**EXECUTIVE BOARD MEETING**

SM/23/68

March 10, 2023

To: Members of the Executive Board

From: The Secretary

Subject: **April 2023 Global Financial Stability Report—Chapters 2 and 3 and Online Annexes**

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| Board Action: | Executive Directors' **consideration** (Formal) |
| Tentative Board Date: | **Wednesday, March 29, 2023** |
| Publication: | Yes, it is intended that the full set of the April 2023 Global Financial Stability Report documents will be released to the public at the time of the Global Financial Stability Report press conference, tentatively scheduled for **Tuesday, April 11, 2023**.<br><br>The analytical chapters will be made available to the public on the IMF website in advance of the publication of the full document. |
| Questions: | Ms. Qureshi, MCM (ext. 38942)<br>Mr. Catalan, MCM (ext. 34372)<br>Mr. Tsuruga, MCM (ext. 34706)<br>Mr. Garcia Pascual, MCM (ext. 34083)<br>Mr. Piontek, MCM (ext. 34329) |
| Additional Information: | The paper will be revised for publication in light of the Executive Board discussion. If Executive Directors have additional comments, they should notify Mr. Garcia Pascual and Mr. Piontek for Chapter 2 and Mr. Catalan and Mr. Tsuruga for Chapter 3 by **5:30 p.m. Friday, March 17, 2023.** |

CHAPTER 2

# Nonbank Financial Intermediaries: Vulnerabilities Amid Tighter Financial

**Chapter 2 at a Glance**

**Nonbank financial intermediaries (NBFIs) play a key role in the global financial system**, enhancing access to credit and supporting economic growth. Also, NBFIs' financial vulnerabilities might have increased in the past, amid low interest rates. Case studies presented in this chapter show that NBFI stress tends to emerge with elevated leverage, liquidity mismatches, and high levels of interconnectedness that often spill over to emerging markets. In the current environment of high inflation and tighter financial conditions, central banks can face complex and challenging trade-offs during market stress, between addressing financial stability risks and achieving price stability objectives. Policymakers need appropriate tools to tackle the financial stability consequences of NBFI stress. NBFI direct access to central bank liquidity could prove necessary in times of stress, but implementing appropriate guardrails is paramount.

- **As a first line of defense, robust surveillance, regulation, and supervision of NBFIs are vital**. Priorities should be to close key data gaps, incentivize risk management by NBFIs, set appropriate regulation, and intensify supervision.
- **Central bank liquidity support involves three broad types**:

  1. **Discretionary market-wide operations** should be temporary; targeted to those NBFI segments where further market dislocation and disintermediation could have adverse financial stability implications; and designed to restore market functioning while containing moral hazard. The timing of a marketwide operation is critical—a framework should be in place based on what can be referred to as "discretion under constraints." Data-driven metrics trigger the potential intervention (the constraints), while policymakers ultimately retain the discretion as to whether to intervene.

  2. **Access to standing lending facilities** could be granted to reduce spillovers to the financial system, although the bar for such access should be very high to avoid moral hazard. Access should not be granted without the appropriate regulatory and supervisory regimes for the different types of NBFIs (some of which may not qualify).

  3. **Central banks as a lender of last resort** may need to step in if a systemic NBFI comes under stress. Lending to a systemic NBFI should be at the discretion of the central bank, at a penal rate, fully collateralized, and accompanied by more supervisory oversight. A clear timeline should be established for restoring the liquidity of the institution.
- **Clear communication is critical**, so that central banks are not perceived as working at cross-purposes, such as purchasing assets to restore financial stability while continuing with quantitative tightening to bring inflation back to target. Announcements of central bank liquidity support should clearly explain the financial stability objective and the parameters of the program.
- **Coordination between the central bank and financial sector regulators is essential**, not only for the identification of risks, but also for the management of crisis situations as well as for an assessment of supervisory and regulatory deficiencies.

## Introduction[*]

**1. Nonbank and market-based finance has experienced spectacular growth since the global financial crisis.** During this period, the share of global financial assets held by nonbank financial intermediaries (NBFIs) has grown from about 40 to nearly 50 percent,[1] in part a consequence of regulatory and supervisory initiatives that have made the banking system more resilient and effectively pushed activities to other segments of the financial system. NBFIs include a broad universe of intermediaries. This chapter focuses on a subset that comprises (1) asset managers, such as open-ended investment funds; (2) insurance companies and pension funds; (3) critical financial market infrastructures, such as central counterparties, and

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[1] Global Monitoring Report on Nonbank Financial Intermediation, Financial Stability Board, 2022.

(4) other NBFIs, such as structured finance vehicles.[2] NBFIs have become vital to the intermediation of core financial markets, such as government and corporate bonds, and are a crucial driver of global capital flows to emerging market and developing economies. These flows bring benefits to recipient countries and higher returns and portfolio diversification for international investors. Recent empirical studies show that NBFIs may also play a role as shock absorbers by providing credit during stress episodes as bank lending to firms declines, although credit availability comes at a higher price (Adrian, Colla, and Shin 2012; Elliott, Meisenzahl, and Peydró 2023).

**2. At the same time, vulnerabilities related to financial leverage, liquidity, and interconnectedness have built up in certain segments of the NBFI ecosystem.** Particularly dangerous is the interaction of poor liquidity with financial leverage: the unwinding of leveraged positions by NBFIs can be made more abrupt by the lack of market liquidity, triggering spirals of asset fire sales and investor runs amid large swings in asset prices. Because dealer banks mostly provide NBFIs with financial leverage, interconnectedness can also become a crucial amplification channel of financial stress. This can generate spillovers to other markets, including core funding markets, as well as to other intermediaries (both banks and NBFIs) and across borders (for example, NBFIs intermediating capital flows to emerging market and developing economies). In addition, the extended period of low interest rates and loose financial conditions after the global financial crisis may have also resulted in NBFIs shifting investments to riskier assets to find higher returns (Kashyap and Stein 2023).

**3. As central banks tighten monetary policy to tackle high inflation, strains in financial markets can pose a challenge for policymakers given the tension between price stability and financial stability objectives.** In a low-inflation environment, central banks can ease monetary or macroprudential policies to respond to financial stress, supporting market sentiment and thus loosening financial conditions. In the current high-inflation environment, given that price stability is the central bank's main objective, the provision of liquidity for financial stability purposes becomes more challenging, including from a communications standpoint, and could undermine the fight against inflation. That is, addressing financial stability risks while pursuing the price stability mandate could introduce a challenging trade-off for central banks, which may require NBFI access to central bank liquidity to tackle financial stress.

**4. The first of two objectives of this chapter is to assess key NBFI vulnerabilities that have the potential to amplify shocks in the context of the ongoing tightening of financial conditions (Table 2.1).** In particular, the analysis focuses on vulnerabilities related to leverage, liquidity, and interconnectedness, as well as on emerging market and developing economy vulnerabilities that stem from NBFI intermediation of cross-border flows. These flows tend to be more sensitive to global financial conditions, thus contributing to the procyclicality of capital flows. To illustrate the interaction of these vulnerabilities, this chapter features NBFI case studies and highlights the challenges related to data gaps in order to assess financial stability risks.

**5. The second objective of this chapter is to examine the central bank policy toolbox**. Central bank policy tools are important at the current juncture given the potential tensions between price stability and financial stability objectives. Policies such as opening central bank liquidity support to NBFIs may mitigate periods of liquidity stress or dislocations in core funding markets. At the same time, they may make achieving price stability complicated while raising moral hazard concerns.[3] This chapter discusses some desirable design features of central bank liquidity support—discretionary marketwide operations, standing liquidity facilities, or lender of last resort—that support NBFIs based on recent observations and some longstanding principles.

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[2] This chapter covers a subset of NBFIs and, given that the NBFI ecosystem is very broad and highly heterogeneous, some institutions and vulnerabilities are inevitably discussed only briefly.

[3] For example, buying sovereign bonds to address dysfunction in that market while raising policy rates and reducing the size of the central bank's balance sheets may create communication and implementation challenges, especially if such measures are prolonged and untargeted.

Because robust regulation and supervision are the first line of defense to address and mitigate the systemic risks emerging from the NBFI sector, the chapter briefly discusses key regulatory and supervisory priorities for NBFIs.[4]

**Table 2.1. Preliminary Assessment of Vulnerabilities of Major NBFIs**

| NBFI (GFA) | Financial Leverage | Liquidity Risk | Interconnectedness | Currency Mismatches |
|---|---|---|---|---|
| Investment funds, excluding money market funds and hedge funds ($58 trillion, 12 percent of GFA) | Low but medium for bond funds with derivative exposures | High for open-end funds holding illiquid emerging market/high yield assets; medium otherwise | High, cross-border spillovers (emerging market and developing economies) and potential links to banks on derivative exposures | Low but significant externalities to foreign exchange market |
| Insurance companies ($40 trillion, 9 percent of GFA) | Low | Low, but medium if subject to policy surrenders | Medium; insurance companies are large holders of bank debt; some exposure to margin calls | Low but medium is subject to policy surrenders |
| Pension funds ($43 trillion, 9 percent of GFA) | Low, medium in jurisdictions with large share of defined benefit schemes | Low, but could be high in some jurisdictions with large share of defined benefits schemes and negative cash flows | Severe data gap does not allow to make any informed assessment here but could be high in some jurisdictions with large share of defined benefits schemes and negative cash flows | Low |
| Money market funds ($8.5 trillion, 2 percent of GFA) | N/A | Low, but medium for prime funds | High; key players in core funding markets | N/A |
| Structured finance vehicles ($6 trillion, 1 percent of GFA) | Medium/high | Medium | Medium: insurance and pension funds can be large investors in structured finance vehicles | Low |
| Hedge funds ($6 trillion, 1 percent of GFA) | Medium/high | Medium; most hedge funds have strengthened liquidity terms | Medium/high | Medium |
| Central counterparties ($0.7 trillion, 0.1 percent of GFA) | N/A | High, but central counterparties have strong risk and financial management controls to reduce such risk | High, given their systemic position across markets | N/A |

Sources: Financial Stability Board; and IMF staff.
Note: GFA = global financial assets; N/A = not applicable; NBFIs = nonbank financial intermediaries.

## NBFIs' Use of Financial Leverage Can Amplify Shocks

**6. Very low rates and asset price volatility since the global financial crisis have incentivized investors and institutions to use financial leverage to boost expected returns**. However, vulnerabilities stemming from leverage can sometimes be unknown to both authorities and market participants because they are difficult to measure or because leverage is hidden (Adrian and Jones 2018). Financial leverage can take many forms, including the use of repurchase agreements, margin borrowing in prime brokerage accounts, synthetic leverage associated with the use of various financial derivatives (such as futures or swaps), and leverage embedded in structured finance vehicles that provide a high amount of market exposure with low initial committed equity or mezzanine capital.[5]

**7. Hedge funds are one type of NBFI that can employ complex or concentrated investment strategies that use leverage.** On the basis of available data, regulators in various jurisdictions are making public certain measures of cash and synthetic leverage used by hedge funds. For example, globally, hedge fund cash leverage (in the form of secured and unsecured borrowing) tends to be modest in aggregate at about 1.8 times net asset value, although some individual funds may have much higher multiples (Figure 2.1, panel 1). However, the use of synthetic leverage through derivatives by hedge funds domiciled in the United States has

[4] The evolving and growing NBFI sector, the associated financial stability risks, and the regulatory challenges remain topics of key importance. The IMF has done considerable work in this area in recent issues of the *Global Financial Stability Report* (such as Chapter 3 of the October 2022 issue on investment funds, Chapter 3 of the April 2022 issue on fintech, Chapter 3 of the October 2019 issue on institutional investors, and Chapter 3 of the April 2015 issue on insurance). On NBFI regulation, some of the recent detailed proposals are Garcia Pascual, Singh, and Surti (2021), Financial Stability Board (2022a and 2022b), and IOSCO (2019).

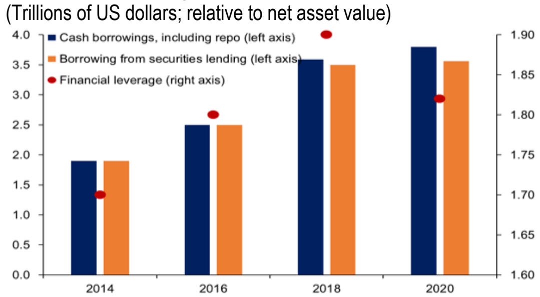
[5] Some transactions can use multiple forms of leverage; for example, collateralized loan obligations can have three layers of leverage: debt issued by sub–investment grade companies, leverage embedded in the collateralized loan obligation vehicle, and the financing on margin of collateralized loan obligation tranches.

increased from 8 times to 14 times net asset value on an asset-weighted basis, with some investment strategies above 20 times net asset value (Figure 2.1, panel 2). More broadly, the ratio of notional amount to gross market value—a proxy for synthetic leverage—suggests that financial institutions (banks and NBFIs) take much more derivatives-based leverage than do dealers and nonfinancial companies (Figure 2.1, panel 3).[6]

**Figure 2.1. Financial Leverage of Nonbank Financial Intermediaries**

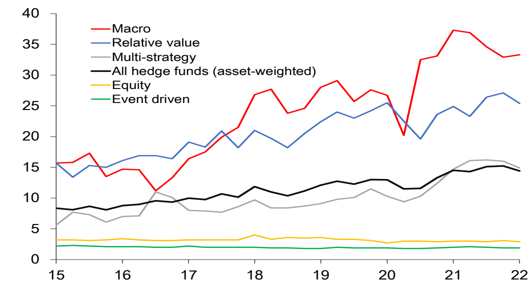
*Global hedge funds' cash leverage is more modest in aggregate compared with the use of synthetic leverage.*

**1. Hedge Funds' Aggregate Secured and Unsecured Borrowing and Financial Leverage**
(Trillions of US dollars; relative to net asset value)



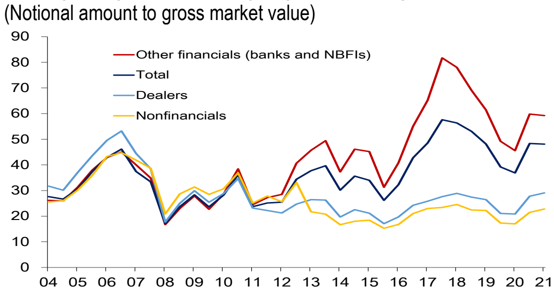

*Hedge funds' synthetic leverage through derivatives has risen and is elevated for some strategies.*

**2. Hedge Funds' Gross Derivative Notional Exposure to Net Asset Value, by Strategy**
(Notional amount to net asset value)



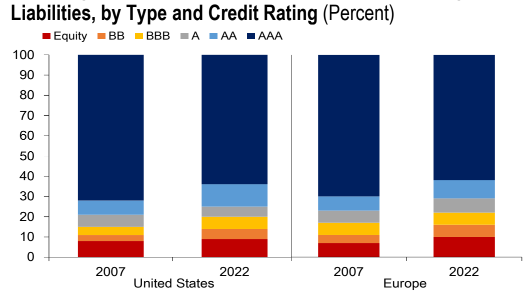

*Other financials, such as banks and nonbank financial intermediaries, take on more leverage than others.*

**3. Proxy for Synthetic Leverage, by Counterparty**
(Notional amount to gross market value)




*New CLOs have a larger equity cushion than those before the global financial crisis.*

**4. Average US and European Collateralized Loan Obligation Liabilities, by Type and Credit Rating** (Percent)




Sources: Bank for International Settlements; Barclays; IOSCO Hedge Fund Survey; US Securities and Exchange Commission; and IMF staff calculations.

Note: In panel 1, financial leverage is from the IOSCO Hedge Fund Survey and is estimated as the ratio of cash borrowed to net asset value. In panel 2, the data are for US-domiciled hedge funds and are provided by the US Securities Exchange Commission in its quarterly private fund statistics. In panel 3, other financials include central counterparties, banks and securities firms, insurance companies, special-purpose vehicles, hedge funds, and other financial customers. Dealers are large commercial and investment banks and securities houses that participate in the interdealer market and/or have an active business with large customers, such as large corporate firms, governments, and nonreporting financial institutions. CLOs = collateralized loan obligations; NBFIs = nonbank financial intermediaries.

**8. The collateralized loan obligation market provides a good example of a securitization vehicle where leverage is layered in the form of underlying assets—leveraged loans to sub–investment grade firms—and embedded in the capital structure through equity and mezzanine debt (rated A and below) below AAA-rated tranches.**[7] Before the global financial crisis, an additional form of leverage was employed by investors through the financing of the AAA tranches. Compared with the structures that prevailed before the global financial crisis, current collateralized loan obligations have less embedded leverage, with a higher share of equity and mezzanine debt as a cushion to protect AAA bond holders, and the practice of financing AAA tranches appears not to be common anymore (Figure 2.1, panel 4).[8]

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[6] Whereas gross leverage is one metric for leverage, using it as the sole metric may be misleading because derivatives are often used for hedging. Other metrics should be considered to supplement gross leverage for a more comprehensive analysis.

[7] Collateralized loan obligations are asset-backed securities issued by a special purpose vehicle (SPV). The SPV acquires a portfolio of leveraged loans, which it finances through the issuance of securities in the form of bonds—senior and mezzanine tranches—and equity.

[8] In addition, whereas the rapid growth of leveraged finance and collateralized loan obligations has parallels to developments in the US subprime mortgage market and CDOs during the run-up to the global financial crisis, there are significant differences such as collateralized loan obligations being less complex and more transparent (see Sirio and Avalos 2019).

**9. Leveraged entities have a higher risk of financial distress, as they are more vulnerable to sudden changes in asset prices that may force them to de-lever, amplifying the initial price declines.** As discussed later in the chapter, it is the combination of poor market liquidity, high leverage, and a high degree of interconnectedness between NBFIs and banks that is most dangerous to the financial system, because it can amplify asset prices changes and spread stress to corners of the financial system that ex ante may seem to have little in common.

## Liquidity Vulnerabilities at Nonbank Financial Intermediaries Catalyze Stress

**10. The NBFI sector encompasses a wide range of institutions**, **some of which typically provide liquidity services to markets and institutions (such as principal trading firms or broker-dealers), while others typically demand liquidity (such as investment funds).** Liquidity stress in the NBFI sector can spill over to the broader financial sector—as could be seen during recent stress episodes such as the March 2020 dash-for-cash episode, or in association with liability-driven investment funds in the United Kingdom—and eventually to the real economy.[9] To be sure, some NBFIs can also be important providers of liquidity at times of stress. For example, Timmer (2018) finds that insurance companies and pension funds act countercyclically, buying securities after large price declines.

**11. Three key liquidity-related vulnerabilities are associated with NBFIs:**

- ***Liquidity mismatches.*** Some NBFIs may hold relatively illiquid assets but allow investors to redeem shares on a daily basis and at a price that does not reflect the liquidation value of the assets. Liquidity mismatches make funds vulnerable to runs because investors have an incentive to redeem ahead of others—which can contribute to volatility in asset markets and threaten financial stability (see Chapter 3 of the October 2022 *Global Financial Stability Report*). Over the past year, the liquidity of open-end funds' holdings has deteriorated to levels last seen at the onset of the COVID-19 pandemic, implying high vulnerabilities of asset markets as a result of liquidity-mismatches (Figure 2.2, panel 1).

