14] GenAI can lower barriers to entry for algorithmic trading, as it facilitates coding, testing, and automation of trading in less technologically sophisticated trading venues. It could also help mitigate some of the obstacles that have previously impeded the proliferation of algorithmic trading. For example, in asset classes with highly diverse instruments (for example, corporate bonds) that do not

[13]These limits can include restrictions on the total volume of trades, maximum loss thresholds, or limits on exposures to specific assets or markets. A survey of energy traders conducted by the Dutch Authority for Consumers and Markets found that algorithms are subject to position limits (14/15), price limits (13/15), volume limits (12/15), and other limits (ACM 2024).

[14]See, for example, London Stock Exchange Group 2024.

**Table 3.1. Potential Impact of the Adoption of Artificial Intelligence in Algorithmic Trading**

| | Negative Scenario | Positive Scenario |
|---|---|---|
| **Market liquidity** | **AI magnifies existing risks related to algorithmic trading by facilitating its growth.** AI could "democratize" and expand algorithmic trading activity to a broader set of assets and geographic areas. This could exacerbate risks related to sudden liquidity withdrawal under stressed conditions. | **AI increases the stability of algorithmic trading under stressed conditions.** AI-driven algorithms could operate in a wider set of market conditions than traditional algorithms, with lower flash-crash risk, and reduced liquidity-withdrawal under stress. |
| **Leverage** | **AI-driven strategies boost short-term leverage.** As arbitrage opportunities are exploited more efficiently by more advanced algorithms, remaining opportunities might require higher leverage to deliver similar returns. | **AI improves the management of leverage and related risks.** AI could facilitate more frequent and automated management of leveraged positions, based on more inputs, and mitigate operational lags. |
| **Interconnectedness** | **AI increases interconnectedness.** AI could proliferate algorithmic trading to other asset classes, geographic regions, and trading venues, and also operate in between different market segments; that is, in a multi-asset and multitrading venue approach. | |
| | Increased interconnectedness leads to higher correlations between capital market segments, facilitating spillovers and transmission of stress. | Market access, efficiency, and liquidity improve for some market segments, including emerging markets. |

Source: IMF staff assessment.
Note: AI = artificial intelligence.

naturally lend themselves to automated trading, GenAI can facilitate the processing of complex text-based data (such as bond indentures) to enable more standardized risk analysis, and pricing tools can support liquidity.[15]

On balance, the impact of these changes from a financial stability perspective is highly uncertain. Given the nascent nature of the use of AI in algorithmic trading, multiple scenarios could materialize. Table 3.1 outlines the potential positive and negative scenarios related to liquidity, leverage, and interconnectedness in financial markets.

## New Dynamics That Could Be Driven by Further Adoption of Artificial Intelligence

Beyond these traditional risk areas, AI could create new market dynamics and new risks to financial stability:

- *AI-driven strategies could drive higher and more procyclical trading volumes.* AI can quickly process vast amounts of new information and may therefore spur larger and more frequent portfolio adjustments, leading to higher trading volumes. Portfolio turnover for AI-powered ETFs[16] provides evidence for this scenario. ETFs with AI-driven strategies have experienced significantly higher turnover than other active or passive ETFs (Figure 3.11, panel 1), whose turnover has been relatively stable or slightly declining in recent years.[17,18] These higher trading volumes not only can enhance price discovery during stable market conditions but also can contribute to market instability in times of stress. Three sample AI-driven ETFs increased their portfolio turnover during the March 2020 market turmoil, providing some evidence for procyclicality (Figure 3.11, panel 2).
- *Markets could react faster to news.* There is some evidence of higher-speed adjustment based on an examination of historical releases of the Federal Open Market Committee minutes, usually a complex and lengthy document. Intraday market data suggest that, after the introduction of large language models, the initial market reaction following the release of the minutes (up to 45 seconds) tends to reflect its eventual impact more accurately than in the period before the introduction of these technologies (Figure 3.11, panel 3).
- *AI algorithms could collude or manipulate markets.* Risks in this area are currently being investigated through theoretical models of potential interactions

[15]Examples of AI-driven tools in bond markets include Overbond (https://overbond.com/) and BondGPT (https://www.ltxtrading.com/bondgpt).

[16]AI-powered ETFs are ETFs whose security selection and weights are optimized and periodically rebalanced using AI techniques with the objective to outperform their respective benchmarks.

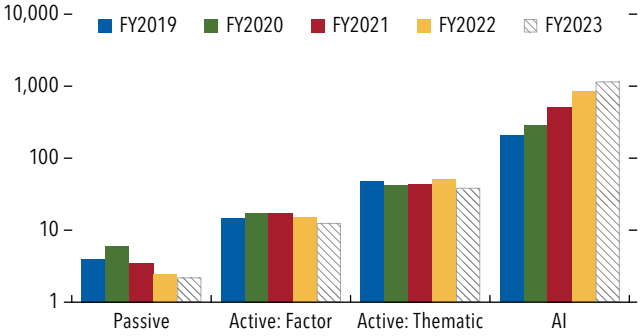
[17]Bonelli and Foucault (2023) find that big data allows active asset managers to find new trading signals but that doing so requires new skills. Thus, big data can reduce the ability of asset managers lacking these skills to produce superior returns, and it has the potential to displace high-skill workers in finance.

[18]Chen and Ren (2022) find that AI-powered mutual funds do not outperform the market but that they do significantly outperform their human-managed peers through superior stock selection capability and lower turnover ratios.

## Figure 3.11. New Artificial Intelligence Trading Dynamics

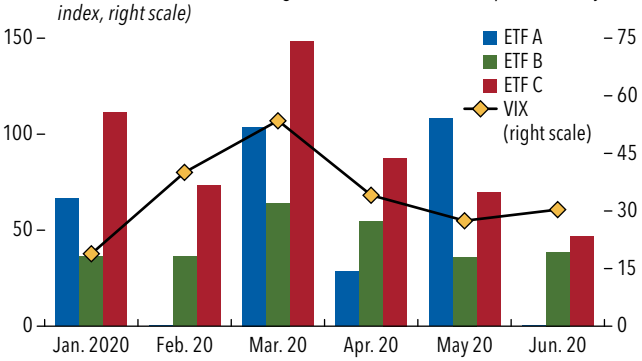
The annual turnover of AI ETFs outstrips that of other active ETFs and has been increasing.