- ***Liquidity spirals.*** In combination with financial leverage, a lack of market liquidity can lead to so-called liquidity spirals, where a decline in asset prices leads to a deterioration of funding liquidity, which then spills back to further impair market liquidity (Brunnermeier and Pedersen 2009). Such liquidity spirals are evident in the UK pension fund stress episode, where amid already relatively poor liquidity in UK gilt markets (Figure 2.2, panel 2) margin calls as a result of large losses in derivative positions caused pension funds to sell gilts in a manner that contributed to further illiquidity in that market (see the case study on UK pension fund stress later in this chapter).

- ***Crowded trades.*** Common exposures to assets, in combination with correlated liquidity shocks, can amplify stress events.[10] For example, redemptions can force investment funds to sell assets, which depresses prices and can lead to further sales by other market participants with similar portfolio holdings, amplifying the initial shock. Over the past two years, the portfolios of investments funds have become more similar compared with previous years according to some measures, raising the threat of correlated liquidity shocks among funds (Figure 2.2, panel 3).

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[9] Theory and evidence support the notion that fire sales in securities markets can affect credit supply (Shleifer and Vishny 2010; Diamond and Rajan 2011; Abbassi and others 2016; Irani and others 2020).

[10] Empirical evidence for this mechanism can be found in Greenwood and Thesmar (2011) for equities and in Falato and others (2021) for bond markets.

**Figure 2.2. Risks for the Nonbank Financial Intermediary Sector Are on the Rise**

*Liquidity mismatches in open-end funds have been increasing again…*

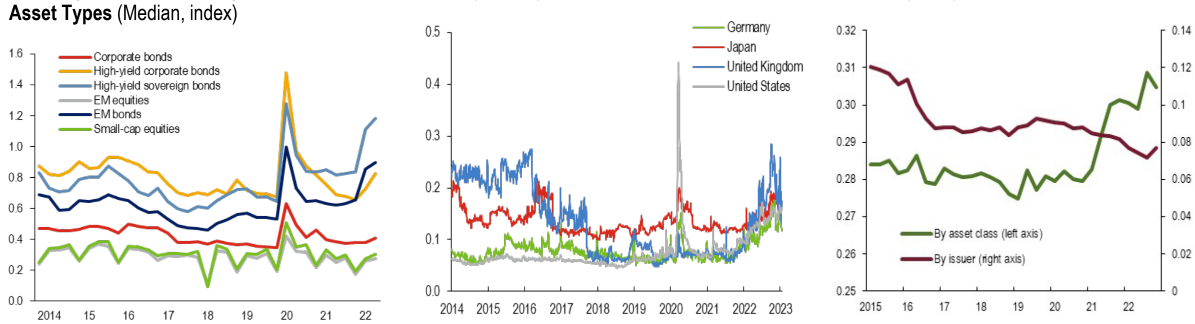
**1. Asset-Level Vulnerability as a Result of Illiquidity of Funds' Holdings, Different Asset Types** (Median, index)

*…against a backdrop of deteriorating market liquidity…*

**2. Median Bid-Ask Spreads, Government Bonds** (Percent)

*…and common holdings across funds' portfolios may be rising.*

**3. Similarity of Global Fixed-Income Fund Portfolios** (Index)




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

Note: Panel 1 shows the evolution of the median asset-level vulnerabilities for different asset classes. The vulnerability measure is constructed based on Jiang and others (2022) and captures the weighted average funds owning an asset, with liquidity defined as the portfolio-level bid-ask spread across funds. See Online Appendix 3.2 of the October 2022 *Global Financial Stability Report* for further details. Panel 2 shows the five-day rolling-window average percentage bid-ask spread of outstanding plain-vanilla, fixed-coupon sovereign bonds issued by Germany, Japan, the United Kingdom, and the United States. Only bonds with maturity longer than one year are considered. Panel 3 shows the average cosine similarity of fixed-income investment fund portfolios over time. Only funds with assets under management larger than $1 billion and with at least 50 percent of portfolio holdings available are considered. Similarity is defined by asset class and by issuer, based on the cosine similarity measure of Girardi and others (2021). Asset classes are equity, investment funds, asset-backed securities, mortgage-backed securities, and bonds by issuer type (sovereign, corporate, financial, agency, municipal) and further classified into high-yield and investment-grade as well as long term (above 10-year maturity) and short term (below three-year maturity). EM = emerging market.

## The Increasing Interconnectedness of Nonbank Finanicial Intermediaries and the Financial System

**12. NBFIs' growing role in domestic financing and cross-border capital flows is a positive feature of an open and integrated financial system.** Having a broader set of financial intermediaries with different risk profiles, specialized expertise and time horizons fosters efficiency and allows for diversification of risks. At the same time, however, increased interconnectedness makes the financial system more complex and can be a source of vulnerability if it becomes a shock amplifier.

**13. Linkages can be within the NBFI ecosystem, whereby an NBFI provides liquidity to or purchases a financial instrument issued by another NBFI.** They can also be between NBFIs and the banking sector, whereby banks and NBFIs have exposures to a common counterparty or asset or NBFIs are financed by banks. Because of these linkages, NBFIs using a high degree of leverage or engaging in liquidity and maturity transformation can amplify or spread financial stress.

**14. Available data show that NBFIs' interconnectedness with the rest of the financial system has increased.** In aggregate, the portion of domestic funding to other financial intermediaries from banks and insurers has declined since the global financial crisis, while funding among NBFIs has increased (Figure 2.3, panel 1).[11] Large data gaps remain, however, with roughly half of aggregate NBFI domestic funding sources unaccounted for. At the same time, banks' cross-border linkages with NBFIs have risen, underscoring the sector's importance in cross-border intermediation (Figure 2.3, panel 2).[12]

**15. NBFIs are playing a larger role in the intermediation of capital flows to emerging market and developing economies.** In the decade between the global financial crisis and the start of the COVID-19 pandemic, emerging market and developing economies benefitted from strong capital inflows. Foreign-

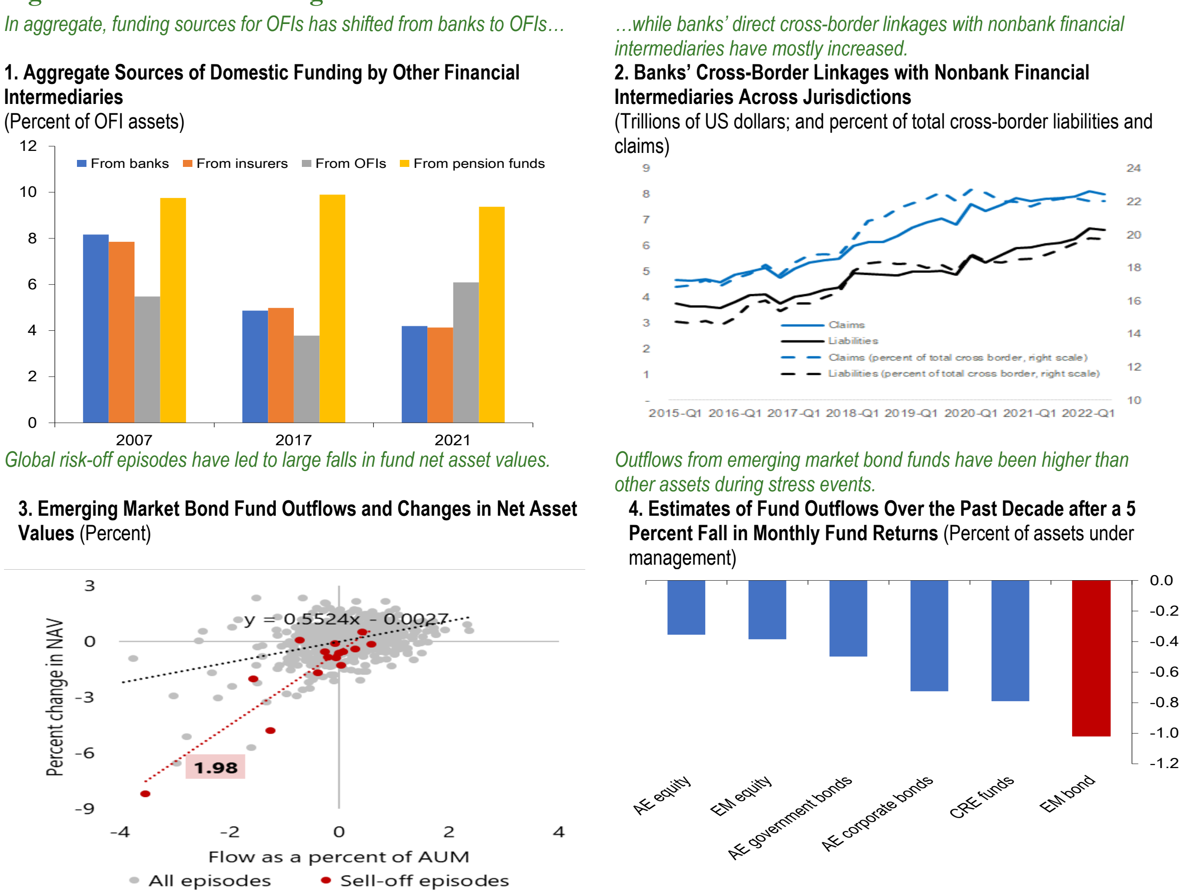
[11] This trend has exceptions, such as the rising exposure of European insurers to higher-yielding bank debt in recent years. See Chapter 1 of the April 2021 *Global Financial Stability Report*.

[12] See Garcia Pascual, Singh and Surti (2021) and Financial Stability Board (2022c).

currency-denominated debt accounts for a significant share, mostly in US dollars, financed through NBFIs such as investment funds, whose assets more than tripled in the decade since the global financial crisis. Although these flows have brought many benefits to the recipient economies and diversified emerging market and developing economy funding sources, they have also contributed to building up vulnerabilities such as higher external debt.

**16. Emerging market and developing economy debt funds tend to experience very large redemptions during risk-off episodes (Figure 2.3, panel 3).** Funds that are either passively managed or that follow benchmark indices appear to play a particularly important role in accentuating the procyclicality of capital flows. The size of outflows from emerging market and developing economy debt funds is generally larger than for other types of funds during stress episodes (Figure 2.3, panel 4).[13] In addition, liquidity mismatches in emerging market and developing economy debt funds—given the medium to low liquidity of most fixed-income assets in these economies—may exacerbate the scale of redemptions under stress market conditions.

**Figure 2.3. Financial Linkages of Nonbank Financial Institutions**




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

Note: In panel 1, OFIs follow the Financial Stability Board's definition and are a subset of the nonbank financial intermediary sector comprising all financial institutions that are not central banks, banks, public financial institutions, insurance corporations, pension funds, or financial auxiliaries (see Financial Stability Board 2022). AE = advanced economy; AUM = assets under management; CRE = commercial real estate; EM = emerging market; OFIs = other financial intermediaries; NAV = net asset value.

[13] Further pressure on outflows can be also related to non–benchmarked investors, and multi-sector bond funds in particular. These unconstrained funds can be a source of spillovers to emerging markets and potentially exert a sizable effect on cross-border flows (Cortes and Sanfilippo 2021).

## Regulatory Data Gaps

**17. Regulatory data gaps for NBFIs are significant, and they inhibit the ability of the regulator to assess and monitor systemic risks.**[14] Although the availability of regulatory data has improved over time, gaps in most NBFIs remain meaningful and uneven among jurisdictions in comparison to the banking sector where data quality and availability are generally adequate. The simple heat map in Table 2.2 provides a qualitative assessment for regulatory data gaps across types of NBFIs and vulnerabilities.

**18. Significant data gaps exist for monitoring the liquidity vulnerabilities of investment, money market, and hedge funds**. Although most regulators require high-level reporting of asset liquidity, data are typically not reported at a sufficient frequency or in detail. Some jurisdictions require rule-based liquidity classification disclosures (most funds in the United States, European Union, as well as alternative investment fund managers), whereas others require reporting on specific factors, such as credit rating, as proxies for liquidity, which are often insufficient for analyzing liquidity risks. The data gap is wider on the liability side: funds often have limited visibility for their investor base because of the complex nature of distribution channels. Where investor data are available, the reporting may not consider arrangements such as notice periods and gates. Differences in methodologies on liquidity metrics also hamper cross-border comparability.[15]

**Table 2.2. Regulatory Data Gaps for NBFIs**

| NBFI<br>(GFA) | Financial Leverage | Liquidity | Interconnectedness | Currency Mismatches |
|---|---|---|---|---|
| Investment funds (excl. MMFs & hedge funds) | | | | |
| Insurance companies ($40 trillion, 9% of GFA) | | | | |
| Pension funds ($43 trillion, 9% of GFA) | | | | |
| Money market funds ($8.5 trillion, 2% of GFA) | N/A | | | N/A |
| Structured finance vehicles ($6 trillion, 1% of GFA) | | | | |
| Hedge funds ($6 trillion, 1% of GFA) | | | | |
| CCPs ($0.7 trillion, 0.1% of GFA) | N/A | | | N/A |

Source: IMF staff elaborations.

Note: This table is to be read jointly with Table 2.1 on NBFI vulnerabilities. Red denotes no/very little data in areas with high or medium/high vulnerabilities; orange denotes no/very little data in areas with low/medium vulnerabilities; yellow denotes some data in select jurisdictions in areas with high or medium/high vulnerabilities; light green denotes some data in select jurisdictions in areas with low or medium vulnerabilities; dark green denotes broadly adequate data irrespective of level of vulnerabilities. CCP = central counterparty; excl. = excluding; GFA = global financial assets; MMF = money market fund; N/A = not applicable; NBFI = nonbank financial intermediary.

**19. Likewise, data gaps are a key hindrance for leverage analysis of investment funds.**[16] The United States and European Union members collect detailed data on leverage metrics for hedge funds, although these data arrive with a significant lag and at a low frequency. Many other jurisdictions, including many emerging market and developing economies, lack a definition of leverage, which also hampers cross-border comparison. Leverage disclosures for investment funds that are not hedge funds are often not detailed enough to allow for assessments of the extent of leverage that is less visible to regulators.

[14] This section focuses only on regulatory data gaps; other gaps such as for public data, investor data, and "available for purchase" data are not covered.

[15] In addition, granular data are scarce for liquidity management tool disclosures, especially for tools such as swing pricing, and are mostly absent for access to credit lines.

[16] In many countries, reporting is subject to a threshold, resulting in industrywide data gaps.

**20. For pension funds, significant data gaps limit the assessment of leverage and liquidity, particularly with regard to the use of derivatives.** Pension funds' use of synthetic leverage through derivatives is often managed by third-party asset managers, making it difficult for regulators to get a precise understanding of the leverage of these funds. In addition, corporate sponsors typically extend commitments to provide extra liquidity to their pension schemes if needed, but details of these commitments are often beyond the required regulatory reporting, thereby making it difficult to analyze sources of liquidity during adverse market events. To hedge their sizable foreign asset positions (OECD, 2021), some pension funds engage in foreign exchange derivative contracts, which are typically over the counter and are difficult for regulators to monitor.[17]

**21. Relatively tight regulations for insurance companies, particularly strict capital requirements, limit the degree to which these companies invest in riskier assets.** These regulations typically require an assessment of a broad range of risks including leverage and foreign exchange risks, which would thereby be included in regulatory reporting. However, as insurance companies make extensive use of third-party investment managers, a detailed and timely examination of the actual underlying risk exposures may not always be feasible. This can obscure synthetic leverage used by investment managers to enhance returns. Also, exposures to illiquid private credit exposures such as collateralized loan obligations can disguise the embedded leverage in these structured products.

**22. Data gaps loom even larger for unregulated or even unregistered types of NBFIs, such as family offices.** Considering the unregulated nature of these entities, regulatory data are practically nonexistent, except in situations where partial data are collected through banks and regulated NBFIs concerning their transactions with such NBFIs. Although not all types of risk are equally relevant for the diverse set of unregulated or unregistered institutions, individual entities can be large and play important roles in specific financial market segments. Wide data gaps make it challenging for regulators and supervisors to gauge the systemic risks that can build up (an example is the family office Archegos, whose outsized equity derivative liabilities in relation to a set of major banks only became visible to regulators after its failure).

**23. Major data gaps exist in the reporting of derivative exposures across NBFIs.** Important details, such as the direction of positions—long versus short—and information about counterparties is often missing in disclosures. For exchange-traded and centrally cleared over-the-counter derivatives, detailed data are available through central counterparties but are highly confidential and, therefore, require robust data-sharing arrangements with the relevant supervisors. Recent over-the-counter derivative-market reforms in the Group of Twenty have helped introduce central clearing requirements for interest rate and credit derivatives across a broad range of advanced and major emerging economies. However, the reforms have generally not extended to foreign exchange and commodity derivatives.[18]

## Four Case Studies of Nonbank Financial Intermediaries

**24. Given the growth in the NBFI sector and the vulnerabilities described, this chapter examines four recent episodes involving NBFIs and markets where NBFI vulnerabilities are building.** The aim is to emphasize the potential for financial leverage, market liquidity, and interconnectedness to interact and cause spillovers in the financial system.

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[17] In some cases, not hedging against currency risks is an explicit part of the investment strategy of pension funds in order to generate additional returns and avoid high costs for hedging currency risks of long-maturity assets.

[18] In some jurisdictions, supervisors have mandated the collection of detailed derivative transaction data across all major types of derivatives (such as through the European Union's European Market Infrastructure Regulation). However, the complexity of processing and analyzing these data and the fact that derivative trading is concentrated in a few jurisdictions (in particular, the United Kingdom, United States, and European Union), limits the use of activity-based data collection to a small number of advanced jurisdictions.

## Case Study 1: UK Pension Fund Stress: Could It Happen Elsewhere?

**25. The UK pension fund and liability-driven investment strategies episode in 2022 is an example of the interplay of leverage, liquidity mismatches, and interconnectedness.**[19] In late September 2022, concerns about the UK fiscal outlook led to a sharp rise in UK gilt yields that, in turn, led to large mark-to-market losses in levered fixed-income positions of defined-benefit pension funds, causing margin and collateral calls. To meet these calls, pension funds were forced to sell gilt securities, pushing gilt yields even higher in a self-fulfilling price dynamic. To prevent risks to financial stability, on September 28, 2022, the Bank of England announced temporary and targeted purchases of long-dated gilts, which was apparently effective in stabilizing gilt yields.

**26. This episode raises the question as to whether a similar stress event could happen in other jurisdictions that have pension funds that use financial leverage.** Pension funds achieve financial leverage by using repurchase agreements and derivatives such as interest rate swaps. Among a global sample of large pension plans that disclose data on derivative exposures, the average ratio of gross notional exposure of derivatives to assets has increased over the past decade, with some pension plans that have significantly increased the use of derivatives (Figure 2.4, panel 1). These pension funds are also active users of repurchase agreements, which can contribute to further increasing financial leverage.[20] Recent surveys also suggest increasing interest in investing in liability-driven investment strategies that use leverage (Figure 2.4, panel 2). Over the past decade, pension funds have also increased their overall prevalence, particularly as a share of global GDP, increasing from 40 to almost 60 percent during 2011–21. Those pension funds using financial leverage could be subject to margin and collateral calls during periods of high market volatility in the future, which given their large footprint might contribute to exacerbate periods of stress in financial markets. As a result, authorities should make sure that those leveraged pension funds have adequate liquidity risk management processes in place to account for large margin and collateral calls.

**27. Despite the similarities between pension plans in the United Kingdom and other jurisdictions, the UK pension fund industry has some unique features that contributed to amplify stress in the 2022 crisis:**

- UK pension plans have less diversified portfolios, with a larger share invested in fixed income. A more diversified portfolio allows funds to better withstand shocks and access liquidity in different asset classes and geographies. UK pension plans also have an elevated share of defined-benefit assets, only behind Japan and The Netherlands among the top seven global pension fund jurisdictions (Figure 2.4, panel 3). Defined-benefit pension funds are generally active users of liability-driven investment strategies to hedge long-dated liabilities. UK funds also have elevated duration risk, compared with other jurisdictions that have significantly shorter duration that results in less price sensitivity to rapid increases in bond yields.
- The UK stress event was exacerbated by the fact that the country's pension plans owned a large share of the gilt market—a share of more than 50 percent of certain long maturities—illustrating the elevated interconnectedness between pension funds and the domestic sovereign and corporate bond markets (Figure 2.4, panel 4). Pension funds in other jurisdictions—particularly The Netherlands and Switzerland—have an even higher share. However, this might be mitigated in those countries because of their lower share of defined-benefit plans and more diversified overall portfolios.[21]

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[19] Liability-driven investment strategies allow pension funds to hedge the interest rate and inflation risk that arises from their long-term liabilities, using leveraged investments to both maintain hedges and to invest in riskier assets to meet their return targets. UK insurers are also users of liability-driven investment strategies, but they were less affected by the events in September 2022 because of a combination of factors including greater expertise in liquidity risk management, lower use of financial leverage, and shorter liabilities.

[20] Repurchase agreements were key contributors that exacerbated the UK liability-driven investment episode in 2022, as the value of collateral pension funds used to borrow in the repo market declined sharply.

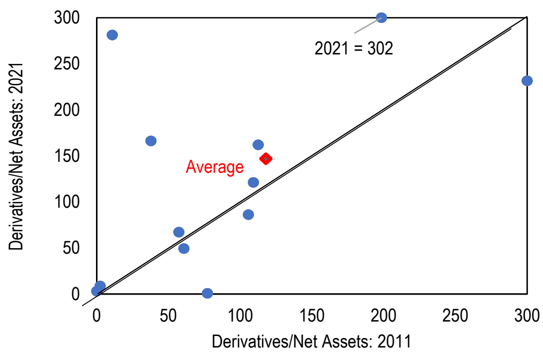
[21] The Netherlands also benefits from being part of the wider and more liquid euro area bond market. In addition, the Dutch pension system may benefit from the existing undergoing reform (to be completed by January 1, 2027) which transitions its defined benefit pension system to a largely defined contribution-style arrangement.

- UK pension funds are also reportedly subject to other jurisdiction-specific factors, which made them more vulnerable. First, UK pension funds rely more on using centrally cleared swaps that only allow for cash to be posted to pay for variation margins. This increases the pressure to sell the most liquid fixed-income holdings—UK gilts, in particular—to access cash in a timely manner. Second, their funds have a sizable share of small- to medium-sized plans that can have more concentrated investment strategies and use pooled liability-driven investment asset management vehicles, making it more challenging for managers of those vehicles to coordinate with plan sponsors to promptly raise cash to pay for margins.

**Figure 2.4. Pension Funds and Financial Stability**

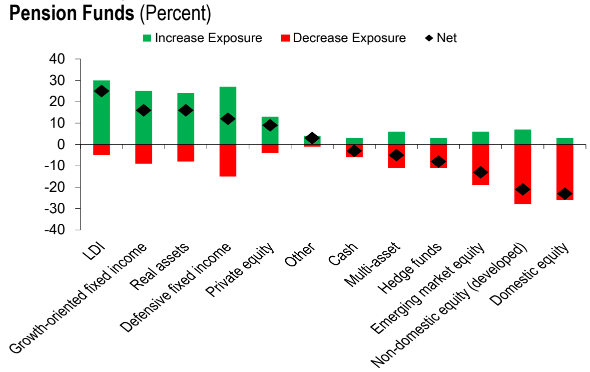
*The financial leverage of selected pension funds has risen over the past decade…*

**1. Financial Leverage of Selected Pension Funds** (Percent)



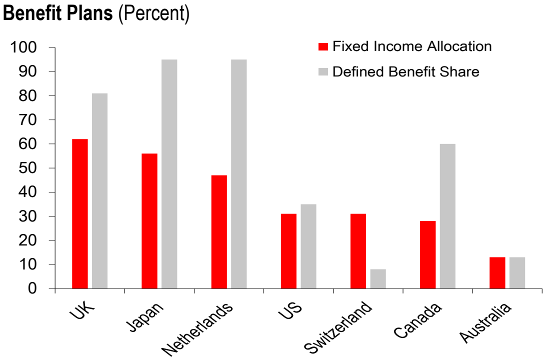

*…while surveys indicated increasing willingness to increase exposure to riskier liability-driven investment strategies.*

**2. 2021 Survey of One-Year-Ahead Asset Allocation Plans of European Pension Funds** (Percent)



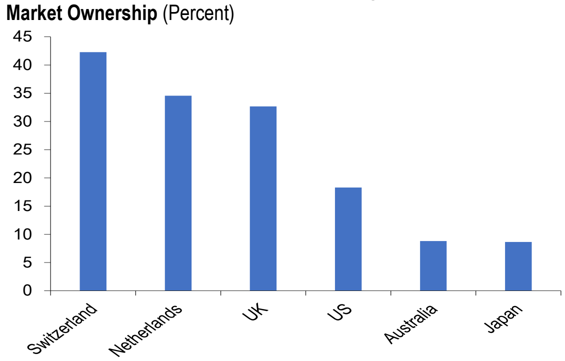

*UK pension funds had less diversified portfolios and an elevated share of defined-benefit plans…*

**3. Pension Fund Fixed-Income Allocation and Share of Defined Benefit Plans** (Percent)




*…and UK pension funds own a sizable share of their domestic sovereign and corporate bond markets.*

**4. Pension Fund Share of Domestic Sovereign and Corporate Bond Market Ownership** (Percent)




Sources: Annual reports of selected pension funds; Bloomberg Finance L.P.; Financial Stability Board; Mercer European Asset Allocation Insights 2021; UK Pension Protection Fund Purple Book; Willis Towers Global Pension Assets Study 2022; and IMF staff calculations.

Note: Panel 1 uses the gross notional exposure of derivatives as a proxy for the financial leverage of pension funds. Note that these funds are also active users of repurchase agreements, which can further increase their financial leverage. This panel includes a sample of 12 pension funds in seven jurisdictions (Canada, Japan, The Netherlands, Norway, Sweden, United States, and United Kingdom) that provide data on derivatives' gross notional exposures in their annual reports. These 12 funds have combined assets under management of more than \$5 trillion, which is almost 10 percent of global pension fund assets. Panel 2 is based on a survey on the European defined-benefit pension industry by Mercer, covering pension funds in 11 jurisdictions. In panel 3, the seven jurisdictions account for more than 90 percent of global pension fund assets. LDI = liability-driven investment.

28. **The rise in bond yields over the past year means that pension plans are in a better position in terms of solvency, given that the gap between the value of their assets and liabilities has improved significantly.** This trend likely ameliorates, but does not eliminate, the vulnerabilities mentioned earlier.

## Case Study 2: Recent Stress in Debt Markets and Project Finance Lenders in Korea

**29. Financial stress emerged in Korea's debt markets in October 2022 amid tightening financial conditions and falling property prices.** The default of a commercial paper issued against real estate project finance loans—a market in which NBFIs such as insurance companies and nonbank credit intermediaries actively participate—set off a broad-based repricing of asset-backed securities, corporate bonds, and short-term notes. Spreads between commercial papers and monetary stabilization bonds—perceived as a risk-free rate—widened to 220 basis points, a level not seen since the global financial crisis (Figure 2.5, panel 1). Corporate bond yields also rose sharply across the board. Complicating matters, the default occurred against the backdrop of increased borrowing needs from both banks—in part owing to the post-pandemic normalization of prudential policy—as well as a state-owned energy firm to cover its operating loss.

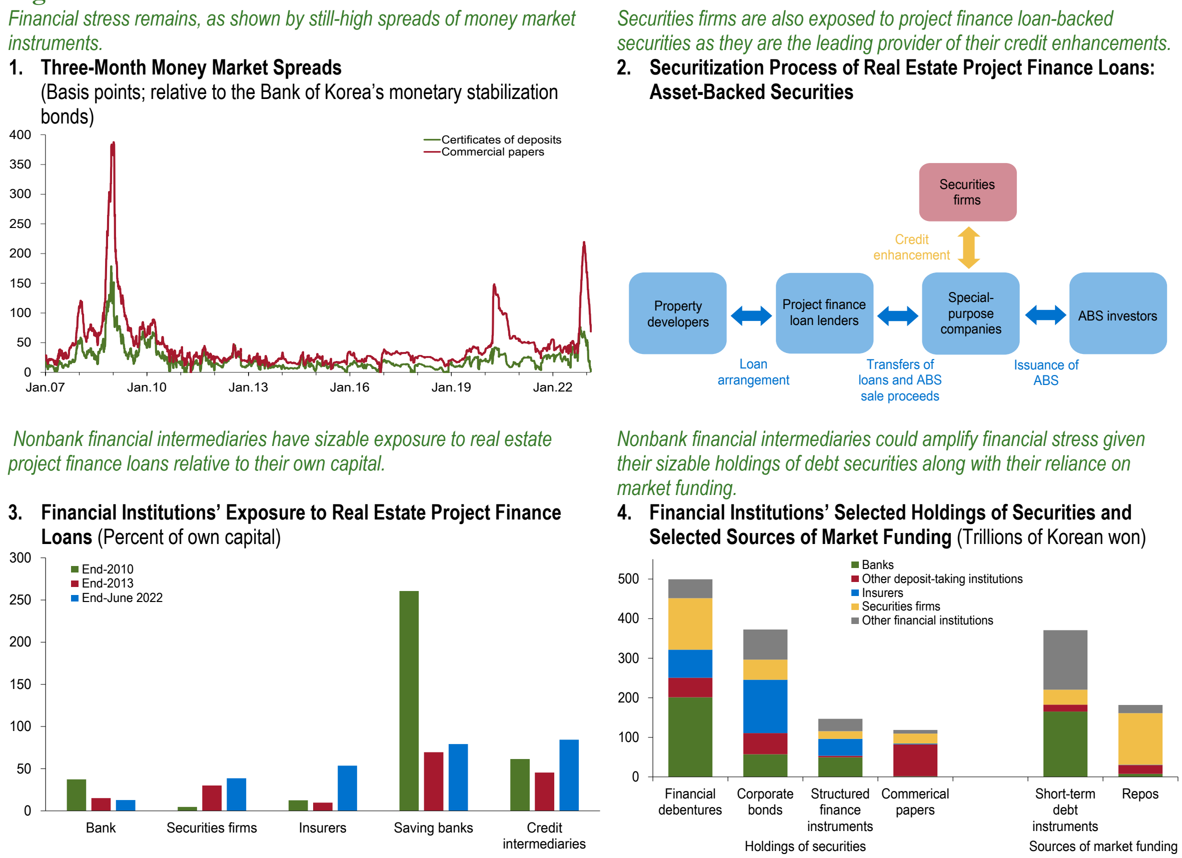
**30. The funding structure of project financing loans in the Korean case appears fragile, as NBFI lenders use high levels of leverage.** These lenders issue short-term asset-backed securities with maturity of up to one year through special-purpose companies to finance longer-term project finance loans with maturity of three to five years (Figure 2.5, panel 2). As of June 2022, outstanding project finance loans amounted to KRW112 trillion (5 percent of GDP). The main NBFI lenders were insurance companies (39 percent) and nonbank credit intermediaries (24 percent).[22] About 35 percent of project finance loans were securitized, and another type of NBFI, securities firms, usually provided substantial credit guarantees to asset-backed securities. The maturity mismatch of these asset-backed securities makes them vulnerable to market sentiment, rising interest rates, and refinancing risk. Although it is unlikely that the delinquency rate for project finance loans will rise to the peak of 2013 (8.2 percent that year), the real estate sector continues to face headwinds, with falling property prices. NBFIs are exposed to these delinquencies because in addition to issuing short-term debt against these loans, they also commit their own capital to them (Figure 2.5, panel 3). More broadly, the debt market stress also revealed vulnerabilities related to NBFIs, which fund their sizable holdings of debt securities with short-term market funding (Figure 2.5, panel 4).

**31. The Korean authorities introduced measures to alleviate systemwide funding stress and ensure that real estate project finance loans are rolled over: asset purchases, provision of liquidity and credit guarantees, relaxation of prudential policy, and use of administrative directives.** Asset purchases, which were carried out largely by major state-owned and private financial institutions, targeted mostly investment-grade corporate bonds and commercial papers (notably, those backed by project finance loans). While continuing to focus on curbing inflation, the Bank of Korea provided additional liquidity to banks by relaxing its collateral rules and to securities firms by using repo transactions. Public financial institutions also provided credit guarantees to support the origination of project finance loans. The normalization of some prudential measures was postponed, and several property-related restrictive regulations were relaxed. Administrative directives were used to reduce bond issuances by banks and state-owned enterprises.

**32. Market stabilization measures have helped ease liquidity stress although some strains linger**. Credit spreads started to narrow in late December 2022 after a purchase of higher-risk asset-backed securities was carried out, and the Bank of Korea provided liquidity to securities firms in an amount larger than initially announced. However, credit spreads remain wide, especially for lower-rated borrowers, reflecting market concerns about a further correction of property markets. Notwithstanding their effects in containing market stress, it is important that support measures remain temporary, with a clear exit strategy, to limit moral hazard concerns and fiscal risks. The authorities should also take proactive actions to manage potential solvency issues related to real estate-related financing.

[22] About 70 percent of project finance loans are originated for residential real estate development.

**Figure 2.5. Recent Financial Stress in Local Debt Markets in Korea**




Sources: Bank of Korea; Bloomberg Finance L.P.; CEIC; and IMF staff calculations.
Note: In panel 4, securitized financial products would appear under structured finance instruments. ABS = asset-backed securities.

## Case Study 3: Commodity-Trading Firms and Financial Stability Risks

**33. Commodity-trading firms are critical intermediaries between the producers and users of key commodities such as agricultural products, fossil fuels, metals, and minerals.** In some cases, they are also important producers of commodities (for example, producers of minerals, fossil fuels, and agricultural products). Inventories constitute a large part of their assets, typically financed by a high level of short-term debt that is largely composed of bank loans (Figure 2.6, panel 1).

**34. The relatively high level of short-term debt can give rise to liquidity risks, especially because large trading firms tend to hold fewer liquid assets than short-term debt (Figure 2.6, panel 2, *x* axis).** In the current environment of tighter financial conditions and relatively high volatility in commodity prices, short-term debt rollovers have become more challenging.[23] Banks may not be as willing to provide large amounts of short-term lending and may view commodity-trading firms as riskier, especially if commodity price fluctuations are higher. Adequate equity ratios (Figure 2.6, panel 2, *y* axis) and prompt sales of existing inventory can mitigate these risks somewhat, provided that market functioning remains orderly.

**35. Commodity trading firms also use commodity derivative contracts to both hedge against price declines (of their large inventories) but also (to a lesser extent) to speculate.** In a volatile market environment, commodity traders can quickly be faced with higher margin requirements, requiring the immediate transfer of liquid assets (in particular, cash) as collateral, as witnessed ahead of the nickel market suspension at the London Metal Exchange in March 2022 (see Box 1.1 in the April 2022 *Global Financial*

[23] See *Financial Times*. 2022. "Trafigura's Finance Chief Warns of Commodity Industry Stress." March 23.

*Stability Report*). During that episode, a number of commodity trading firms cautioned that the liquidity challenges they face may threaten their ability to continue supplying commodities to the economy.

**36. The hidden risks from trading commodity derivatives point to significant regulatory and data gaps.** Even though commodity-trading firms are heavily engaged in complex and risky derivatives trading, they are not subject to the same level of regulation or supervision as financial institutions. In addition, some very large commodity traders (not shown in Figure 2.6) are private companies that are subject only to very limited (or no) public reporting requirements. To the extent that derivative trades happen on exchanges, the corresponding positions can be monitored, but they do not allow market regulators and supervisors to make a holistic assessment of commodity-trading firms' risk exposures. For OTC trades, the scarcity of reported data on commodity derivatives makes it particularly difficult to monitor large risk exposures. These positions can become large enough that a materialization of risks can impact the functioning of a corresponding commodity market on a regulated exchange, as during the nickel market suspension.[24]

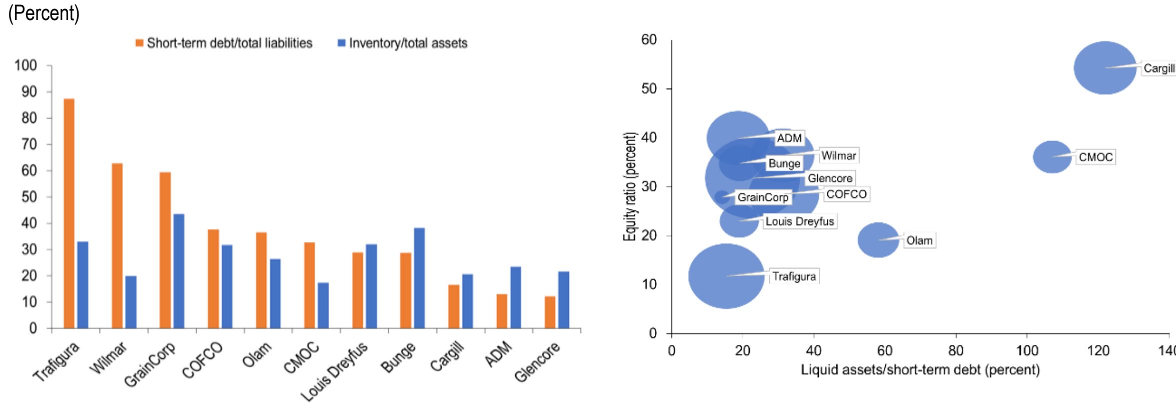
**Figure 2.6. Financial Structure of Commodity Trading Firms**

*Commodity trading firms hold large amounts of inventories often financed by short-term funding…*

**1. Short-Term Debt and Inventories**
(Percent)

*…making them vulnerable to funding shocks and margin calls, despite generally high equity ratios.*

**2. Liquid Asset and Equity Ratios**




Sources: Bloomberg Finance L.P.; S&P Capital IQ; and IMF staff calculations.
Note: Data are as of the third of quarter 2022 or the latest available fiscal year. The panels cover major listed commodity-trading firms for which data are publicly available. Short-term debt comprises all financial debt with a remaining maturity of less than one year. In panel 2, the equity ratio is defined as total equity over total assets. The size of the bubbles indicates firm size, ranging from $4 billion to $140 billion. Liquid assets are cash, cash equivalents, and short-term investments. ADM = Archer-Daniels-Midlands; CMOC = CMOC Group Limited, formerly China Molybdenum; COFCO = China Oil and Foodstuffs Corporation.