**1. Portfolio Turnover of ETFs**
*(Percent of assets under management)*



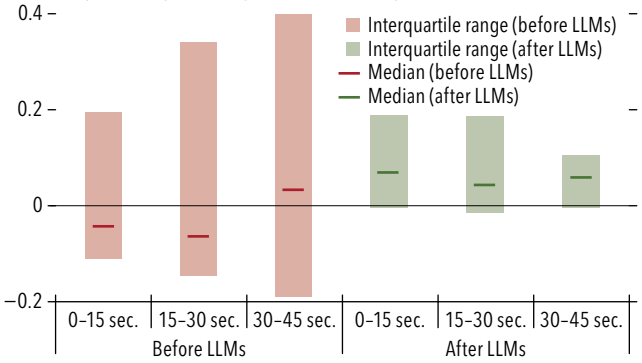

AI-driven trading could drive higher trading volumes, especially during periods of volatility.

**2. Gross Turnover and Implied Volatility Index**
*(Percent of assets under management at end of month; implied volatility index, right scale)*



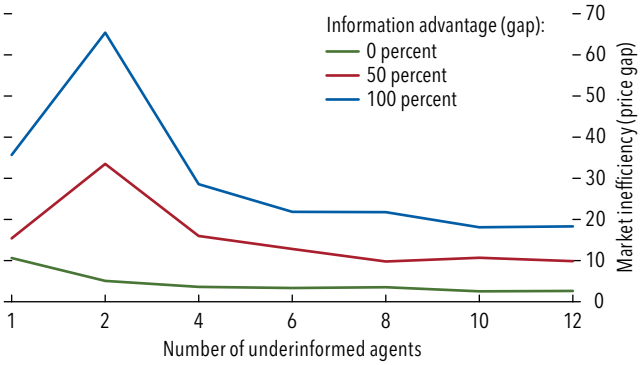

Some theoretical frameworks point to the possibility of tacit algorithmic conclusions.

**3. S&P 500 Index Normalized Market Reaction after Release of Federal Open Market Committee Minutes**
*(Proportion of price change at the 15-minute point)*




Theoretical models point to various possible market structure outcomes, including algorithmic manipulation.

**4. Market Inefficiency for AI Traders Who Are Learning under Information Asymmetry**
*(Percent)*



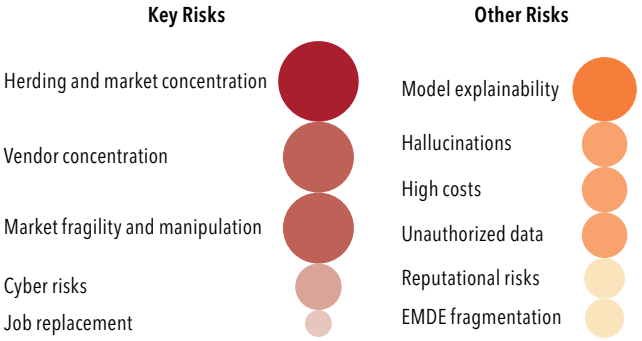

Sources: Bloomberg Finance L.P.; US Securities and Exchange Commission filings; and IMF staff calculations.

Note: In panel 2, ETF A, B, and C are samples of three AI-powered EFTs operating during the period. The implied volatility index is the VIX index. In panel 3, events have been included if the index price change surpassed 0.2 percent at the 15-minute mark. The periods before and after LLMs are separated by the publication of Vaswani and others (2017), which introduced the attention model and transformer architecture. Both the before and after LLM subsamples contain 15 qualifying datapoints. Panel 4 shows simulated scenarios from Fan, Pelger, and Yu (forthcoming), where deep learning-based reinforcement learning agents with different signals trade with each other. The panel displays the price gap between the market price and fundamental value. AI = artificial intelligence; ETF = exchange-traded fund; FY = financial reporting year; LLM = large language model.

### Figure 3.12. Market Intelligence: Risks and Regulation

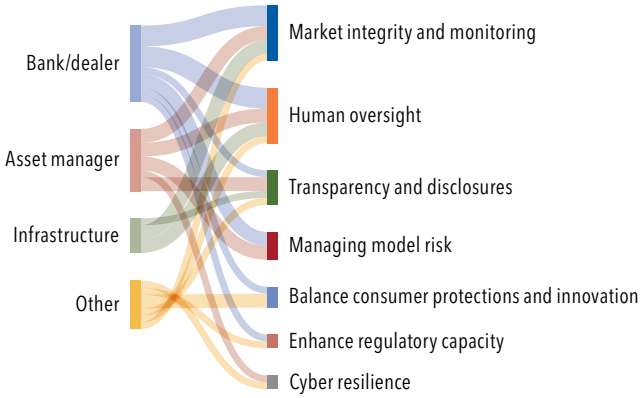
Some of the largest risks involve herding and market concentration as well as model explainability.

**1. What Risks Are Associated with Using Generative AI?**
*(Share of participants)*




Most market participants agree that regulators should ensure market integrity through monitoring and maintain human oversight of decision making.

**2. How Do You Expect Regulatory Authorities to Respond to the Risks of Generative AI?**




Sources: IMF, October 2024 *Global Financial Stability Report* market intelligence; and IMF staff calculations.

Note: For both panels, deepfake risks are included in the cyber categories, and additional information on market intelligence can be found in Box 3.1. In panel 1, the size and color of the bubbles represent the share of participants. Panel 2 shows that industry market participants expect regulatory authorities to intervene to limit the risks of generative AI. Infrastructure refers to market infrastructure firms. Other industry types in panel 2 include AI vendors, academia, and rating agencies. AI = artificial intelligence; EMDE = emerging market and developing economies.

between AI trading algorithms. Such models show a variety of different possible outcomes. In some cases, tacit algorithmic collusion could emerge (Dou, Goldstein, and Ji 2024). By contrast, the empirical literature points to the possibility of a "winner takes all" scenario (Baron and others 2017), which could result in market inefficiency—measured by the price gap between market prices and fundamental values—and manipulation. Manipulation is more likely if one algorithm has either an information or a latency advantage, and when the market has fewer players (Figure 3.11, panel 4).[19]

[19]Figure 3.11, panel 4, shows simulated scenarios from Fan, Pelger, and Yu (forthcoming). The panel displays the price gap between the market price and fundamental value based on a simulated market with informed and uninformed algorithmic traders that learn from each other's actions. One informed reinforcement learning agent holds one-eighth of the total market buying power, while the remaining buying power is evenly split among varying numbers of uninformed reinforcement learning agents. When the number of uninformed agents increases, it becomes harder for the informed reinforcement learning agent to manipulate the price, and hence, the equilibrium price gets closer to the fundamental value. The scenario with two uninformed agents makes it most likely to generate self-perpetuating trends, which are initiated by the informed reinforcement learning agent and take the form of local price bubbles.

## Financial Stability Implications

### Market Participants Are Most Worried about Concentration Risk

Participants in the IMF outreach cited potential herding and market concentration as a key financial stability risk that could result from wider and continued adoption of AI models in capital markets, especially those working at market infrastructure providers, assets managers, and academia (Figure 3.12, panel 1). This concern was viewed as especially pertinent if trading and investment strategies were to become largely derived from open-source AI and trained on similar data sourced from the same set of vendors. Correspondingly, vendor concentration was also viewed as a potential source of systemic risk, as overdependence on a limited number of AI model providers and data vendors could lead to mass disruptions to trading and investment were one or some of these vendors to fail.

Participants in the outreach also saw a possibility for widespread adoption of AI to introduce market manipulation (for example, through deepfakes or misinformation). Some participants mentioned market fragility issues—including the drying up of market

liquidity, excess volatility, and flash crashes—arising from fast-paced decision making and ineffectiveness of guardrails that may result, for instance, from the poor design of such guardrails, the growing complexity of the AI system, or even a malicious intervention.[20] Other participants viewed threats such as cyberattacks on financial intermediaries and market utilities, and large-scale data poisoning as a potential source of systemic risk (Box 3.2). To a lesser extent, the acquisition of data scientists and other professionals that can work in an AI-driven environment was also raised as a concern.

Some participants raised concerns that the lack of model explainability and model hallucination[21] could be detrimental to trust in markets. Others expressed concern over high costs associated with fine-tuning sophisticated models using large data sets creating potential for an unlevel playing field, with large firms having an advantage. Few participants also worried that customer fraud, unauthorized use, and data access could pose risks and compliance issues, leading to reputational damage. To a lesser extent, the adoption of AI could exacerbate spillovers of advanced economy shocks to emerging market and developing economies,[22] particularly if AI models are more sensitive to price fluctuations and managed against a basket of various asset classes. Alongside increasing transactions and sensitivity to market news, cross-border capital flow volatility could also increase and be destabilizing, particularly for relatively smaller and less liquid markets with largely fragmented participants.

[20]Guardrails refer to various microstructure mechanisms (such as pretrade controls, circuit breakers, volatility parameters, and kill switches). Issues with participant systems may impact a trading venue's ability to maintain a fair and orderly market. This might necessitate a trading venue to introduce microstructure mechanisms and tools to manage these risks and address the issues that arise. For details, see IOSCO (2015).

[21]See Shabsigh and Boukherouaa (2023, p. 7), who explain how "GenAI's ability to generate new content based on training data comes with the risk that GenAI models could produce wrong but plausible sounding answers or output and then defend those responses confidently—a phenomenon broadly referred to as 'hallucination.'"

[22]A potential AI use case for emerging market and developing economy assets is on managing foreign exchange risk. Some corporate treasurers are experimenting with AI techniques to assess currency risk exposure, predict market trends, and calculate optimal foreign-exchange hedging ratios. See Lipsky, Cole. 2024. "Banks, Vendors Mine AI for Corporate FX Hedging." Risk.net, June 6. https://www.risk.net/markets/7959503/banks-vendors-mine-ai-for-corporate-fx-hedging.

## Regulators Are Expected to Enhance Monitoring and Provide Guidance on the Risk Management of Artificial Intelligence Models

In response to the growing uncertainty and risks emerging from the adoption of AI/ML, participants in the IMF outreach expected regulatory authorities to provide clarity and guidance on model risk management, emphasize stress testing for extreme scenarios, and provide transparency and clearer disclosures (Figure 3.12, panel 2). Stakeholders also anticipated guidance on industry-specific regulatory structures to avoid violation of existing regulations, guidelines on AI use in consumer-facing applications, and accountability frameworks. Both buy-side and sell-side entities, along with academia and market infrastructure providers, emphasized the need for balanced regulation that ensures responsible use of AI without stifling innovation while at the same time ensuring adequate consumer protection. There was consensus that capital market supervisors should focus on providing guidelines and best practices rather than strict rulemaking, given the rapidly evolving nature of AI technology in financial markets. Some participants noted the importance of addressing bias in AI models and the potential need for supervisors to ensure better AI preparedness through continuous upskilling while integrating AI/ML (including sophisticated AI) in their supervision and market surveillance functions. Their overall sentiment was that the regulatory approach should be flexible and adaptable to keep pace with the rapid advancements in AI technology in the financial sector.

## Summarizing the Financial Stability Challenges: Current and Prospective

The use of AI in capital markets is still relatively nascent, and currently the financial stability risks associated with its adoption appear contained. Even so, there are already well-documented instances of sophisticated AI being used to generate disinformation with the goal of manipulating markets, and more importantly, more malicious cyber threats (see Box 3.2).