## Case Study 4: Vulnerabilities in Private Credit Markets

**37. Private credit refers to the provision of credit by NBFIs to often smaller borrowers through direct lending (about 40 percent) and other structures (Figure 2.7, panel 1).[25]** In terms of size, the private credit market rivals the institutional leveraged loan market, which is driven by large bank syndications. Both markets had approximately $1.4 trillion outstanding in 2022.[26] Some of the vulnerabilities highlighted in this chapter—liquidity mismatches and use of financial leverage—appear to be less prominent in this sector. These vehicles typically do not carry maturity or asset-liability mismatches because investors' capital is locked in for many years, so there is no run risk. They also appear to use limited financial leverage. Banks can provide such leverage as credit lines, collateralized borrowing, and capital call lines.[27] However, interconnectedness is a

[24] As a response, the LME has introduced reporting requirements for OTC derivative positions of its members for a range of metals.

[25] See Block and others (2023).

[26] See the October 2022 *Global Financial Stability Report.* Private credit, provided by dedicated funds, is often referred to as "direct lending" because it is not issued or traded in the public markets and the debt is not originated by regulated bank syndicates. Most private credit is provided as direct lending for private companies that cannot access, or want to circumvent, public markets, or that want certainty of execution and confidentiality.

[27] A "capital call line" is a line of credit typically provided by a bank to a private equity firm that can be used to enhance debt fund returns or to provide bridge financing for limited partnership capital.

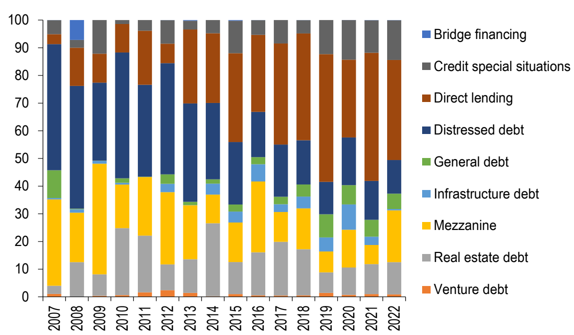
key channel of risk, given that most private credit investors are usually institutional investors in the NBFI ecosystem that could face a capital call ("dry powder") in the event of broader market stress or face losses on their investments (Figure 2.7, panel 2).

**38. Rapid growth of private credit markets may have increased vulnerabilities in the financial system, with potential systemic implications.** Privately financed leveraged buyout transactions with high debt multiples tend to be more vulnerable to economic slowdowns. Competition in private credit has led to deterioration in covenant quality, and managers of private credit deals often finance deals of other managers, which concentrates risk.[28] Lending is largely opaque, driving an accumulation of asset quality performance risks that may be hard for market participants and regulators to discern until it is too late to counteract. In all, private credit is a relatively new asset class, with performance untested in a prolonged economic downturn. If private credit were suddenly restricted in a market stress event, smaller borrowers could face rollover risks if bank financing is unable to handle the new credit demand under current regulations. Because of the low transparency and limited liquidity in private credit markets, spillovers to other markets could occur during a stress episode as investors are forced to sell other assets with more timely mark-to-market pricing and more liquid secondary markets in order to access cash.

**Figure 2.7. Private Credit Markets**

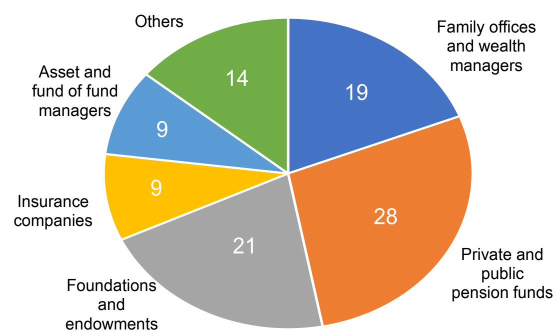
*Direct lending is the main source of private credit financing.*

**1. Share of Private Credit Capital Raised, by Type, 2022:Q3** (Percent)




*Pension funds are the largest investors in private credit vehicles.*

**2. Investors in US Private Credit Funds, 2022** (Percent)




Sources: Goldman Sachs; PitchBook LCD; Preqin; and IMF staff calculations.
Note: Q3 = third quarter.

## Policies to Support Financial Stability in a High-Inflation Environment

**39. The case studies illustrate how NBFI stress often emerges as a result of a combination of vulnerabilities related to elevated financial leverage, liquidity, and interconnectedness.[29]** Under the current high-inflation environment, higher interest rates and tighter financial conditions can interact with these vulnerabilities in the NBFI ecosystem, potentially triggering investor runs and asset fire sales. In such circumstances, central banks may then face a challenging trade-off between safeguarding financial stability and simultaneously maintaining price stability. Consequently, ongoing monitoring and timely identification of vulnerabilities in the NBFI ecosystem is particularly important at this juncture to ameliorate the difficult trade-off between the price stability and financial stability mandates. The appropriate policy response by central banks should account for the emerging vulnerabilities in NBFIs; the monetary policy framework in place; and critically, the supervisory, regulatory, and legal framework of each jurisdiction.

[28] Wiggins, Kaye. 2022. "Selling to Yourself: The Private Equity Groups that Buy Companies They Own." *Financial Times*, June 21.

[29] The Financial Stability Board's 2023 workplan outlines work being taken forward to address NBFI vulnerabilities, with a particular focus on addressing the rise in demand for liquidity in stress periods, but also considering the lack of resilience of liquidity supply in a stress episode.

## Closing Data Gaps, Enhancing Risk Management, and Strengthening Regulation and Supervision

**40. Several key guardrails are essential to safeguard financial stability.** They include (1) closing data gaps to facilitate appropriate and timely risk assessment by market participants (by encouraging market discipline) and supervisory authorities; (2) incentivizing stronger risk management by the NBFIs themselves; (3) implementing adequate and comprehensive regulatory standards; and (4) conducting appropriately resourced and intensive supervisory oversight. With these elements in place, the need for action by central banks should be reduced, or at least limited to tail risks, thereby mitigating the risk of moral hazard.

**41. To carry out adequate supervision and regulation, the availability of reliable and comparable data is a key prerequisite.** Closing data gaps should therefore be a policy priority. Adequate data coverage enables regulators and central banks to analyze risk profiles appropriately and calibrate necessary regulatory approaches.

**42. In terms of robust risk management and regulation to manage the risks from a growing NBFI sector, NBFI entities themselves should improve their risk management to address the vulnerabilities to which they are exposed.** In addition, adequate regulation proportionate to the risks of different types of NBFIs is key moving forward. The heterogeneity of NBFI business models suggests that a one-size-fits-all approach to regulation is not appropriate. NBFIs need to be regulated and supervised from a myriad of different angles. Conduct requirements such as public disclosure are important to support market discipline and price discovery, as are governance requirements to ensure proper risk management, and prudential regulations (such as capital and liquidity management tools) to address quantifiable risks (such as credit, market, and liquidity). Jurisdictions should ensure supervision is adequately intrusive to ensure compliance with all relevant regulatory elements for each sector (see Box 2.1 for a brief overview of NBFI supervisory and regulatory priorities).[30]

## Guidelines for Central Bank Intervention to Provide Liquidity

**43. Central bank intervention should aim to address liquidity and not solvency problems.** The latter should be left to relevant fiscal (or resolution) authorities. Liquidity should be provided to counterparties that are compelled by supervision and regulation to internalize liquidity risk (the "stick") so that central banks may need to intervene only to address systemic liquidity risks (the "carrot"). A significant part of the risk should remain in the marketplace ("partial insurance") to minimize moral hazard. The financial stability intervention should be parsimonious to avoid conflicting with the monetary policy stance, especially in a tightening cycle. This means pricing it to be relatively expensive to avoid attracting opportunistic demand. Finally, central banks should introduce appropriate risk mitigation (for example, haircuts) and agree on loss-sharing with the fiscal authorities[31] to manage risks to their own balance sheet.

**44. What is different about NBFIs, and when should they be eligible for central bank liquidity?** NBFIs were traditionally not at the center of the financial system and credit intermediation compared to banks. Hence, they are usually not central bank counterparties for monetary policy purposes although there have been exceptions (i.e., discount houses in the UK and primary dealers and money market funds in the US). NBFIs have grown to become key financial intermediaries, including in liquidity provision during normal times, as banks have stepped back. Liquidity support to the NBFI sector has been primarily provided through the standard counterparties (banks). Therefore, opening access to central bank liquidity to NBFIs could be necessary if there is a high risk of contagion either to systemically important institutions or markets, or if the sector or entities are important for financial intermediation and credit provision. The challenge is to transpose

[30] For a detailed discussion of policy options for investment funds see Garcia Pascual, Singh and Surti (2021) and Chapter 3 of the October 2022 *Global Financial Stability Report*, as well as Financial Stability Board (2022a and 2022b) and Claessens and Lewrick (2021).

[31] The fiscal authorities commit to underwrite part or all the losses that the central bank may incur because of the liquidity support either by providing guarantees or by setting up a special purpose vehicle. Partial risk sharing could be considered to incentivize prudent program design.

the well-established principles for central bank liquidity provision to NBFIs while addressing the "new" risks appropriately. It is therefore paramount to guarantee that appropriate guardrails are in place, including in terms of NBFI supervision and regulation (Box 2.1).

**45. On lending, the central bank could expand eligible collateral (with appropriate haircuts) and/or expand the counterparty list to add NBFIs if the new counterparties are appropriately regulated and supervised** (see Table 2.3).[32] In practice, NFBIs generally use financial market infrastructures of a given jurisdiction and settle the transactions with their banking agents, which is usually one of the standard counterparties. To improve efficiency during stress periods, eligible counterparts could pre-position collateral at the central bank; this entails placing securities in a central bank account which are then readily available for them to pledge as collateral against any lending operation.

**46. On purchasing, the central bank could broaden the list of counterparties in asset purchase operations to those that are not part of monetary operations.** This should be done as is appropriate to avoid relying on dealer banks' intermediation, and/or expanding the universe of purchased assets.

**47. Regarding the type of central bank interventions, there are three broad categories:** (1) discretionary marketwide operations, (2) standing lending facilities, and (3) discretionary provision through lender of last resort (LOLR) arrangements.

**48. First, discretionary marketwide operations may be required to deal with broad market liquidity stress events.** "Marketwide" refers to asset-purchase and lending operations aimed at re-establishing proper functioning of a market segment (such as government bonds, see Case Study 1), or to cope with stress in a NBFI segment (such as money market funds). "Discretionary" means that the timing and amounts of the operation are decided by the central bank. Lessons from previous stress events highlight that such operations should be (1) temporary, (2) targeted at those segments of the NBFI ecosystem where further market dislocation and disintermediation could have adverse macro-financial stability implications, and (3) designed to restore market functioning while containing moral hazard (King and others 2017). In the past, programs have been "time-bound" if the amount announced is sufficiently large to influence market expectation. Alternatively, the program could be "state-contingent" and "self-liquidate" to facilitate exit once market stress abates.[33] In addition, central banks should guarantee that appropriate risk mitigation measures are in place.

**49. Regarding the timing of discretionary marketwide interventions, early provision of liquidity may be preferable to avoid contagion and lessen solvency risk, although it risks increasing moral hazard.** A framework based on "discretion under constraints" should be in place. This means data-driven metrics should guide the decision to intervene (the constraints), while policymakers ultimately retain the discretion on whether to intervene. The metrics may be based on a heatmap of indicators—such as funding spreads, premium in relation to a risk-free benchmark, margin requirements, trading volumes, bid/offers spreads, and price volatility—with appropriate thresholds. This can be complemented with more sophisticated methods based on forecasts of the short-term distributions of these indicators.[34] The thresholds should ensure that the central bank will contemplate intervening only to respond to extreme tail risks. While these metrics are important guideposts, policymakers' judgment remains crucial in the decision to provide liquidity and ameliorate systemic risk.

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[32] For example, in response to funding pressures during the global financial crisis, the US Federal Reserve established the Primary Dealer Credit Facility, which provided primary dealers (securities dealers licensed and supervised by the Federal Reserve) with committed funding collateralized by investment-grade securities. In other markets (for example, Hungary, India, Korea), central banks expanded term repo operations to NBFIs (for example, mutual funds, insurance companies) to address sectoral liquidity stresses. Collateral swaps are also an effective tool to support a return to market-based activity when markets are hampered by uncertainty about underlying collateral asset value.

[33] State contingent operations involve setting parameters, such as maximum credit spreads, at which the operations are conducted. When credit spreads 'normalize', counterparts resort to market-based transactions and the operation is no longer needed. Self-liquidating operations are operations, that in duration, span the expected period of liquidity stress. Examples include purchases of short-term commercial paper and the provision of short-term funding.

[34] Lafarguette and Veyrune (2021) provide an illustration concerning the foreign exchange market.

**50. Second, access by NBFIs to central banks' standing lending facilities could be granted to reduce the risk of fire sales and spillovers to the financial system.** In contrast with discretionary marketwide operations, standing facilities are permanently available at the initiative of the eligible counterparties.[35] Importantly, the bar for such access should be very high to avoid moral hazard.[36] Central banks should coordinate with NBFI regulators to ensure that the appropriate regulatory and supervisory regimes are in place proportionate to the risk profiles of the different types of NBFIs, some of which may not qualify because of a high-risk profile. The central bank should also charge a sufficiently high rate to discourage recourse to the facility in normal times (IMF 2020).

**51. Third, in case of idiosyncratic (not marketwide) stress at a systemically-important NBFI, central banks should be prepared to act as LOLR.** In some cases, an ex-ante designation of a systemically important NBFI may be in place with accompanying appropriate supervisory and regulatory guardrails (in non-systemic cases, the institution may be left to the relevant resolution/bankruptcy procedures to instill market discipline). General LOLR principles applied to banks or standard counterparties provide the template for responses in such cases. The principles affirm that lending should be at the discretion of the central bank, after exhausting other liquidity support options, only to solvent firms, at a penal rate, fully collateralized, and with more intrusive supervisory oversight (Dobler and others 2016). To compensate for the higher risk taken by the central bank, including possibly because of lower-quality collateral and large exposure, conditions could be imposed on the borrower. These might include conditions on the use of the funds, and conditions that the measures taken should have a clear timeline to reestablish the liquidity of the institutions. Extra attention is also needed to protect the central bank through loss-sharing arrangements with the government. Finally, LOLR may be necessary even when standing lending facilities are available. For example, this may happen if a systemically-important institution has exhausted its eligible collateral, then the LOLR may provide emergency liquidity against lower quality collateral, but with tighter risk-mitigation measures and conditionality.[37]

**52. Transposing LOLR principles to NBFIs is challenging.** Criterion for solvency and viability are not as clearly defined for NBFIs as for banks. LOLR could be provided only to institutions fully in the surveillance perimeter of the central bank, which supposes full information transfer from the NBFI regulators and the enough capacity at the central bank to process this information.

**53. Clear communication is critical**. In the current high-inflation environment, central banks may be perceived as working at cross-purposes during periods of market stress—they may need to provide liquidity to restore financial stability while bringing inflation back to target, both by hiking the policy rates and possibly by shrinking their balance sheets. In these circumstances, central banks should use separate tools aimed at price stability and financial stability, if available. A clear separation of tools may support communication and strengthen the effectiveness of policy action. The communication should clarify the source of the stress, the objectives of the intervention and its modalities, the time horizon of the intervention, if appropriate, and the time and threshold for exit that preferably does not overlap with the timing of monetary policy operations.

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[35] Standing lending facilities are defined here as pre-committed, on-demand, and unlimited short-term funding (see IMF 2018 and Maehle 2020).

[36] NBFIs have been included in the monetary policy framework to improve control of the short-term rate when the list of standard counterparties was too restrictive for efficient monetary policy implementation (for example, money market funds in the United States).

[37] An example of a systemically important NBFI (where idiosyncratic support may be justified) may be a central counterparty that clears a significant proportion of risks in a particular market, or any other NBFIs deemed to be systemic by policymakers because of size, centrality in the financial system, the financial services provided, or other reasons. In particular, the activity of central counterparties are narrowly based, with risks directly tied to the price volatility of collateral, which is mostly observable. Any such support can be predicated on compliance with the relevant Principles of Financial Markets Infrastructures, and on any risk management criteria that the central bank (or other regulator) may have set.

**Table 2.3. Liquidity Frictions: Diagnoses and Potential Responses**

| Nonbank Financial Intermediaries | Risks | Security Types | Central Bank Responses |
|---|---|---|---|
| Nonbank intermediaries | Securities dealers lose access to funding because of uncertainty about:<br>• Counterparty creditworthiness<br>• Collateral values | Sovereign bonds | Collateralized lending (for example, repo): expanded eligibility for counterparties |
| | | Corporate bonds, asset-backed securities | Collateral upgrade (that is, swaps) |
| | | Commercial paper | Asset purchases: expanded counterparties and asset universe |
| | Securities dealers cannot sell assets at reasonable prices | All types of securities | Asset purchases: expanded counterparties and asset universe |
| Investment funds (including money market and hedge funds) | Funds face temporary redemption pressures (liquidity mismatches) | All types of securities | Collateralized lending (for example, repo): expanded eligibility for counterparties |
| | Funds face persistent redemption pressures (liquidity mismatches) | All types of securities | Asset purchases: expanded counterparties and asset universe |
| Pension funds | Funds face early/unexpected redemption | All types of securities | Asset purchases: expanded counterparties and asset universe |
| | Funds face liquidity pressure arising from derivative/valuation | All types of securities | Collateralized lending (for example, repo): Expanded eligibility for counterparties |
| Insurance | Insufficient liquidity buffer/ unexpectedly high pay-off | All types of securities | Asset purchases |
| Central counterparties | Central counterparties lose access to funding (and cannot sell high-quality liquid assets) | High-quality liquid assets | Idiosyncratic (Lender of last resort) |
| Systemic nonbank financial intermediaries regardless of the type | A systemically important (solvent) nonbank financial intermediary loses access to funding | Various, including credit claim | Idiosyncratic (Lender of last resort) |

Source: IMF staff.
Note: The central bank response depends on the nature of the liquidity issue. Collateralized lending would respond in priority to temporary funding pressure while asset purchases would address market illiquidity and liquidity drain with less chance of recovery.

## Crisis Management: A Coordinated Response

54. **Regulatory coordination across sectors and jurisdictions is essential both for identifying risks and managing crisis situations**. Specifically, internationally coordinated reforms can reduce the risks of cross-border spillovers, regulatory arbitrage, and market fragmentation. Most NBFI regulators across sectors have adopted a risk-based supervisory framework that enables interventions to be adequately calibrated to risks and vulnerabilities and that has mechanisms in place to share information with other regulators and central banks. Jurisdictions should ensure that their data-sharing arrangements ensure timely coordination to swiftly identify cross-sectoral risks and determine further action as needed. Most jurisdictions also have contingency and business continuity requirements for their NBFIs that should be monitored as part of regular supervisory activities. However, the Financial Stability Board recently noted that resolution regimes for systemic NBFIs, including central counterparties and insurers, should be strengthened, and that such regimes should be introduced where they do not exist.[38] The Financial Stability Board also identified the need to address obstacles (for example, legal, regulatory, and operational) to cross-border funding in resolution, including the ability to mobilize collateral across borders.

## Cross-Border Considerations

55. **Well-designed policies to address liquidity stresses in NBFIs can have a favorable effect on international spillovers by reducing the procyclicality of cross-border flows and mitigating exchange rate pressures.** This is especially the case in emerging market economies that are exposed to large portfolio flows. To harness the benefits that growing cross-border flows bring to emerging market and developing economies, a combination of both recipient and source country policies is needed (Garcia Pascual, Singh, and Surti 2021). In source countries, such policies include robust regulation of NBFIs and well-designed central

[38] The Financial Stability Board (2022a and 2022b) calls for urgent work to address cross-border resolution challenges in the nonbank sector.

bank interventions. In recipient emerging market and developing economies, the appropriate mix of macro-financial policies is critical and may include foreign exchange intervention, macroprudential, and capital flow measures.[39] Cross-border coordination in the introduction of policy measures would reduce regulatory arbitrage and improve implementation.

### Box 2.1. Regulatory and Supervisory Priorities for Nonbank Financial Intermediaries

Regulators should prioritize periodic comprehensive systemic risk assessments across all nonbank financial intermediaries (NFBIs). Such assessments should include systemwide stress testing as well as stress testing of those NBFI subsectors and markets that pose high systemic risks. Certain vulnerabilities, such as liquidity spirals, crowded trades, and indirect interconnectedness, need additional marketwide assessments, especially for high-risk markets such as derivatives, repo, securities lending, and leveraged loans, among others. A special focus should be placed on interconnectedness, as this vulnerability cannot be assessed using microprudential (financial-institution-level) stress testing.

With respect to liquidity mismatches, the structural resilience of open-ended investment funds should be improved. For funds holding very illiquid assets, the liquidity offered to investors should be calibrated closer to the liquidity of funds' assets. Regulators should also focus on greater, more effective, and consistent use of liquidity management tools (such as swing pricing, antidilution levies, in-kind redemptions, and redemption gates, among others) with suitable implementation guidance (see Chapter 3 of the October 2022 *Global Financial Stability Report*). Where private incentives do not align with financial stability goals, mandating the use of some liquidity management tools or mandating power to the regulators to activate at least some of those tools, in the public interest, may be necessary. Jurisdictions should also improve their ability to assess liquidity mismatches in the investment fund sector, including by closing knowledge gaps on the liability side—what is called "knowing your investor risk profile." Moreover, funds' liquidity risk management practices could be strengthened. Finally, where policy has been agreed already, such as the Financial Stability Board's policy proposals to enhance money market fund resilience, it is important that jurisdictions take steps to implement the agreed reforms.[1]

Regulation should also aim to improve leverage disclosures, risk management, and consistency in measurement and consider leverage caps where appropriate. Data granularity for hedge funds and overall improvement in disclosures for other leveraged funds should be prioritized. For other highly leveraged NBFIs, regulators should consider improved reporting in line with their structure and use of leverage, especially off-balance-sheet and over-the-counter derivatives. At a cross-border level, international standard-setters should lead improvements in cross-border consistency in the measurement of leverage beyond hedge funds. Regulators for lenders/counterparties (for example, banks) should improve risk-management in such entities with respect to their NBFI exposures. The lack of such management was highlighted in the Archegos and UK liability-driven investment cases. In some cases, regulators might consider leverage caps.

Microprudential stress testing for liquidity and leverage risks should be required and improved. Regulators may consider issuing guidance, as appropriate, for a minimum level of stress testing requirements and frequency to improve the overall quality of stress testing in the NBFI sector.

Financial Sector Assessment Programs have repeatedly noted insufficient resourcing of NBFI supervisory authorities coupled with, in some cases, lack of operational independence, both of which hamper supervisory abilities. Robust resources and independence in line with international standards should be a priority. Also, regulators collecting a substantial amount of granular data but lacking the processing and analytical capabilities should focus on building such capacity. Coordination across sectors is key, given the diversity of regulators supervising NBFIs as should be leveraging on financial stability committees for the collection and analysis of information. Cross-border cooperation needs to be strengthened, particularly on data sharing, supervision, and the use of liquidity management tools. Global standard-setting bodies can play a crucial role in this regard.

1 The US Securities and Exchange Commission has consulted on a proposed rule on Money Market Fund reform (see https://www.sec.gov/rules/proposed/2021/ic-34441.pdf). The Bank of England and the Financial Conduct Authority published a Discussion Paper on the Resilience of Money Market Funds (see https://www.fca.org.uk/publication/discussion/dp22-1.pdf) and expect to consult on a set of reforms in 2023.

[39] For information on the IMF's Integrated Policy Framework, see http://www.imf.org/en/Topics/IPF-Integrated-Policy-Framework. For further information on capital flows, see IMF (2022). See also Chapter 3 of the April 2020 *World Economic Outlook*.

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CHAPTER 3

# Geopolitics and Financial Fragmentation: Implications for Macro-Financial Stability

### Chapter 3 at a Glance

- Rising geopolitical tensions among major economies have intensified concerns about global economic and financial fragmentation.
- Financial fragmentation induced by geopolitical tensions could have potentially important implications for global financial stability by affecting the cross-border allocation of capital, international payment systems, and asset prices.
- Geopolitical tensions, proxied by the divergence in the foreign policy orientation of investing and recipient countries, matter significantly for cross-border portfolio allocation. For example, a one standard deviation increase in geopolitical tensions between an investing and a recipient country—equivalent to the diverging voting behavior of the United States and China in the United Nations since 2016—could reduce bilateral cross-border portfolio and bank allocation by about 15 percent.
- An increase in geopolitical tensions with major partner countries could cause a sudden reversal of cross-border capital flows, with the effect being more pronounced for emerging market and developing economies than for advanced economies.
- This could pose macro-financial stability risks by increasing banks' funding costs, reducing their profitability, and lowering their provision of credit to the private sector. These impacts are likely to be disproportionately larger for banks with lower capitalization ratios.
- Greater financial fragmentation stemming from geopolitical tensions could also exacerbate macro-financial volatility in the longer term by reducing international risk diversification opportunities in the face of adverse domestic and external shocks.

**Policy Recommendations**

- Policymakers need to be aware of potential financial stability risks associated with a rise in geopolitical tensions and devote resources to their identification, quantification, management, and mitigation.
- To develop actionable guidelines for supervisors, a systematic approach that employs stress testing and scenario analysis is needed to assess and quantify geopolitical shock transmission to financial institutions.
- Based on the assessments of geopolitical risks, banks and nonbank financial institutions may need to hold adequate capital and liquidity buffers to mitigate the adverse consequences of rising geopolitical risks.
- In the face of rising geopolitical tensions, the adequacy of the global financial safety net needs to be ensured through strong levels of international reserves held by countries, bilateral and regional financial arrangements, and precautionary credit lines from international financial institutions.
- Given the significant risks to global macro-financial stability, countries should make utmost efforts to strengthen engagement and dialogue to diplomatically resolve geopolitical tensions and prevent economic and financial fragmentation.

## Introduction*

1. **Rising geopolitical tensions have intensified concerns about global economic and financial fragmentation.** Geopolitical tensions have increased globally over the past few years amid deteriorating diplomatic ties between the United States and China, and Russia's invasion of Ukraine.[1] This increase is reflected in the growing incidence of geopolitical threats and conflicts, a rise in military spending across economies, and increased disagreement in the voting behavior of the United States and China on foreign policy issues in the United Nations (Figure 3.1). The escalation in geopolitical tensions has raised concerns about greater geoeconomic fragmentation—a policy-driven reversal of economic and financial integration, often

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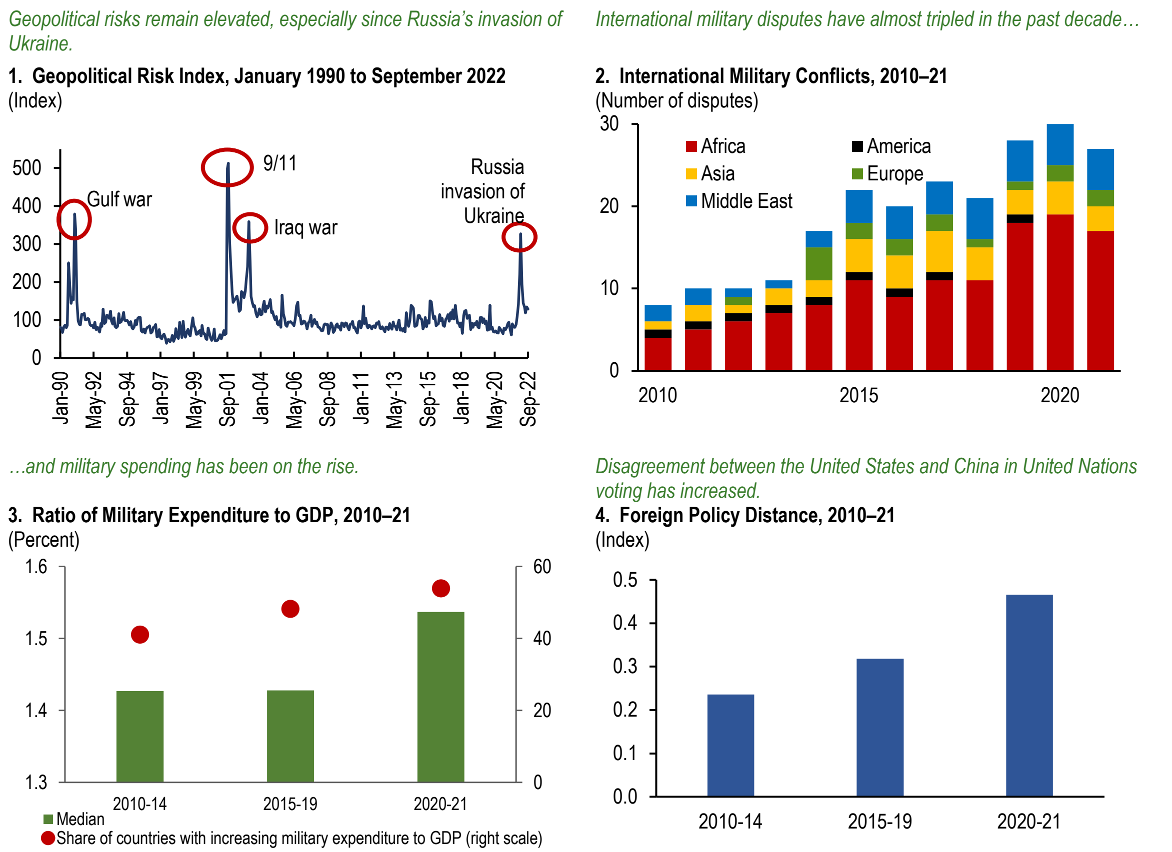
[1] The term "geopolitics" is a multidimensional concept that has traditionally been used to describe the practice of states to control and compete for territory, though in recent decades, power struggles for other reasons (such as trade or politics) and of a diverse set of agents—including corporations, rebel groups, and political parties—have also been considered as part of geopolitics (see Caldara and Iacoviello 2022 and references therein).

guided by strategic considerations (Aiyar and others 2023)—that could be costly for the world economy.[2]

**Figure 3.1. Rise in Global Geopolitical Tensions**



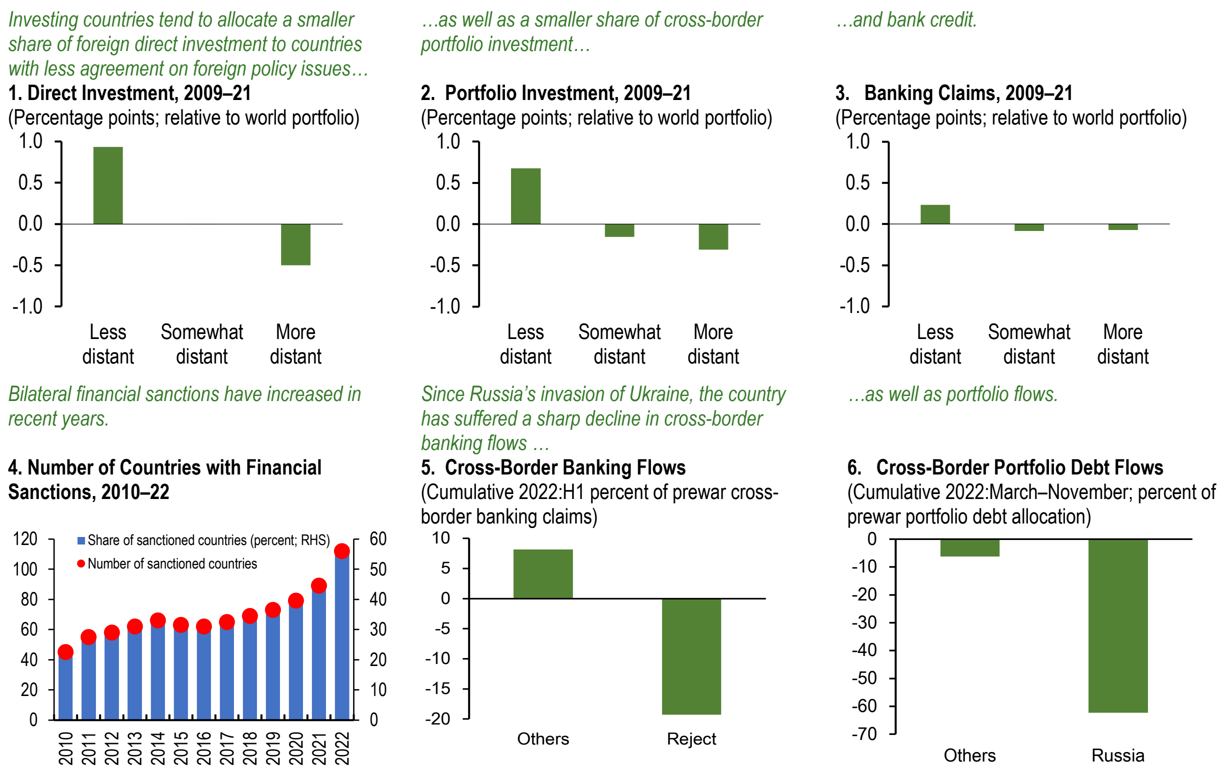

Sources: Caldara and Iacoviello (2022); Häge (2011); The Uppsala Conflict Data Program; SIPRI Military Expenditure Database; and IMF staff calculations.
Note: Panel 1 shows the news-based geopolitical risk index computed by Caldara and Iacoviello (2022), which is defined as the "threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political factors that affect the peaceful course of international relations." The index is normalized to be equal to 100 on average for the 1985–2019 period. Panel 2 is based on data from the Uppsala Conflict Data Program, where international military conflicts are defined as a contested incompatibility (resulting in at least 25 battle-related deaths in one calendar year) between (1) two or more governments (interstate); (2) a government and a nongovernmental party where the government side, the opposing side, or both sides, receive troop support from other governments (internationalized intrastate); and (3) a state and a nonstate group outside its own territory, where the government side is fighting to retain control of a territory outside the state system (extrasystemic). Conflicts between a government and a nongovernmental party with no interference from other countries are excluded from the sample. Panel 3 plots the median military spending to GDP across all countries in the sample, and the share of countries in the sample with an increase in this ratio, averaged over the indicated time periods. Panel 4 plots the average disagreement in foreign policy between the United States and China based on their voting patterns in the UN General Assembly (Häge 2011), with values standardized from –1 (less disagreement) to 1 (more disagreement). See Online Annex 3.1 for more details on data sources and variables. SIPRI = Stockholm International Peace Research Institute.

2. **Geopolitical factors may already be influencing the global economic and financial landscape.** Several studies document that geopolitical factors matter for international trade linkages and that global trade has declined in recent years after major countries imposed new restrictions on the exchange of goods and services (see Fisman and others 2022, Góes and Bekkers 2023, and the October 2022 *Regional Economic Outlook: Asia and Pacific*). Geopolitical relationships also seem to matter for allocating cross-border capital, with investors generally allocating a smaller share of capital to recipient countries with more distant foreign policy

[2] An escalation of geopolitical tensions could lead to countries imposing policy measures that restrict the cross-border flow of goods and services, capital, labor, and technologies with rival countries, resulting in increased fragmentation across countries. Such fragmentation may entail strategic advantages for individual countries but is likely to impose significant economic costs in the aggregate (Aiyar and others 2023).

outlooks to their country of origin (Figure 3.2, panels 1–3; April 2023 *World Economic Outlook*).[3] Moreover, as geopolitical tensions have risen in recent years, restrictions on cross-border capital flows have also increased (Figure 3.2, panel 4), with apparent implications for international capital allocation.[4] For example, after Russia's invasion of Ukraine and the subsequent sanctions imposed by the United States and European Union on Russia, cross-border banking and portfolio debt flows to Russia and its allies (countries that rejected the motion in the United Nations in March 2022 to condemn Russia's war on Ukraine) have reversed sharply, with allocations falling by about 20 and 60 percent relative to prewar levels, respectively (Figure 3.2, panels 5 and 6).

**Figure 3.2. Geopolitical Tensions and Global Financial Fragmentation**




Sources: Bank for International Settlements, Locational Banking Statistics; FinFlows; Global Financial Sanctions Database; Institute of International Finance, Capital Flows Tracker; ; IMF, Coordinated Portfolio Investment Survey; IMF, Coordinated Direct Investment Survey; and IMF staff calculations.
Note: Panels 1–3 show the average share of bilateral cross-border financial assets allocated to a recipient country by a source country, in excess of the total cross-border financial assets allocated to the recipient country by all source countries. The latter adjustment is made to account for the different economic sizes of recipient countries. The averages are taken over the indicated years for different ranges of the bilateral foreign policy distance measure, with less, somewhat, and more distant indicating country-pairs in the bottom, middle, and top third of the sample distribution of the distance measure. Panel 4 indicates the number of countries with financial sanctions (dots) and the share of countries with financial sanctions in the sample (bars). Panel 5 shows the sum of cross-border banking flows over the first and second quarters of 2022 to countries that "rejected" the motion to condemn Russia's invasion of Ukraine (including Belarus, Eritrea, North Korea, Russia, and Syria) in the UN General Assembly meeting of March 2, 2022, and all others that did not reject the motion (that is, those that were "absent" or voted "abstain" and "accept" on the motion; excluding Ukraine), in percent of total cross-border claims of these groups in the fourth quarter of 2021. Panel 6 indicates the sum of portfolio debt flows to Russia and all other countries (excluding Ukraine) that did not vote to reject the motion after the onset of the war (March through November 2022) in percent of their prewar (February 2022) portfolio debt allocation.