The analytical work and the market participant responses to the IMF's outreach documented in this chapter demonstrate that rapid adoption of AI in capital markets is likely and that it may drive some

transformative impacts on markets that lead to several financial stability challenges:

- ***Increased market speed and volatility under stress***
  - Continued growth of AI-enhanced algorithmic trading strategies could enhance market liquidity and bring efficiency gains, manifesting in the form of more prompt price adjustments in response to new information and also thinner margins for traders. But both could incentivize an increased use of leverage across the financial system and result in more amplification between falling asset prices, volatility, and deleveraging in periods of stress.
  - AI models may herd and produce rather similar decisions, especially during stress periods resulting in procyclical financial stability risks. During normal times, AI models may uncover new trading opportunities, leading to more diverse investment strategies that would be positive for financial market resilience. During adverse shocks, however, models could simultaneously rebalance portfolios toward safe assets, creating a self-fulfilling spiral of fire sales.
  - Novel adverse events—such as the COVID-19 pandemic in 2020—may drive AI model outcomes that are difficult to comprehend, or models may simply shutdown, requiring humans to make decisions on and process a voluminous number of trades. This vulnerability could be more heightened if AI trading algorithms collude with each other, resulting in a winner-dominated market that could be more easily upended by adverse shocks.
- ***More opacity and monitoring challenges***
  - AI may spur further migration of activities to NBFIs. Since the global financial crisis, trading and investment activity, and especially capital market activities, have steadily migrated out of the banking sector and into NBFIs (see Chapter 2 of the April 2023 *Global Financial Stability Report*). Some NBFIs have now built extensive expertise and technology to help them take advantage of new advances in AI. Regulatory requirements for banks regarding the explainability and transparency of internal models—compared to comparatively lighter requirements for NBFIs—give NBFIs a competitive advantage over banks in reaping the benefits of complex models, thereby raising systemic opacity.
  - AI models could generate portfolios across different asset classes, geographic regions, and trading venues, creating correlations and interconnectedness that are not relevant at the current juncture. This could undermine the ability of regulators to monitor financial risks holistically.
  - There will likely be emergent, new forms of risks (for example, potential complex interactions between autonomous AI agents not visible at the level of individual institutions or at the regulatory level).
- ***Increased operational risks as a result of reliance on a few key third-party AI service providers***
  - AI models and related information technology services currently reside with a handful of key providers with dominant computational power and established large language models. If capital markets activities become too reliant on these models, the failure of these providers may lead to market stress akin to the failure of key financial market utilities such as clearing houses.
- ***Increased market manipulation and cyber risks***
  - Fraud, disinformation, and deepfakes will likely become more sophisticated as AI advances and could be used by bad actors to manipulate financial markets and asset prices.
  - Data integrity and confidentiality could be compromised, leading to AI models producing suboptimal trading and investment decisions.

## Regulatory and Supervisory Developments

### International, National, and Supervisory Artificial Intelligence Initiatives

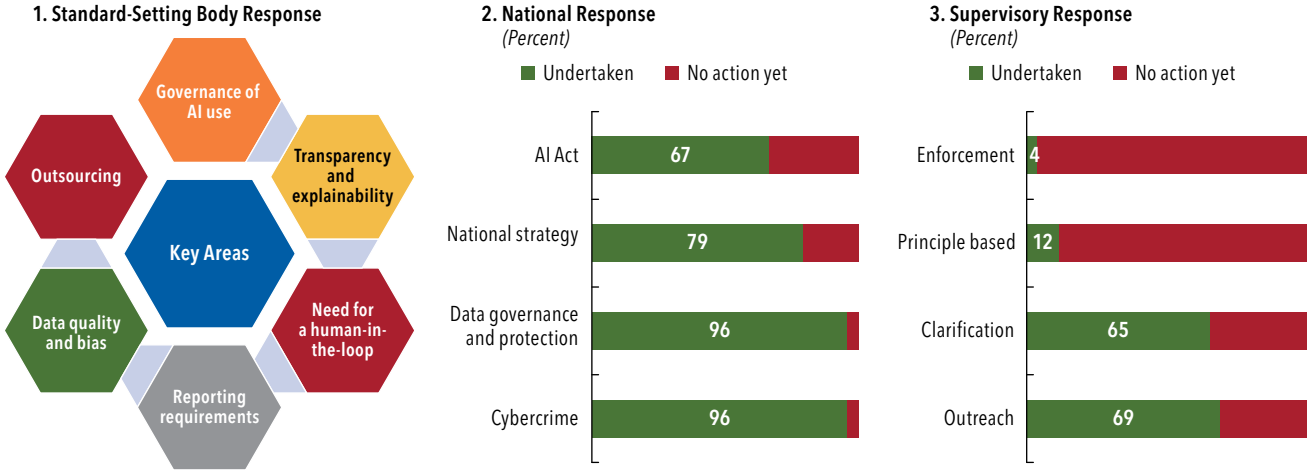
International organizations, standard-setting bodies, and financial sector authorities for larger capital markets have identified the use of AI/ML by market intermediaries and asset managers as a key priority, given the cautious but steady pace of its uptake. As capital markets are already subject to regulation and supervision, institutions are responsible for AI systems they deploy, whether internally developed or externally sourced. Existing regulatory and supervisory frameworks for capital markets are largely technology-neutral and are also applicable to AI systems. Ongoing work by financial sector authorities explores and provides guidance on application of existing prudential frameworks as well as the need for additional frameworks to effectively cover the risks specific to the use of AI,

**Figure 3.13. Standard Setter, National, and Supervisory Artificial Intelligence Initiatives**

Standard-setting bodies are designing frameworks by building on accepted practices, while considering their application to AI.

Governments with large capital markets are leveraging cyber and data frameworks to pivot to AI strategies ...

... whereas financial supervisors are cautious and respond through targeted outreach and clarification of existing standards.




Sources: Panel 1: IMF staff literature review of international standards and regulatory and supervisory publications. Panels 2 and 3: UN Institute for Disarmament Research AI Policy Portal; UN data protection and privacy legislation worldwide; and IMF staff analysis and review of AI-related initiatives taken by financial sector authorities.

Note: The analysis covers the jurisdictions with stock exchange operators with a market capitalization of listed companies exceeding $1 trillion as of March 2024. The sample consists of 24 jurisdictions, of which 11 are members of the European Economic Area, and 26 financial market authorities, of which 11 are from the European Economic Area and 3 are from the United States. AI = artificial intelligence.

which so far focus more on conduct issues such as ethics, fairness, and transparency.

Most current AI initiatives by standard-setting bodies begin by saying that financial sector authorities should remain vigilant on AI deployment by capital market participants and be prepared to respond to an acceleration in the pace of adoption. It is recommended that financial sector authorities update their skills and supervisory tools to monitor more complex investment strategies and process more granular data in real time. In addition, financial sector authorities should proactively question whether extant regulatory frameworks adapt to novel forms of AI with a comprehensive view of emerging risks.

In this context, standard-setters and financial sector authorities have issued or are revisiting assessments (FSB 2017b), guidance, and regulatory frameworks that take into account the various risks of AI deployment (Figure 3.13, panel 1) in a number of key areas. Existing frameworks issued by the Financial Stability Board (FSB), Bank for International Settlements, and national regulators address financial stability, market integrity, and investor protection concerns mostly by building on the principles of technology-neutral, results-based, and proportional regulation and supervision (Monetary Authority of Singapore 2018; Hong Kong Monetary Authority 2019).[23] The FSB issued guidance for managing third-party risk and cyber incidents (FSB 2020, 2023a). The Basel Committee frameworks for banking institutions that participate in capital markets include principles and recommendations on data governance and operational and cyber risk management (BCBS 2013; BIS 2023). The US National Institute of Standards and Technology (NIST) has recently issued a relevant AI framework (NIST 2024). The International Organization of Securities Commissions (IOSCO) has addressed algorithmic trading and market volatility (IOSCO 2018) and AI risks in market intermediaries

[23]While issued by the US Executive Power, the Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence (https://www.whitehouse.gov/briefing-room/presidential-actions/2023/10/30/executive-order-on-the-safe-secure-and-trustworthy-development-and-use-of-artificial-intelligence/) encourages independent regulatory agencies to consider using their authority to prevent discrimination and address risks arising from the use AI to financial stability.

and asset management (IOSCO 2021). Currently, IOSCO is conducting a two-year project to assess risks and challenges associated with the use of AI, with potential policy guidance expected by the first quarter of 2025 (IOSCO 2024).

An IMF review of actions taken by 26 authorities in large capital markets finds that governments have already begun to formulate comprehensive AI strategies and act in the areas of data protection, governance, and cybercrime (Figure 3.13, panel 2). Some jurisdictions are also considering dedicated AI legislation to ensure robust governance for this rapidly evolving technology. However, supervisory authorities remain cautious in this area, and so far, have focused primarily on clarification and outreach, rather than on enforcement (Figure 3.13, panel 3).

### Best Practices

Given the rapidly evolving and uncertain landscape of AI in capital markets, engagement through outreach is crucial. Establishing public/private forums to develop overarching principles (Office of the Superintendent of Financial Institutions 2023), partnering with the industry to build a risk framework (Monetary Authority of Singapore 2024), and conducting surveys on the applicability of existing frameworks are mechanisms that can be conducive to a safe adoption of AI (US National Archives 2021; Institute for Workplace Equality 2022; Bank of England 2024). Engagement also helps financial sector authorities assess whether existing risk management guidance takes into account the specific challenges of AI models, namely explainability, robustness, data bias/privacy, and cybersecurity, and to what extent AI is being used in the sector and for which particular services and activities. Other practices within the banking sector relate to requesting notification by banks prior to their adoption of certain technologies or arrangements with third parties (BCBS 2024).

AI is providing numerous opportunities for supervisors to generate efficiency gains by automating data quality checks to ensure completeness, correctness, and consistency. AI can also combine multiple data sources, even when original data lack a unique identifier, and help financial sector authorities detect anomalies in trading patterns, reflected in changes in prices, volume, and volatility (di Castri and others 2019). Other applications may aim to identify misleading information or perform real-time monitoring of market transactions. GenAI offers new possibilities to financial sector authorities because it enhances information retrieval, content creation, and code generation, debugging, and explanation, as well as legacy code optimization. These tools could enable financial sector authorities to accelerate the deployment of more traditional use cases such as fraud detection or monitoring of market activity, or streamline data management tasks.

While the adoption of new and emerging technology for supervisory processes (known as SupTech) continues to trend upward, the adoption rates between advanced economies and emerging market and developing economies are uneven (Cambridge SupTech Lab 2023).[24] Periodic upskilling and upgrading should help financial sector authorities identify AI use–specific issues like models designed to "game the regulation" and detect algorithmic coordination. Finally, existing cross-sectoral thematic reviews could reveal potential herding or material interconnectedness among market participants and also help identify best practices in the use of AI (Securities and Exchange Board of India 2019).

## Policy Recommendations

Regulation and supervision in AI-related areas should be enhanced to address potential financial stability risks for both the banking and NBFI sectors. Regulatory and supervisory frameworks should follow a balanced approach, allowing financial sector participants to reap the potential benefits of AI while acknowledging its risks (IMF and World Bank 2018). Across sectors, supervisors should continue to strive for cyber resilience and address dependency on data, models, and third-party service providers by requesting risk mapping. Specific to capital markets, areas that could be strengthened further relate to over-the-counter markets and existing measures to address volatility. Implementation of these recommendations will require regulatory reporting to allow for continued structural assessment of the developments and accompanying risk, which is more achievable with an outreach or survey approach.

[24]In 2023, 79 percent of advanced economies and 54 percent of emerging market and developing economies had adopted SupTech tools, compared to 50 percent and 31 percent, respectively, in 2022.