**3. An increase in geopolitical tensions could have adverse implications for macro-financial stability.** Imposing financial restrictions, or increased uncertainty and risk aversion

[3] The similarity in foreign policy outlook is captured by the agreement in voting behavior of the investor and recipient countries in the UN General Assembly; see Online Annex 3.2 for details. The trends reported in Figure 3.2 (panels 1–3) are supported by Kempf and others (2022), who show that US-domiciled investors invest less in countries with ideologically distant governments.
[4] The sharp increase in the number of sanctioned countries in 2022 reflects the financial sanctions imposed by Russia on the European Union. The increase in financial sanctions across countries has been accompanied by a rise in other types of sanctions in recent years, notably trade sanctions (see Online Annex Figure 3.2.2).

generated by geopolitical tensions, could exacerbate global financial fragmentation as international investors reallocate investment portfolios and credit lines away from geopolitically more distant countries.[5] This could trigger a sharp reversal of capital flows and a decline in asset prices, with associated consequences for macro-financial stability.[6] Beyond these near-term effects, increased financial fragmentation may make countries more vulnerable to adverse domestic and external shocks by reducing opportunities to diversify risk, thereby raising the likelihood of systemic financial crisis in the longer term as well.

**4. The financial effect of a rise in geopolitical tensions may not be uniform across countries.** Countries are likely to be affected more if tensions escalate with their major economic and financial partners.[7] Economies with less developed financial systems or inadequate external buffers may also be more vulnerable to geopolitical shocks because of their limited capacity to absorb the adverse consequences of such shocks.

**5. Against this backdrop, this chapter examines the role of geopolitical factors as drivers of financial fragmentation and the associated financial stability risks**. The chapter begins by laying out a simple conceptual framework to discuss the main channels through which geopolitical tensions could lead to financial fragmentation and threaten macro-financial stability. It then uses a sample of advanced economies and emerging market and developing economies over the past two decades to review global financial developments and empirically analyze three key questions. First, do geopolitical factors influence the cross-border allocation of capital? Second, do geopolitical shocks, and the financial fragmentation driven by those shocks, affect macro-financial stability as proxied by the profitability, solvency, and lending behavior of banks? And third, does financial fragmentation make countries more vulnerable to adverse shocks by reducing their international risk diversification opportunities?[8]

**6. To capture geopolitical factors, the empirical analysis primarily relies on a commonly used measure of "geopolitical distance" between countries obtained from Häge (2011).** This measure reflects the divergence in countries' voting behavior in the UN General Assembly, such that countries with more dissimilar voting patterns are deemed more geopolitically distant.[9] The sensitivity of the results is examined using alternative measures based on the UN voting behavior from Häge (2011) and Bailey, Strezhnev, and Voeten (2017), as well as other proxies, such as bilateral financial sanctions and arms trade.[10]

## How Geopolitical Tensions Can Affect Financial Stability: A Conceptual Framework

**7. Geopolitical tensions could lead to financial instability through two key channels.** The first is directly through a financial channel triggered by restrictions placed on capital flows

[5] In principle, financial systems may already be fragmented to some extent because of regulatory differences, technological and natural barriers, market forces, trade and capital account policies, and taxation (Claessens 2019). Geopolitical factors could be an important contributor to financial fragmentation through the imposition of trade and capital account restrictions or an increase in uncertainty.
[6] As discussed later, the effect on capital flows, asset prices, and macro-financial stability could be amplified by restrictions imposed on trade and technology, and by supply-chain and commodity-market disruptions. While in principle the impact of a sudden disruption in financial ties with one country (or a group of countries) could be mitigated if the countries that are more similar geopolitically increase their portfolio allocation to the affected economy, in practice such reallocations may take some time to materialize, leading to financial stress in the affected economy, particularly in the short run.
[7] Countries may also be affected indirectly if their major trade and financial partners are involved in a geopolitical conflict with another country through cross-border macro-financial spillovers, or financial contagion. This chapter focuses on the direct effect of geopolitical tensions with partner countries.
[8] See Online Annex 3.1 for the list of countries in the sample. The exact sample composition varies across analyses based on data availability.
[9] This measure is based on the "S" measure in Signorino and Ritter (1999) and calculates the distance metric as the sum of squared deviations in the UN votes. See Online Annex 3.2 for further details.
[10] The various geopolitical measures considered in this chapter are strongly positively correlated. For example, the correlation between the geopolitical distance measures obtained from Häge (2011) and Bailey, Strezhnev, and Voeten (2017) range from 0.6 to 0.9. Similarly, the likelihood of imposing financial sanctions is significantly higher in relation to countries that are more geopolitically distant. See Online Annex 3.2 for further details.

and payments (such as capital controls, financial sanctions, and international asset freezing) or through an increase in uncertainty and investors' risk aversion to future restrictions, the escalation of conflict, or expropriations (Figure 3.3). These factors could affect cross-border capital allocation and lead to financial fragmentation, as well as to a decline in asset prices, as investors and lenders may adjust portfolio investment allocations and cut cross-border credit lines to the rival country (or group of countries).[11] If capital is suddenly reallocated, it could generate liquidity and solvency stress in the financial and nonfinancial sectors by increasing funding costs or debt rollover risk and by reducing asset values and overall profitability, thereby threatening macro-financial stability.[12,13]

**8. The effects of the financial channel on financial stability could be exacerbated through a real channel.** An increase in geopolitical tensions could also affect financial instability indirectly through a real channel triggered by restrictions on international trade and technology transfer, and by disruptions to supply chains and commodity markets. This outcome could adversely affect international trade and economic growth and generate inflationary pressures. These factors could, in turn, adversely affect the liquidity and profitability of nonfinancial corporations, generating credit risks for banks and undermining macro-financial stability.

**9. These financial and real channels are likely to be mutually reinforcing.** Adverse feedback loops between the financial and real channels could arise if, for example, restrictions on international trade were to reduce economic output, which would discourage cross-border investment and further weaken economic activity and trade interlinkages.[14] Similarly, physical commodity market disruptions caused by a spike in geopolitical tensions could lead to higher inflation, warranting a tightening of monetary policy that could dampen asset prices and raise borrowing costs for nonfinancial firms, posing financial stability risks.

**10. Financial fragmentation induced by geopolitical tensions could also increase the vulnerability of economies to adverse shocks by limiting the diversification of cross-border exposures.** Beyond the near-term effect of a reallocation of cross-border capital on macro-financial stability discussed earlier, financial fragmentation could increase the volatility of capital flows in the longer term by limiting the possibilities for international risk diversification.[15] The higher volatility of capital flows could, in turn, lead to greater volatility in domestic financial markets, making financial systems more susceptible to shocks and prone to crisis.[16]

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[11] See Coeurdacier, Kollmann, and Martin (2010) and Okawa and van Wincoop (2012) for more general theoretical frameworks on the effects of cross-border frictions and transaction costs on international asset and liability portfolios.

[12] A large body of literature shows that sharp and sudden reversals in cross-border capital flows are associated with financial crises, particularly in emerging market and developing economies (Ghosh, Ostry, and Qureshi 2017; Reinhart and Rogoff 2009). Focusing on geopolitical risks, Phan, Tran, and Iyke (2022) show that banking stability declines as such risks increase, while several studies (Jung, Lee, and Lee 2021, Ghasseminejad and Jahan-Parvar 2020, Salisu and others 2022) find that an increase in geopolitical risks is associated with a decline in stock returns and increased market volatility. Gurvich and Prilepskiy (2015) show that financial sanctions imposed by Western countries on Russia after its annexation of Crimea in 2014 had a significant impact on foreign funding and output.

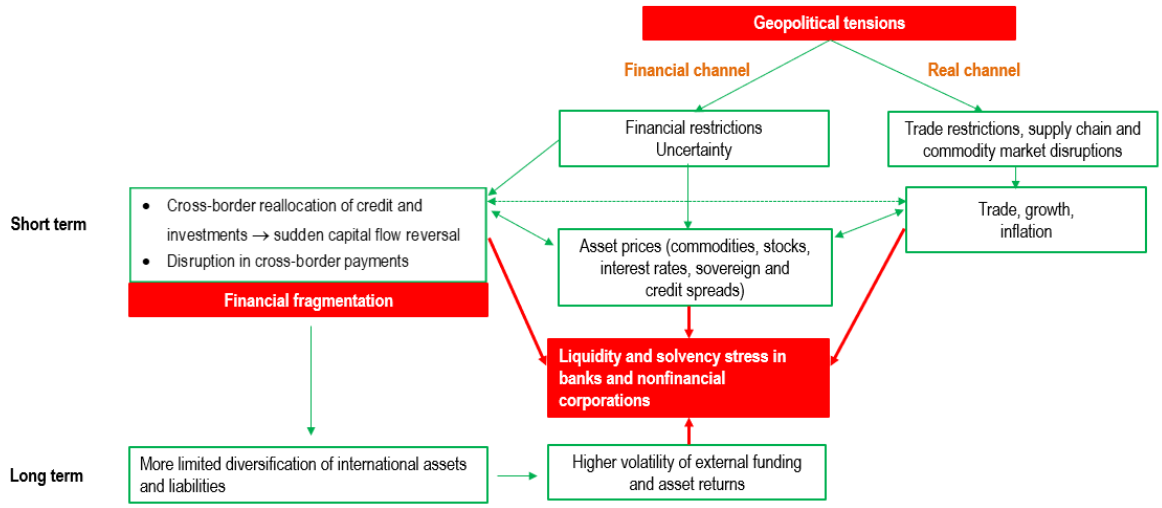
[13] A reversal in foreign direct investment as a result of geopolitical tensions could lead to the closure of factories and stores, reducing economic growth and hurting employment directly (Busse and Hefeker 2007; April 2023 *World Economic Outlook*).

[14] Several studies establish a strong interrelationship between cross-border financial and trade linkages (Cavallo and Frankel 2008).

[15] Financial fragmentation could also increase the volatility of capital flows in emerging market and developing economies by limiting their financial deepening and development, thereby weakening their capacity to absorb shocks.

[16] While greater financial integration can also expose countries to external shocks and increase the volatility of capital flows, such risks could be mitigated through appropriate policy frameworks (Ghosh, Ostry, and Qureshi 2017; IMF 2020; see also Chapter 2 of the April 2023 *Global Financial Stability Report*). Moreover, several types of capital flows such as foreign direct investment and portfolio equity flows are potentially less destabilizing and can help smooth consumption and finance productive investment.

**Figure 3.3. Key Channels of Transmission of Geopolitical Tensions and Macro-Financial Stability**




Source: IMF staff.
Note: The figure shows the two key channels of transmission, financial and real, through which geopolitical tensions could contribute to financial fragmentation and exacerbate macro-financial stability risks. In addition to these channels, macro-financial stability could also be affected if geopolitical tensions increase cybersecurity risks, compliance, legal and reputational risks for entities, risks associated with money laundering and financing of terrorism, or climate-related risks because of lack of international coordination to mitigate climate change.

**11. The effects of geopolitical tensions and financial fragmentation depend on country characteristics.** The effect of geopolitical tensions on macro-financial stability could be highly asymmetric depending on country characteristics such as financial interconnectedness, level of financial development, and the size of available external buffers to help cushion the effect of a sudden reallocation of foreign capital. Countries whose currencies are commonly held as international reserves may also over time face a shift in the preferences of foreign official investors (such as central banks) toward reserve assets of geopolitically more aligned countries, with potentially destabilizing effects on financial markets (Aiyar and others 2023).[17] In some cases, the adverse consequences of financial fragmentation induced by geopolitical tensions may be mitigated if it helps to ensure greater continuity in the availability of external finance as countries move away from less predictable financing from geopolitically distant countries to potentially more stable financing from geopolitically aligned countries.

**12. The macro-financial effect of geopolitical tensions could spill over to other countries not directly involved in conflicts.** The effects of geopolitical tensions could reverberate across borders to major trading and financial partners, posing a risk to global financial stability through, for example, losses at financial institutions, withdrawal of credit lines, decline in asset prices, high inflation, or a slowdown in economic activity as a result of disruptions to cross-border trade and supply chains (Chițu and others 2022).[18] The cross-border spillover effects are likely to be larger if geopolitical tensions involve major, globally integrated economies, rather than smaller economies with more localized trade and financial interlinkages. While some "neutral" countries may be able to take advantage of the global re-allocation of

[17] Central banks may reshuffle their portfolios, fearing that geopolitically motivated asset freezing—or other administrative measures—could restrict access to reserve assets. The reserve composition may also change naturally if, as a result of an increase in geopolitical tensions, countries start to trade more with geopolitically aligned countries, invoicing in national currencies. See Aiyar and others (2023) for a more detailed discussion on the implications of geoeconomic fragmentation for the composition of global reserves.
[18] History offers examples of severe cross-border financial contagion triggered by geopolitical conflicts. For example, after the rise in geopolitical tensions that precipitated World War I, British banks that were at the center of the global financial network faced defaults from German counterparts and liquidity constraints. In trying to restore their liquidity positions, British banks cut credit lines to counterparties in the United States, which was not yet involved in the conflict (Ferguson 2008).

capital resulting from increased geopolitical tensions between major economies by attracting new foreign capital, the beneficial effects of such capital are likely to depend on their absorptive capacity and the policy framework in place to manage large capital inflows.

13. **Geopolitical tensions could affect financial stability through several other channels**. Nontraditional risks such as cybersecurity risks may increase as a result of geopolitical tensions, threatening macro-financial stability.[19] Geopolitical tensions and financial fragmentation may also split commodity markets along geopolitical lines and make it more difficult to address climate change, which requires international cooperation to set country-level greenhouse gas reduction commitments, as well as deeper global financial integration to support the needed investments to mitigate and adapt to climate change (Rajan 2022, Aiyar and others 2023). This might increase the risk of a disorderly climate transition that could magnify the risks to financial systems (see Chapter 5 of the April 2020 *Global Financial Stability Report* and Chapter 3 of the October 2021 *Global Financial Stability Report*). Furthermore, addressing the external debt problems of many countries after the COVID-19 pandemic requires cooperation among stakeholders, without which both creditor and borrower countries may suffer significant losses (Gaspar and Pazarbasioglu 2022).

14. **This chapter focuses on the direct financial channel of transmission of geopolitical tensions.** In what follows, the chapter documents how cross-border financial relationships have evolved over the past few decades to gauge any emerging signs of increasing fragmentation along geopolitical alignments. It then more formally assesses the role played by geopolitical factors in determining cross-border financial interlinkages and their implications for macro-financial stability.

## The Changing Global Financial Landscape

15. **Global financial integration increased sharply in the run-up to the global financial crisis, but the momentum has slowed since then.** Total external financial assets and liabilities expanded rapidly in the 1990s and through most of the 2000s as cross-border capital flows surged in both advanced economies and emerging market and developing economies amid declining capital account restrictions (Figure 3.4). This trend reversed at the start of the global financial crisis, when cross-border capital flows to many countries declined sharply. It has slowed down since then as capital flows relative to output have been well below their precrisis peak in advanced economies and in emerging market and developing economies.

16. **Several factors may explain the decline in cross-border capital flows, including increasing capital account restrictions across countries.** The reduced cross-border capital movements since the global financial crisis are largely the result of a decline in banking flows triggered by a retrenchment of global banks from foreign jurisdictions (Lane and Milesi-Ferretti 2018). However, other factors such as official restrictions increasingly imposed on capital flows may also have played a role (Figure 3.4, panel 3).[20] Capital account restrictions on both capital inflows and outflows have increased notably since the global financial crisis and are now almost

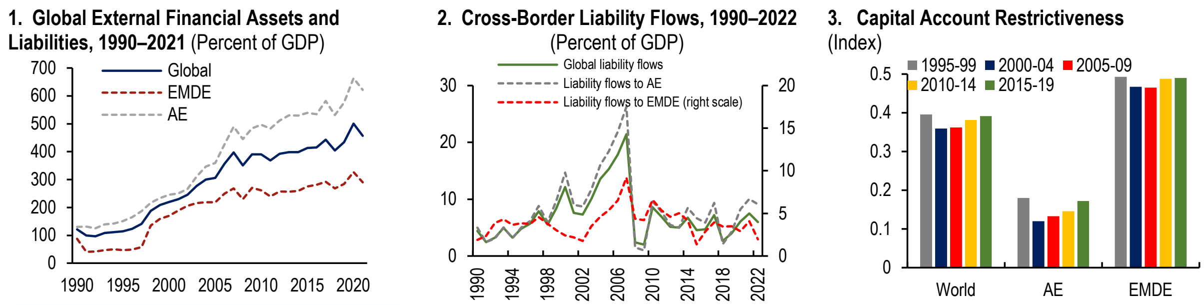
[19] Other nontraditional risks may include compliance, legal, and reputational risks for financial institutions as well as risks associated with money laundering and financing terrorism.

[20] Global banks may have retreated from international lending activity for a range of factors such as new capital and liquidity regulations being imposed on banks after the global financial crisis, foreign country risk being reappraised, and ultra-loose monetary policy and low interest rates that encouraged the growth of nonbank financial intermediation (Avdjiev and others 2020, Rankin, James, and McLoughlin 2014). Cross-border capital flows may have also declined because of correspondent banking relationships being reduced, particularly in developing economies (Rice, von Peter, and Boar 2020).

as prevalent as the levels observed in the early 1990s in both advanced economies and emerging market and developing economies.[21]

**Figure 3.4. Developments in Global Financial Integration**

*Cross-border external positions expanded sharply in the 1990s, but the momentum has slowed since the global financial crisis…* *…as capital flows have declined…* *…amid increasing capital account restrictions*




Sources: External Wealth of Nations database; Fernández and others (2016); IMF, Balance of Payments Statistics; and IMF staff calculations.
Note: Panel 1 indicates the sum of the total stock of external assets and liabilities for all countries (global), AE, and EMDE as a percentage of the sum of their respective GDPs. Panel 2 indicates the sum of total liability flows (positive values indicate nonresident capital inflows) for all countries, AE, and EMDE as a percentage of the sum of their respective GDPs. Panel 3 indicates the average capital account restrictiveness for all countries, AE, and EMDE over the indicated time periods, following Fernández and others (2016), with higher values indicating greater restrictiveness. AE = advanced economy; EMDE = emerging market and developing economy.

17. **Despite the shifts in cross-border capital flows, the United States dominates in global financial markets, although the importance of China has increased.** The share of the United States in global debt and portfolio equity investment has remained broadly constant over the past few decades, although its share in foreign direct investment has declined (Online Annex Figure 3.3.1). Concurrently, China and several international financial centers (such as Ireland and Luxembourg) have grown in importance in the global financial system, with a notable increase in their holdings of external assets.