## Address Increased Market Speed and Volatility under Stress

Financial sector authorities and trading venues should determine whether designing new or modifying existing volatility response mechanisms is necessary to respond to crash events potentially originated in AI-driven-trading. Existing circuit breakers may need to be re-parameterized in light of changing market structures. However, poorly designed circuit breakers may exacerbate volatility and interfere with market efficiency and price discovery (Vereckey 2023). Testing algorithms in controlled environments could help financial sector authorities, trading venues, and market actors assess their behavior in extreme circumstances.

Financial sector authorities, trading venues, and central counterparties should review margining requirements and other buffers in light of potentially rapid AI-driven price moves. In line with policy proposals by the Basel Committee on Banking Supervision, the Bank for International Settlements' Committee on Payments and Market Infrastructures, and IOSCO, further international work is needed to (1) foster market participants' preparedness for the large variation margin calls that can occur during market stress; (2) identify good practices for variation margin collection and distribution by the central counterparty; (3) understand the degree and nature of the central counterparty margin models' responsiveness to volatility and other market stresses; and (4) review initial margin levels in non-stress times, including a review of the effectiveness of tools to reduce the procyclicality of margin models (BCBS, CPMI, and IOSCO 2022).

## Address Increased Opacity and Monitoring Challenges

Financial sector authorities should ask financial institutions to regularly map interdependencies between data, models, and technological infrastructure supporting AI models.[25] These models may feed on shared or interdependent data sources; share a common architecture; and rely on a small number of providers for software, data, and cloud services. In addition, data sets may not cover a complete financial cycle, undermining the reliability of models built upon them (Gensler and Bailey 2020). Although regulatory frameworks require assessing the cumulative effects of models, they do not mandate a joint assessment of data dependencies. An updated view of these interdependencies will enable financial sector authorities to proactively manage risks and promote a resilient ecosystem.

Financial sector authorities should continue to strengthen their oversight and regulation of NBFIs by requiring them to identify themselves and disclose AI-relevant information. The authorities could monitor the activity of market participants that conduct a substantial amount of trading activity ("large traders") (IOSCO 2011). Each such large trader should be uniquely identified and provide information on its activities to its registered broker-dealer in its securities market, which would allow for monitoring by financial sector authorities. Other measures, such as those proposed by the FSB and IMF, and which also address risks of further adoption of AI in the NBFI sector, should aim to continue strengthening resilience there (see Chapter 2 of the April 2023 *Global Financial Stability Report*; FSB, n.d.). On that point, enhancing risk management and strengthening liquidity buffers could contribute to the resilience of NBFIs, thereby mitigating the effects of asset mispricing or liquidity runs.

## Address Increased Operational Risks as a Result of Reliance on a Few Key Third-Party Artificial Intelligence Service Providers

Financial sector authorities should undertake a coordinated approach to the regulation and supervision of AI service providers. To this purpose, it is crucial to map the relationships and correspondences between critical AI service providers and essential IT infrastructure providers Failure or disruption of critical third parties may affect the stability of and confidence in the financial sector (Federal Reserve System, Federal Deposit Insurance Corporation, and Department of the Treasury 2023; see also European Securities and Markets Authority 2023). Comparable and interoperable regulatory approaches to critical service providers facilitate compliance across the financial sector and coordination among financial sector authorities (FSB 2023b). The authorities should also ensure that the definition of critical service providers is broad enough to capture the systemic use of common AI models (Bank of England 2024).

Financial sector authorities should continue to strive for resilience in capital markets by requiring protocols to avoid, protect against, respond to, and recover from attacks. AI systems are exposed to various types of attacks that can affect both the data used to train the

[25]Similar to, but expanded to data and AI systems, see Principle 4 of the BCBS "Principles for Operational Resilience" (BCBS 2021).

algorithm and the model itself, and that aim to either manipulate model results or extract their coding. AI systems are like other information technology systems, so cybersecurity needs should be contemplated at various stages—namely the design, development or procurement, deployment, and operations stages (National Cyber Security Centre 2023).

### Address Over-the-Counter Monitoring Needs and Resilience Risks

Financial sector authorities should be prepared to adopt measures that ensure continued market integrity, efficiency, and resilience of over-the-counter markets when AI use proliferates. The authorities should consider collecting and disseminating more detailed information on over-the-counter transactions, requiring market participants to account for liquidity shifts in their risk management framework, establishing or expanding existing incentives for market-makers to enhance liquidity, improving incentives for central clearing, and establishing margin requirements for non-centrally cleared derivatives. In the event of shocks, backstop measures could include central bank liquidity provision to market-making banks or indirectly support non-bank dealers by easing market funding conditions (CGFS 2014).

## Box 3.1. IMF Staff Market Outreach: Qualitative Assessment of Advances in Artificial Intelligence and Its Implications for Capital Markets

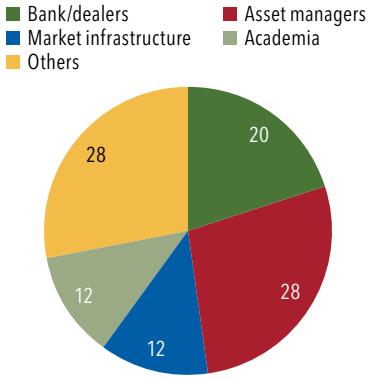
IMF staff conducted extensive outreach across various stakeholders to gather market intelligence on how financial institutions—both buy-side and sell-side firms—are harnessing advances in artificial intelligence (AI) for capital market activities, and on the potential impact of AI adoption. The objective was also to gain a forward-looking view on how the rise of sophisticated AI (including generative AI) technologies might influence financial activity in the future, especially in terms of the use of AI and machine learning (ML) for asset allocation and trading.

IMF staff engaged in a large number of meetings with bank/dealers, AI vendors, asset managers, academia, rating agencies, and market infrastructure firms, among others (Figure 3.1.1), and received detailed responses from 27 stakeholders directly involved in AI topics and business. While buy-side firms include asset managers, mutual funds, hedge funds, pension funds, private equity firms, and institutional investors, sell-side firms consist of investment banks, brokerage firms, market makers, and research analysts. Bilateral discussions focused on the use of AI/ML, including sophisticated AI for investing across various asset classes, expected use cases and benefits in investment and trading decisions, prospects around AI-based trading autonomy, risks and challenges (including potential systemic risks), and expected regulatory guidance on AI deployment. The outreach also sought feedback on the potential impact on emerging market and developing economies in terms of capital flows and potential fragmentation risk.