18. **Overall, bilateral financial interlinkages appear to have weakened in recent years, with cross-border investment becoming more concentrated in fewer partner countries.** Both advanced economies and emerging market and developing economies tend to have closer financial relationships with advanced economies (Online Annex Figure 3.3.2). In the past few years, however, cross-border financial exposures among advanced economies have increased, whereas international financial exposures appear to be becoming increasingly concentrated more generally, with major advanced economies and emerging market economies engaging in financial trade with fewer partner countries (Figure 3.5).[22]

19. **Geopolitical factors may be influencing cross-border capital allocation**. Although global financial interlinkages are complex and driven by many factors, geopolitical affinities (as measured by the similarity of countries' voting behavior in the United Nations) do seem to matter for cross-border capital allocation, as shown in Figure 3.2 (panels 1–3).[23] Recent events

[21] In general, measures to capture restrictions on capital account transactions reflect the presence of such restrictions but not their intensity. Thus, it is plausible that capital account restrictions in place in earlier periods were generally more severe than those observed in recent periods.
[22] Given their sizable financial exposures to advanced economies, but greater differences on geopolitical issues, emerging market and developing economies are particularly vulnerable to a spike in geopolitical tensions with financial partners (Chapter 4 of the April 2023 *World Economic Outlook*).
[23] Disagreement between countries on foreign policy exhibits a clear clustering pattern, whereby countries that disagree (agree) with the United States also tend to disagree (agree) with the European Union, while those that agree (disagree) with China, tend to disagree (agree) with the United States (Online Annex Figure 3.3.3). Although such a clear-cut pattern is not visible in the network of bilateral financial interlinkages (Online Annex Figure 3.3.4), recent data on cross-border portfolio/direct investment and banking links suggest a weakening of the relationship of the United States and European countries with Russia. For exposure to China, although the trend is less clear cut, two-way portfolio and direct investment allocations between China and the United States and other major advanced economies seems to have declined over the past decade; while they have increased in relation to Russia (Online Annex Figure 3.3.5).

also indicate that geopolitical factors are important in determining cross-border capital allocation. For example, US investment funds' portfolio allocation to Hong Kong SAR has declined notably since March 2019 after protests against the bill supporting extradition to mainland China (Figure 3.6, panel 1).[24] Moreover, US fund flows to China also appear to respond to the escalating political tensions between the two countries, although the effect thus far does not seem to have been persistent (Figure 3.6, panel 2). Given that investors' decisions to allocate capital tend to be driven by many global and domestic factors, this chapter next examines the role of geopolitical factors in driving cross-border capital allocation more formally through regression analysis.

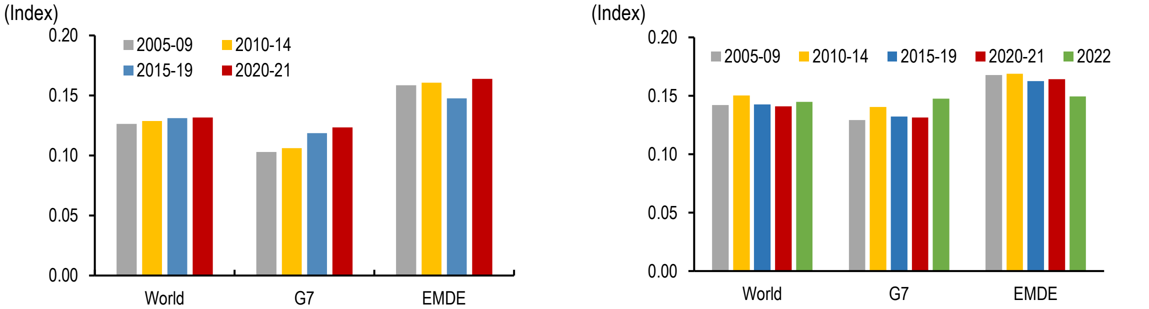
**Figure 3.5. Bilateral Cross-Border Financial Linkages**

*The concentration of portfolio and direct investment is increasing, suggesting a weakening of broader financial linkages.*

*This also holds for banking claims across advanced economies.*

**1. Herfindahl-Hirschman Index for Cross-Border Portfolio and Direct Investment, 2005–21**
(Index)

**2. Herfindahl-Hirschman Index for Cross-Border Banking Claims, 2005–22**
(Index)




Sources: Bank for International Settlements, Locational Banking Statistics; FinFlows; IMF, Coordinated Portfolio Investment Survey; IMF, Coordinated Direct Investment Survey; and IMF staff calculations.
Note: The Herfindahl-Hirschman Index is based on the bilateral total exposure (sum of assets and liabilities of each pair of counterparties relative to the sum of the total assets and liabilities of the reporting country) and is computed as the sum of squares of each reporting country's bilateral exposure to all counterparties. G7 = Group of Seven. EMDE = emerging market and developing economy. See Online Annex 3.2 for more details.

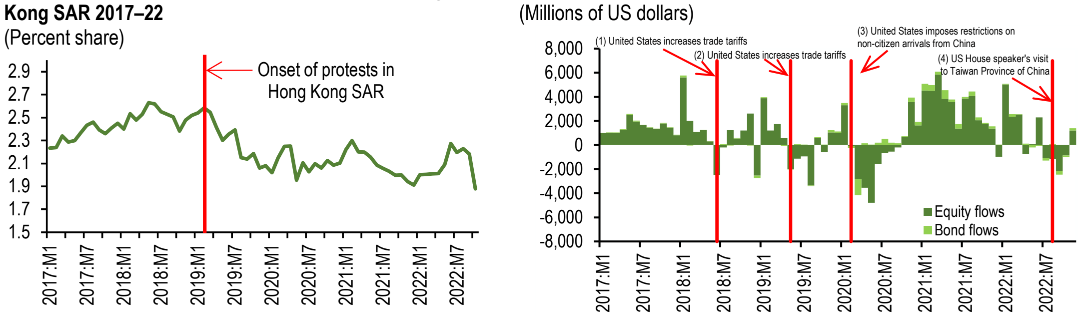
**Figure 3.6. Tensions between the United States and China and Cross-Border Portfolio Investment**

*US funds' portfolio investment in Hong Kong SAR has declined notably since the onset of protests in March 2019…*

*…and its capital allocation to China appears to decline when tensions with the United States escalate.*

**1. US Investment Funds' Portfolio Allocation to Hong Kong SAR 2017–22**
(Percent share)

**2. US Investment Funds' Portfolio Investment Flows to China, 2017–22**
(Millions of US dollars)




Sources: EPFR Global; and IMF staff calculations.
Note: Panel 1 shows US investment funds' portfolio equity and bond allocation to Hong Kong SAR. In Panel 2, the events marked as an escalation of geopolitical tensions between the United States and China (red lines) are as follows: (1) July 2018: The Trump administration imposed fresh tariffs totaling 34 billion US dollars on Chinese goods; (2) May 2019: After trade talks broke down, the Trump administration raised trade tariffs from 10 to 25 percent on 200 billion US dollars worth of Chinese goods; (3) January 2020: The Trump administration barred all non-US citizens who recently visited mainland China from entering the United States amid an outbreak of a new coronavirus that was first reported in the Chinese city of Wuhan; (4) August 2022: US House Speaker Nancy Pelosi visits Taiwan, Province of China. Both panels show unconditional associations between geopolitical events and portfolio allocations/flows.

[24] A similar pattern of reduced funds' portfolio allocations to Hong Kong SAR is observed for several other economies including the G7, though China's allocation to Hong Kong SAR has rebounded to preprotest levels.

## Geopolitical Factors Matter for Cross-Border Capital Allocation

**20. A rise in geopolitical tensions weakens financial relationships between countries.** Investors may decide to allocate less capital to geopolitically distant economies for several reasons, including financial restrictions that increase transaction costs, informational asymmetries, general mistrust, and fear of expropriation. Empirical analysis based on the gravity model of bilateral cross-border financial relationships (Portes and Rey 2005) confirms this intuition, showing that source countries tend to allocate significantly less capital to recipient countries with which they have less agreement on foreign policy issues.

**21. The effect of geopolitical tensions on cross-border banking claims and portfolio allocation is sizable, particularly for investment funds.** Specifically, controlling for a range of country-specific and bilateral factors, an increase of one standard deviation in geopolitical distance between a source and a recipient country—equivalent, for example, to the divergence in the voting behavior of the United States and China in the United Nations since 2016—is associated with a reduction in bilateral cross-border allocation of portfolio investment and bank claims by about 15 percent (Figure 3.7, panel 1).[25] Investment funds' cross-border portfolio allocations are more sensitive to similar changes in geopolitical distance, with investments declining by more than 20 percent.[26] These impacts are conditional on several recipient country characteristics—specifically, cross-border allocations are less sensitive to changes in geopolitical tensions for countries that are more financially developed, or hold larger stocks of international reserves or net foreign assets (Online Annex 3.4).

**Figure 3.7. Effect of Geopolitical Tensions on Cross-Border Capital Allocation**

*Greater geopolitical distance is associated with reduced cross-border banking and portfolio allocation by source to recipient countries…*

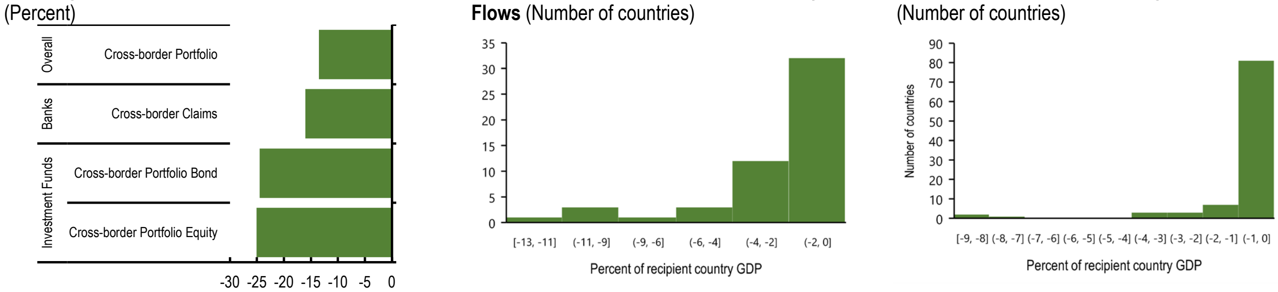
**1. Change in Cross-Border Capital Allocation** (Percent)

*…and could imply a sizable portfolio flow reversal from recipient countries if tensions rise with more geopolitically distant countries.*

**2. Predicted Reversal in Portfolio Liability Flows** (Number of countries)

*The effect on banking flows could also be significant for some economies.*

**3. Predicted Reversal in Banking Flows** (Number of countries)




Sources: Bank for International Settlements, Locational Statistics; EPFR Global; FinFlows; IMF, Coordinated Portfolio Investment Survey; IMF, Coordinated Direct Investment Survey; and IMF staff calculations.
Note: Panel 1 shows the estimated average percent change in portfolio share of a recipient country in a source country's cross-border portfolio investment or banking claims in response to a one-standard-deviation increase in bilateral geopolitical distance within a year. The results for "Banks" exclude offshore financial centers identified as those in Damgaard and Elkjaer (2017). Panels 2 and 3 report the estimated aggregate reduction in overall portfolio and banking flows as a percent of recipient country GDP after an increase of one standard deviation in geopolitical distance in relation to lenders that are geopolitically distant (that is, above the median in terms of the geopolitical distance measure). See Online Annex 3.4 for further details of the results reported here. Bars indicate statistical significance at the 10 percent or lower level.

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[25] The dependent variable is (log) portfolio share of a recipient country in a source country's cross-border portfolio investment or banking claims. To disentangle the role of geopolitical factors in bilateral cross-border investment, the model controls for common global factors (such as global investor risk sentiment and financial conditions) and macroeconomic and structural characteristics of countries by including source-country-time and recipient-country-time fixed effects. It also controls for other bilateral factors that may affect investor allocation decisions such as geographical distance and cultural and linguistic ties between the two countries. All regressors are lagged by one period to mitigate potential endogeneity concerns. Geopolitical distance between countries is measured by how much their voting behavior diverges in the UN General Assembly. See Online Annex 3.4 for details about the definition of geopolitical distance, empirical framework, and further results.

[26] In addition to portfolio and banking flows, foreign direct investment tends to respond strongly to geopolitical factors, with the evidence pointing to increased sensitivity in recent years (see Chapter 4 of the April 2023 *World Economic Outlook*).

**22. A spike in geopolitical tensions could thus trigger potentially large capital flow reversals from countries.** The results obtained from the gravity model suggest that portfolio and banking outflows triggered by geopolitical tensions could be substantial in terms of recipient countries' GDPs. For example, previous results imply that if the geopolitical distance between a recipient country and all partner countries with which it already has little agreement on foreign policy issues were to increase by one standard deviation, the median (mean) gross portfolio investment outflow would be equivalent to 1.5 (2.8) percent of the recipient country's GDP (Figure 3.7, panel 2).[27] The effect could also be significant globally, with the decline in portfolio flows amounting to about 3 percent of world GDP.[28] Broadly similar results hold for cross-border banking flows, although the response to geopolitical shocks is estimated to be smaller, with a median (mean) decline of 0.3 (1) percent of recipient country GDP (Figure 3.7, panel 3).[29]

**23. The results in Figure 3.7 are robust to using other measures of geopolitical distance, such as the extent of arms trade between the source and recipient countries or the imposition of financial sanctions.**[30] For example, a decline of one standard deviation in bilateral arms trade is associated with a 4 to 5 percent decline in equity portfolio investments and banking claims to the recipient country (Online Annex Figure 3.4.2).[31]

**24. In addition to the analysis of bilateral capital allocation, analysis based on aggregate capital flows confirms that rising geopolitical tensions could cause abrupt reversals of capital flows.** The effect is particularly pronounced for emerging market economies, with an increase of one standard deviation in geopolitical distance with a country's financial partners, on average, associated with a decline in net capital flows of about 3 percent of GDP compared to about 2 percent of GDP for advanced economies (Figure 3.8, panel 1).[32] For these economies, a large portion of the total effect on net capital flows corresponds to a decline in portfolio flows (Figure 3.8, panel 2).

**25. In addition to their effect on cross-border capital allocation, an increase in geopolitical tensions could also disrupt cross-border payment activity.** For example, financial sanctions imposed in response to escalating geopolitical tensions could increase the cost of making cross-border payments and undermine the interoperability of different payment platforms. An event-study analysis of international remittance flows as a form of cross-border payment activity shows that financial sanctions could have a strong effect on the volume and price of cross-border remittances (Box 3.1). Specifically, imposing financial sanctions could reduce remittance volume to the sanctioned country by about 17.1 percent within six quarters, while increasing the cost of remittances (fees and foreign exchange margins) by 3 percentage points.

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[27] For recipient countries, bilateral partners with low levels of agreement on foreign policy issues are identified as those with bilateral geopolitical distance above the median. This scenario analysis is conducted to assess the effect of a further rise in geopolitical tensions with countries that are already distant geopolitically, which is a more likely scenario than an escalation of tensions with geopolitically closer countries.
[28] To gauge the potential effect of increased geopolitical tensions on portfolio outflows at the global level, the effect on the recipient countries is weighted by their respective GDPs and then averaged.
[29] From the perspective of an individual country, it is likely that capital outflows triggered by increased geopolitical distance to rival countries could be partially or fully offset by capital inflows from countries that are close strategic partners (Online Annex Figure 3.4.1). Thus, some countries could emerge as beneficiaries of rising global geopolitical tensions by attracting new capital. However, as noted earlier, the macro-financial implications of such capital are likely to depend on countries' absorptive capacity and policy frameworks, as well as the stability of such flows (Ghosh, Ostry, and Qureshi 2017).
[30] These results are also broadly robust to using alternative geopolitical distance measures proposed by Häge (2011), such as the "pi," measure and the "ideal distance point" measure of Bailey, Strezhnev, and Voetens (2017). See Online Annex 3.4 for further details.
[31] Imposing financial sanctions on the recipient country is also associated with a significant decline in cross-border banking claims and portfolio investments, which generally tends to be the aim of such sanctions.
[32] To study the relationship between geopolitical tensions and aggregate capital flows, a panel regression analysis is performed using a weighted-average measure of bilateral geopolitical distance (foreign policy disagreement based on UN voting), where the weights are shares of foreign portfolio and direct investment liabilities in relation to partner countries. See Online Annex 3.5 for further details on the estimation.

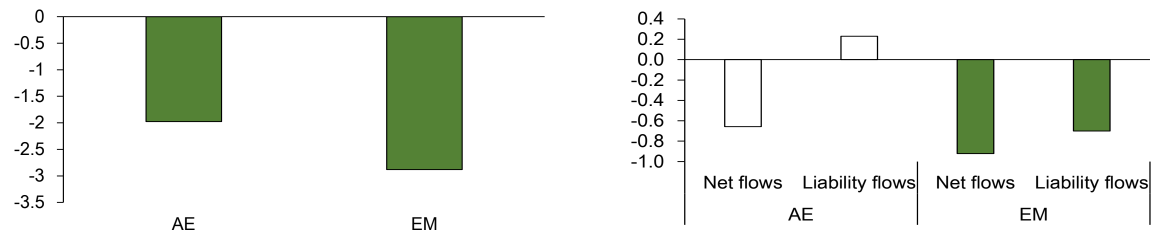
**Figure 3.8. Effect of Geopolitical Tensions on Aggregate Capital Flows**

*An increase in geopolitical distance could lead to a significant decline in capital flows…*

*…with the effect being most pronounced for portfolio flows in emerging market and developing economies.*

**1. Net Capital Flows to GDP**
(Percentage points)

**2. Portfolio Flows to GDP**
(Percentage points)




Sources: IMF, Balance of Payment statistics; and IMF staff calculations.
Note: The bars represent the percentage point change in total net capital flows to GDP in response to a one standard deviation increase in geopolitical distance with a country's financial partners. Geopolitical distance for each recipient country is the financial exposure-weighted average of geopolitical distances with source countries, where financial exposure is computed as the share of portfolio and direct investment liabilities to a source country. Solid bars indicate statistical significance at the 10 percent level or lower. See Online Annex 3.5 for further details on the empirical analysis and results. AE = advanced economy; EM = emerging market economy.

## Geopolitical Shocks Can Pose Financial Stability Risks

**26. Geopolitical tensions could affect the banking sector through several channels**. First, a sudden reversal of cross-border credit and investments leading to financial fragmentation can increase banks' debt rollover risks and funding costs (the "financial" channel in Figure 3.3). Second, for a given amount of external financing, the increased uncertainty associated with geopolitical tensions could widen sovereign bond and credit spreads, reducing the values of banks' assets and increasing their funding costs.[33] In addition, the effect of geopolitical tensions on domestic growth and inflation as a result of possible disruptions to supply chains and physical commodity markets (the "real" channel in Figure 3.3) could exacerbate banks' market and credit losses, further reducing their profitability and capitalization ratios. The solvency and liquidity stress is likely to diminish the risk-taking capacity of banks, prompting them to cut domestic lending, thereby exacerbating the decline in economic growth.

**27. Banks' performance could be significantly affected by a rise in geopolitical tensions.** An increase in geopolitical distance between a country and its financial partners could significantly increase banks' funding costs, reduce their profitability, and prompt them to contract lending to the real economy (Figure 3.9, panels 1-3).[34,35] These effects are notably larger for emerging market and developing economies, underscoring their greater vulnerability and limited capacity to absorb such shocks. The results also show some nonlinearity in the effect of geopolitical tensions, such that the overall effect—in particular, for banks' lending—tends to be larger when tensions in relation to foreign lenders are already elevated.[36]

[33] Banks in global financial centers, which intermediate funds between countries while also performing maturity transformation, could be particularly vulnerable to geopolitical shocks if they raise funds from countries that could suddenly become geopolitically more distant to lend in countries that exhibit greater geopolitical affinity.