Given the challenge to identify a homogenous definition of AI and distinguish AI/ML from sophistication AI, IMF staff adopted the following definitions: "AI/ML models" referred to well-established predictive analytics, including neural networks, clustering algorithms, natural language processing, decision trees, and so on; and "sophisticated AI models" referred to the latest innovations, such as deep learning, reinforcement learning, and large language models. This includes generative AI models capable of generating text, codes, images, and other content. For certain topics for which questions can be asked consistently across participants (for example, asset classes for which AI is used, key risks that are top of mind), staff tabulated the results of answers to the questions.

The IMF's outreach was accompanied by an extensive literature review, data collection, and analytical work. In parallel, staff conducted a regulatory outreach with 10 capital market supervisors of advanced and emerging markets.

**Figure 3.1.1. Participants in the IMF's Market Intelligence Outreach**
*(Percent)*




Sources: IMF, October 2024 *Global Financial Stability Report* market intelligence; and IMF staff calculations.

Note: "Others" includes nonprofit financial organizations, artificial intelligence finance conferences, artificial intelligence vendors, and rating agencies. This figure does not include regulatory outreach.

## Box 3.2. Manipulation and Cyber Risk: The Artificial Intelligence Arms Race

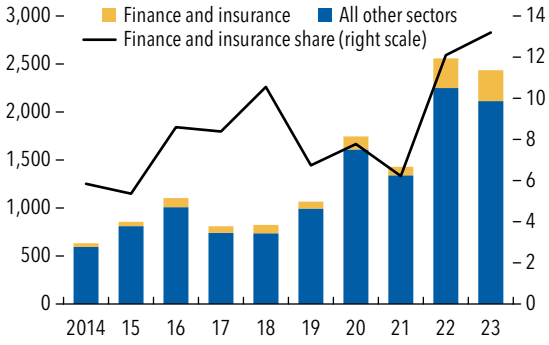
Generative artificial intelligence can be used by bad actors to manipulate markets or to conduct cyberattacks. Cyberattacks have been on the rise in recent years (Figure 3.2.1, panel 1), with the share of attacks on finance and insurance sector entities more than doubling over the past decade. Previous IMF work has shown one measure of potential maximum annual financial firm losses from cyber incidents has increased from $300 million to $2.2 billion since 2017 (see Chapter 3 of the April 2024 *Global Financial Stability Report*).[1] Cybercriminals can produce deepfakes, manipulating audio and video to impersonate key individuals in the financial sector, or spread other misinformation. Such deepfakes can lead to fraudulent transactions, manipulated stock prices, or an erosion of trust in financial institutions, triggering selloffs or deposit runs. Critical financial market or information technology infrastructure can be targeted, leading to significant disruptions in financial markets and beyond.

Although a dedicated AI cyberattack database does not currently exist, AI incidents are being tracked by multiple databases.[2] Despite better AI preparedness, most AI incidents have occurred in advanced economies, even when accounting for differences in GDP (Figure 3.2.1, panel 2). In many cases, AI incidents concern cases where AI was used with a legitimate objective, but where unanticipated consequences appeared. AI incident rates therefore

### Figure 3.2.1. Cyberattacks and Artificial Intelligence Incidents

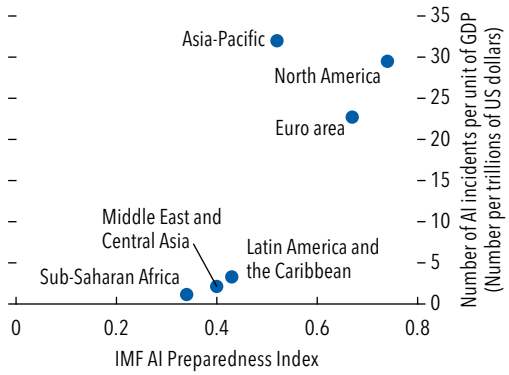
Cyberattacks have increased, with the financial sector share rising as well.

**1. Cyberattacks**
*(Number per year; finance and insurance sector share in percent)*




Despite higher AI preparedness, North America and Europe have higher rates of AI incidents.

**2. AI Incidents per Unit of GDP and AI Preparedness**
*(Number per trillions of US dollars; index)*




Sources: AI, Algorithmic, and Automation Incidents and Controversies (AIAAIC); University of Maryland Center for International and Security Studies; and IMF staff calculations.

Note: AIAAC defines an "incident" as a sudden known or unknown event (or "trigger") that becomes public and which takes the form of a disruption, loss, emergency, or crisis. In panel 2, the IMF AI Preparedness Index incorporates four macro-structural indicators that are relevant for AI adoption: digital infrastructure, innovation and economic integration, human capital and labor market policies, and regulation and ethics. AI = artificial intelligence.

[1]Chapter 3 of the April 2024 *Global Financial Stability Report* explains how the growing instances of cyberattacks post an acute threat to macrofinancial stability. Data cited comes from Figure 3.5, panel 4, of the report.

[2]There are three databases keeping track of so-called AI incidents: (1) the AI Incident Database (https://incidentdatabase.ai/apps/incidents/), (2) the Organisation for Economic Co-operation and Development's AI Incidents Monitor (https://oecd.ai/en/incidents), and (3) the AI, Algorithmic, and Automation Incidents and Controversies Repository (www.aiaaic.org).

**Box 3.2 *(continued)***

largely reflect AI usage rates. This illustrates that the use of AI comes with risks when it behaves in ways that were not anticipated.

Recent incidents illustrate potential mechanisms through which an AI-triggered cybersecurity breach could lead to more significant ramifications. In a 2024 case, a finance worker at a multinational firm in Hong Kong SAR was reportedly tricked by AI-generated deepfake video and audio, allegedly leading to a $25 million payout to fraudsters.[3] This incident shows how generative AI can be used to exploit human or organizational vulnerabilities through personalization and social engineering. In the financial sector, bad actors could gain access to critical systems.

Cyberattacks can disrupt computer systems, with implications for key financial markets. Although a 2023 ransomware attack on the Industrial and Commercial Bank of China is not known to have been related to AI, it reportedly affected US Treasury market conditions.[4]

Finally, fake or genuine social media activity can amplify news and contribute to panic, possibly through manipulation. Reports suggest that First Republic Bank was targeted by an online manipulation campaign.[5]

[3]Chen, Heather, and Kathleen Magramo. 2024. "Finance Worker Pays Out $25 Million After Video Call with Deepfake 'Chief Financial Officer.'" CNN, February 4. https://edition.cnn.com/2024/02/04/asia/deepfake-cfo-scam-hong-kong-intl-hnk/index.html

[4]*Financial Times.* 2023. "Ransomware Attack on ICBC Disrupts Trades in US Treasury Market." November 10. https://www.ft.com/content/8dd2446b-c8da-4854-9edc-bf841069ccb8

[5]Khan, Amil, and Fergus McKenzie-Wilson. "The First 'Safe' Bank Brought Down by Disinformation Attacks." Valent Projects, January 2024. https://www.valent-projects.com/news-and-insights/first-republic-bank-brought-down

## Glossary

This glossary provides descriptions and, where possible, definitions of the most important AI-related concepts, as used in the chapter. It draws from definitions and descriptions used by international standard setting bodies.

| | |
|---|---|
| Algorithmic trading (AT) | Trading in financial instruments whereby an algorithm independently executes trading decisions.[26] Algorithmic trading can be used for trade execution, market-making, or in other proprietary trading strategies. Algorithmic trading strategies vary in complexity and latency; in its simplest guise, algorithmic trading may involve the use of basic trading rules or instruction to feed portions of an order into the market at preset intervals to minimize market impact cost. More complex applications can involve multi-asset trading strategies based on advanced machine learning models. Reinforcement learning allows algorithms to learn dynamically from evolving trading patterns, as well as the actions of other algorithms. |
| Artificial intelligence (AI)[27] | The theory and development of computer systems able to perform tasks that traditionally have required human intelligence. The definition of AI is very broad and would include many simple applications that would generally not be described as AI in the public discourse. For example, simple linear regression would fall under this broad definition, even though most would not classify this as AI. The focus of this chapter is on more **sophisticated AI**, which includes not only generative AI but also more complex nongenerative applications such as clustering algorithms, neural networks, gradient-boosted decision trees, support vector machines, etc. |
| Deep learning | A form of machine learning that uses algorithms that work in "layers" inspired by the structure and function of the brain. Deep learning algorithms, whose structures are called artificial neural networks, can be used for supervised, unsupervised, or reinforcement learning (itself a form of machine learning). |
| FinTech[28] | Technology-enabled innovation in financial services that could result in new business models, applications, processes, or products with an associated material effect on the provision of financial services. |
| Foundation models[29] | An umbrella term referring to a diversity of models that are usually trained by applying deep learning to massive quantities of data, such as text and images. Because the expertise, time, and computing power involved in training foundation models from scratch are typically prohibitive for most nonspecialist firms, these models are usually pretrained and shared with end users for further refinement. |
| Generative AI | AI that generates new content, such as text, images, and videos, often based on user prompts. Generative AI is powered by foundation models, such as large language models. |

[26]Financial Conduct Authority Handbook (2011).
[27]FSB (2017b).
[28]FSB (2017b).
[29]FSB (forthcoming).

| | |
|---|---|
| High-frequency trading (HFT) | HFT is frequently equated to algorithmic trading. However, whereas HFT is a type of algorithmic trading, not all forms of algorithmic trading can be described as high frequency. Algorithmic trading predates HFT and has been extensively used as a tool to determine some or all aspects of trade execution like timing, price, quantity, and venue. Many intermediaries use algorithmic trading for their own proprietary trading or offer it to their clients. It has also become a standard feature in many buy-side firms, mainly with the purpose of devising execution strategies that minimize price impact or to rebalance large portfolios of securities as market conditions change. A number of common features and trading characteristics related to HFT are identified by IOSCO.[30] |
| Large language models (LLMs) | Large language models are AI systems designed to learn grammar, syntax, and semantics of one or more languages to generate coherent and context-relevant language. |
| Machine learning (ML) | A method of designing a sequence of actions to solve a problem that optimizes automatically through experience and with limited or no human intervention. |
| Market-making[31] | The provision of liquidity for clients in financial instruments, whereby a trader sets firm bid-offer quotes and thereby provides liquidity for a specific product or a particular product class. This is designed to avoid temporary imbalances between supply and demand for certain products. |
| Proprietary trading | Describes a trading unit which is separate from the rest of an organization's trading activities and is not involved in client business. It generates profits exclusively from taking positions. This trading unit has no client contact and is not involved in the broker market. |
| RegTech[32] | Any range of applications of FinTech for regulatory and compliance requirements and reporting by regulated financial institutions. This can also refer to firms that offer such applications. |
| Reinforcement learning (RL) | A type of machine learning paradigm where an agent learns to make decisions by taking actions in an environment to achieve some goal. The learning process is driven by the feedback the agent receives from the environment in the form of rewards or penalties. |
| Robo-advisors or automated advice | Applications that combine digital interfaces and algorithms, and can also include machine learning, to provide services ranging from automated financial recommendations to contract brokering to portfolio management to their clients, without or with very limited human intervention. Such advisors may be standalone firms and platforms or can be in-house applications of incumbent financial institutions. |
| SupTech | Any application of FinTech used by regulatory, supervisory, and oversight authorities. |
| Synthetic data | Artificially generated information that is designed to mimic real-world data in terms of statistical properties and structure. Unlike real data, which are directly collected from real-world events or interactions, synthetic data are created through algorithms and simulation models. |

[30]IOSCO (2011, p. 22).
[31]CGFS (2014).
[32]FSB (2017a).

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