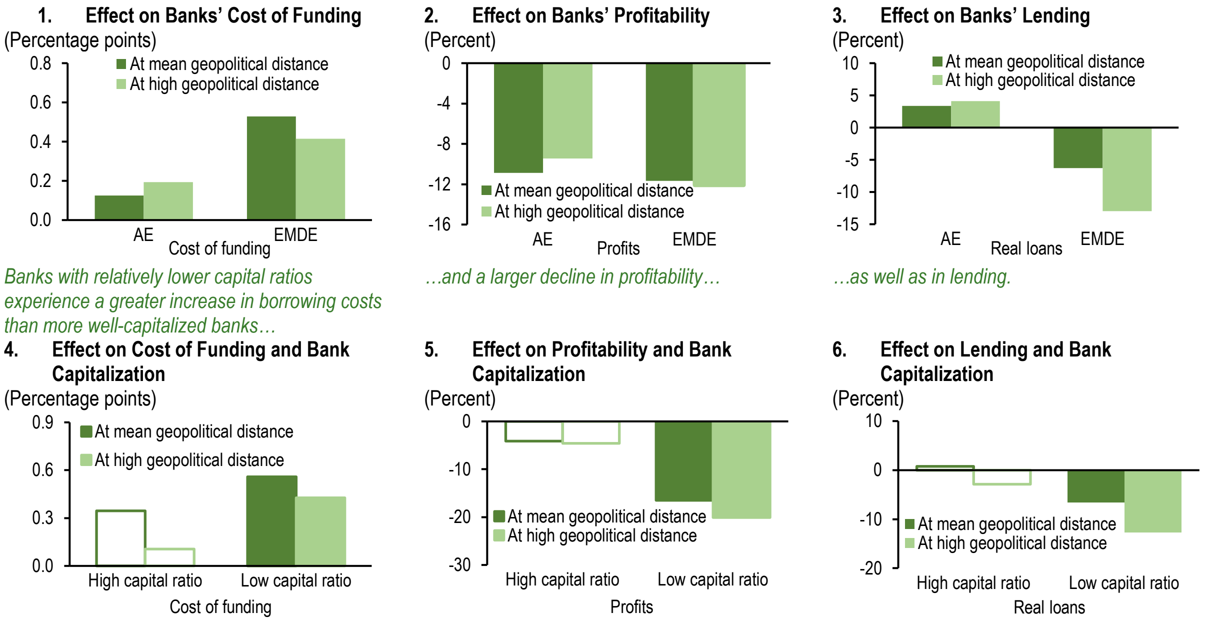
[34] This section uses detailed bank-level data and estimates panel regressions to assess the effects of changes in a country's (weighted-average) geopolitical distance in relation to foreign lenders on banks' funding costs, profitability, and real loan growth. The data are comprised of annual unconsolidated financial statements of more than 5,000 banks from 52 advanced economies and emerging market and developing economies. The regressions control for relevant bank-level characteristics, macroeconomic fundamentals, and time effects. All regressors are lagged one period to mitigate potential endogeneity concerns. See Online Annex 3.6 for more details on the estimation methodology and results.

[35] In addition to higher interest expenses, a deterioration in bond valuations and credit quality of loan portfolios could also undermine the profitability of banks. Completely disentangling the financial channel from the real channel (for example, fully absorbing indirect credit demand side effects) would be feasible if more granular data were available. For example, such granular data could allow for exploiting within-country bank-level variation in geopolitical distances in relation to foreign lenders.

[36] The nonlinearity is captured by including an interaction term between the (lagged) geopolitical distance measure and a dummy variable, which takes the value one if this distance is greater than the 75th percentile of the distribution of geopolitical distance for the specific sample. The coefficient on the interaction term in the regression for banks' funding cost is negative when considering the lagged geopolitical distance measure as in the baseline; however, it turns positive and statistically significant when considering the contemporaneous geopolitical distance measure instead.

**Figure 3.9. Banks' Performance and an Increase in Geopolitical Tensions**

*After an increase in geopolitical distance with foreign lenders, especially in emerging market economies, banks experience higher funding costs…* *…as well as lower profitability…* *…and in response, contract lending to the domestic economy.*




Sources: IMF staff calculations.
Note: Panels 1–3 show the effect on bank outcome variables when a country experiences a one standard deviation increase in geopolitical distance in relation to foreign lenders. The outcome variables are (1) total interest expenses-to-total interest-bearing liabilities, (2) (log) operating profits-to-total assets, and (3) (log) real outstanding gross loans (gross loans in local currency terms divided by the domestic consumer price index). To capture potential nonlinearity in the relationships between geopolitical distance and bank performance indicators, the regressions include an interaction term of geopolitical distance with a dummy variable equal to one when the distance is "high" (above the 75th percentile of the distribution of geopolitical distance for the specific sample) and zero when the distance is "low." Panels 4-6 report whether results differ based on bank capital ratios and is estimated for banks in EMDEs only. "High capital ratio" corresponds to banks with equity-to-total assets ratio above the 75th percentile of the equity-to-total assets ratio of banks in a given country in a given year. The model further includes a large set of bank- and country-specific macro variables, as well as bank and year fixed effects. See Online Annex 3.6 for further details. Solid bars indicate statistical significance at the 10 percent level or lower. AE = advanced economy; EMDE = emerging market and developing economy.

**28. In general, well-capitalized banks are less affected by geopolitical shocks than those that hold less capital.** Separating the effect of geopolitical shocks on banks with high capital ratios (that is, those with capital ratios in the top 25th percentile of the specific country-year distribution) versus other banks, the results show that the latter experience a much larger increase in borrowing costs, decline in profits, and reduction in lending than the former (Figure 3.9, panels 4–6).[37] This suggests that building bank capital buffers should be considered an effective way to mitigate the transmission of geopolitical shocks to the real economy (through credit provision).

## Financial Fragmentation Can Exacerbate Macro-Financial Volatility

**29. Global financial fragmentation resulting from an escalation of geopolitical tensions could lead to a loss of international risk diversification benefits, making countries more vulnerable to adverse shocks.** Under financial integration, countries can reduce their vulnerability to domestic and external shocks by maintaining internationally diversified portfolios of assets and liabilities to help smooth consumption (Obstfeld 1994). By contrast, an escalation of geopolitical tensions that triggers a cross-border reallocation of credit provision and investments can result in more concentrated cross-border financial linkages with

[37] In addition to higher interest expenses, a deterioration in bond valuations and credit quality of loan portfolios could also undermine the profitability of banks, including through a "sovereign-bank nexus" (April 2022 *Global Financial Stability Report*). Disentangling these channels is difficult because of the lack of granular data.

fewer financial partners and increase countries' vulnerability to shocks by limiting their risk-sharing opportunities.[38] Fragmentation can thus also exacerbate the risk of systemic financial stress across countries in the longer term.

**Figure 3.10. Financial Fragmentation Amplifies Vulnerability to Shocks**

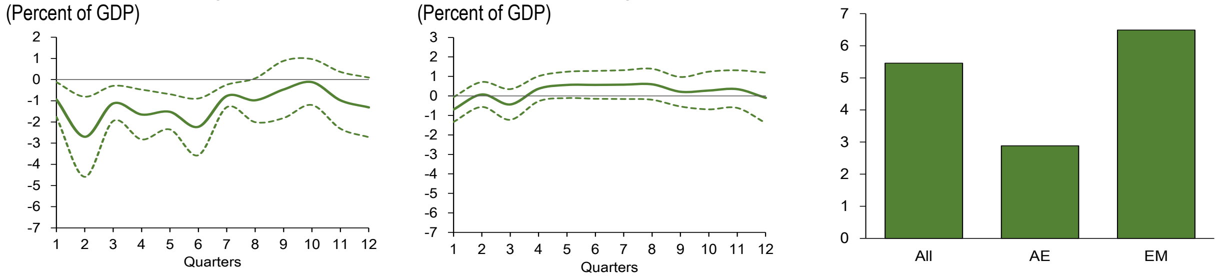
*Monetary tightening in partner countries implies a significant decline in net capital flows to emerging markets with more concentrated foreign exposures relative to those with less concentrated exposures.*

**1. Increase in Foreign Policy Rates and Net Capital Flows to Emerging Market Economies: More Concentrated Foreign Portfolios**
(Percent of GDP)

**2. Increase in Foreign Policy Rates and Net Capital Flows to Emerging Market Economies: Less Concentrated Foreign Portfolios**
(Percent of GDP)

*Countries with more concentrated foreign exposures experience higher capital flow volatility.*

**3. Net Capital Flow Volatility and Concentration of Foreign Portfolios**
(Percent of GDP)




Source: IMF staff calculations.
Note: Panels 1and 2 show the cumulative impulse response of net capital flows to GDP to foreign monetary policy shocks of countries with high and low concentrated financial exposures, respectively, over different horizons. Countries with higher (lower) than median value of Herfindahl-Hirschman Index of portfolio and direct investment liabilities are classified as more (less) concentrated. Foreign monetary policy shock is captured by the change in the monetary policy rate of the largest financial partner county (where financial partners are based on foreign portfolio and direct investment liability exposures) for each country. Dotted lines represent the 95 percent confidence interval. Panel 3 shows the effect of an increase in the foreign portfolio concentration measure from zero (full diversification) to one (full concentration). Panels 1 and 2 are based on the empirical framework presented in Online Annex 3.7.1, and panel 3 is based on the results presented in Online Annex 3.7.2. Bars indicate statistical significance at the 10 percent level or lower. AE = advanced economy; EM = emerging market economy.

**30. Increased concentration of international financial positions amplifies the propagation of external macro-financial shocks, especially to emerging market economies.** Empirical analysis shows that in the face of an adverse foreign monetary policy shock—proxied by a 100 basis point increase in the monetary policy rate of an economy's largest financial partner—net capital flows to emerging market economies with more concentrated international financial positions decline notably (Figure 3.10, panel 1).[39] The effect is both substantial—on average, about 2 percent of GDP—and persistent, lasting up to eight quarters. However, the effect of a foreign monetary policy shock of a similar magnitude on emerging market economies with less concentrated international financial exposures is neither economically nor statistically significant (Figure 3.10, panel 2).[40]

**31. Overall, reduced diversification of international financial positions is associated with greater volatility of capital flows.** In general, countries with more concentrated cross-border financial positions experience a higher volatility of net capital flows to GDP (Figure 3.10, panel 3). Specifically, moving from a case of full diversification (that is, if a country has equal financial exposures to all countries in the world) to extreme concentration (that is, if a country has only one partner country) implies a 5.5 percentage point increase in the volatility of net capital flows to GDP. The effect is more pronounced for emerging market economies than for advanced economies, confirming the weaker capacity of the former to absorb shocks. The effect

[38] Risk diversification may not only depend on the concentration of exposures but also on the correlation of the underlying assets in the international portfolio relative to the home portfolio. Overall, empirical evidence on the risk-sharing benefits of financial integration is mixed (Kose, Prasad, and Terrones 2007). Coeurdacier, Rey, and Winant (2020) argue that the effect of financial integration on welfare is heterogeneous across countries, depending on risk characteristics. In general, countries facing a higher level of uncertainty (such as emerging markets) potentially gain more from risk sharing.
[39] In this exercise, countries with a higher-than-median Herfindahl-Hirschman Index score of portfolio and direct investment liabilities are classified as concentrated. These findings are obtained from a local projection analysis of a sample of advanced economies and emerging market economies over the period between the first quarter of 2000 and the fourth quarter of 2021, while controlling for other relevant external factors and domestic macroeconomic and structural characteristics. See Online Annex 3.7 for more details on the empirical methodology and results.
[40] The effect of a foreign monetary policy shock is also not strong for advanced economies, perhaps because their higher level of financial development allows them to better hedge against such shocks (Online Annex Figure 3.7.1).

is also stronger for countries that have smaller stocks of international reserves (Online Annex 3.7.), confirming the role of reserves in insuring countries against macro-financial volatility.

32. **The welfare loss stemming from reduced risk diversification opportunities could be notable even in more advanced economies**. A scenario analysis based on a simple modeling exercise for the Group of Seven economies suggests that the volatility of macro-financial variables such as output, consumption, corporate profits, and stock and bond prices could increase notably in some countries under fragmentation, implying a significant loss of diversification benefits (Box 3.2).

## Conclusions and Policy Recommendations

33. **This chapter has shown that rising geopolitical tensions can lead to financial fragmentation through cross-border capital reallocation and sudden reversals of international capital flows.** Financial fragmentation induced by geopolitical tensions can increase banks' funding costs, reduce their profitability, and prompt them to contract lending, with potentially adverse effects on economic activity. Emerging market and developing economies are more vulnerable to adverse geopolitical shocks than advanced economies. Countries can, however, mitigate these risks by holding adequate international reserves and by promoting financial development. In addition, banks can mitigate these risks by holding larger capital buffers. The analysis also shows that if geopolitical tensions persist, the long-term costs associated with reduced cross-border risk diversification in the form of capital flow and broader macro-financial volatility could be substantial.

34. **To mitigate the macro-financial stability risks arising from heightened geopolitical tensions, policymakers should consider taking the following steps:**

- *Strengthen Financial Oversight*

35. **Supervisors, regulators, and financial institutions should be aware of the risks to financial stability stemming from a potential rise in geopolitical tensions and devote resources to identify, quantify, manage, and mitigate these risks**. Unexpected but plausible geopolitical shocks could adversely affect financial institutions that are inadequately prepared to absorb losses; therefore, proper risk management and preparedness is crucial. A better understanding and monitoring of the interactions between geopolitical risks and "traditional" credit, interest rate, market, liquidity, and operational risks could help prevent a potentially destabilizing fallout from geopolitical events.[41]

36. **A more systematic approach to the assessment and quantification of geopolitical shock transmission to financial institutions is needed to develop actionable guidelines for supervisors.** Geopolitical risks and their transmission mechanisms could be more formally embedded in stress-testing frameworks and scenario analysis to help inform discussions between supervisors and financial institutions (including through the Internal Capital Adequacy Assessment Process) to build adequate buffers.

[41] Stringent financial restrictions may prompt a shift of capital flows in the restricted country away from well-regulated traditional banks to less regulated or unregulated nonbank financial institutions and crypto assets. To address this risk, supervisors and regulators should expedite the development of a global supervisory and regulatory framework for nonbank financial institutions. See Chapter 2 for a discussion.

- *Build Adequate Buffers and Safety Nets*

**37. In response to rising geopolitical risk, economies reliant on external financing should ensure an adequate level of international reserves, as well as capital and liquidity buffers at financial institutions**. Countries that are exposed to greater geopolitical risk should consider building stronger buffers of international reserves to mitigate the adverse macro-financial consequences of a sudden reallocation of cross-border capital.[42] Regarding the capital and liquidity buffers of financial institutions, the transmission of geopolitical shocks (if material) should be considered in the quantification of credit, interest rate, market, liquidity, and operational risks. The buffers should be calibrated to protect against extreme but plausible losses associated with the materialization of tail risk.

**38. Policymakers should strengthen crisis preparedness and management frameworks to deal with potential financial instability arising from an escalation of geopolitical tensions.** In addition, cooperative arrangements between different national authorities should continue for effective management and containment of international financial crises including through development of effective resolution mechanisms of financial institutions that operate in multiple jurisdictions (IMF 2014).

**39. Higher risk of capital flow reversals driven by geopolitical tensions will increase the demand for global financial safety nets.** Mutual assistance agreements between countries—through regional safety nets, currency swaps, or fiscal mechanisms—could help smaller countries weather shocks.[43] The IMF could play an important role in mitigating the risks from financial fragmentation through its financing facilities, particularly the precautionary lending toolkit at the request of its member countries. In addition, the IMF could help countries build resilience and cope with geopolitical shocks through policy advice and capacity development (Aiyar and others 2023).

- *Strengthen International Cooperation*

**40. In the face of geopolitical risks, efforts by international regulatory and standard-setting bodies should continue to promote convergence in financial regulations and standards to prevent an increase in financial fragmentation.** In cases where countries opt for unilateral actions, “guardrails” could help to limit cross-border spillovers (Aiyar and others 2023). For example, deepening international cooperation to improve cross-border payments, and developing an international framework to enhance the interoperability of payment systems, could help to mitigate disruptions to cross-border payment services arising from geopolitical tensions.

**41. Imposing financial restrictions for national security reasons could have unintended consequences for global macro-financial stability.** Although imposing financial restrictions might address national security concerns, policymakers need to be aware of the potential risks to global macro-financial stability from increased financial fragmentation, high inflation, lower global economic growth, and financial contagion. Policymakers should thus make utmost efforts to resolve political conflicts through diplomacy and negotiations to prevent an escalation of geopolitical tensions and weakening of global economic and financial ties.

[42] The possibility of freezing reserve assets by reserve-issuing countries in the face of an escalation in geopolitical tensions could influence the reserve management decisions of countries towards more geopolitically aligned countries, or lead to more diversified reserve portfolios with possibly increased allocations to gold, and raise the demand for global financial safety net resources (Aiyar and others 2023, Arslanalp, Eichengreen, and Simpson-Bell 2023).
[43] It is possible for mutual assistance mechanisms to be affected by geopolitical tensions and available only to countries with close strategic ties.

## Box 3.1. Geopolitical Tensions and Cross-Border Payments: A Case Study of Remittances

Rising geopolitical tensions often generate the risk of cross-border payment disruptions as a result of imposing financial restrictions. Such restrictions may include freezes of financial assets and investment activities of individuals, firms, and banks, and—in extreme cases—shutting down the cross-border payment communication protocol. Depending on their intensity and scope, these restrictions aim to impede the ability of domestic entities to transact with the rest of the world by increasing the cost (fees and foreign exchange margins) of making cross-border payments and reducing their volume. To formally assess the effect of financial restrictions on cross-border payments, this box analyzes the effect of bilateral financial sanctions on international remittances, which are an important type of cross-border payment and represent a major source of external income for many economies.[1]

The average cost of sending remittances has declined over the past decade as a result of technological progress and global cooperation (World Bank 2022). This trend, however, appears to have reversed in some regions since Russia's invasion of Ukraine.[2] In particular, the average cost of sending remittances (weighted by the volume of remittances) to Eastern Europe and Central Asia surged by 27.4 percent between the end of 2021 and the second quarter of 2022 (Figure 3.1.1, panel 1). A formal analysis of the effect of financial sanctions on remittances in 18 countries from the first quarter of 1980 to the second quarter of 2022 confirms that such measures could have a significant effect on the cost and volume of sending cross-border remittances (see Online Annex 3.5 for further details on the estimation methodology). Specifically, the results show that financial sanctions increase the cost of sending remittances (measured as a percentage of the remitted amount) to sanctioned countries by 3 percentage points (Figure 3.1.1, panel 2), whereas the volume of remittances drops by 17.1 percent after six quarters of sanctions (Figure 3.1.1, panel 3).

[1] Lack of data availability precludes a broader analysis of the effect of geopolitical tensions on all types of payments (for example, trade payments). The focus here is on remittances, as they are an important source of financing for low- and middle-income countries—on average, amounting to about 2.5 percent of GDP, but in some cases more than 26 percent. The Group of Twenty countries have committed to reducing the global average remittance cost to 5 percent, and the UN Sustainable Development Goals have indicated a target of 3 percent to be reached by 2030.
[2] Regional grouping of the remittance price data is based on World Bank (2022).

### Figure 3.1.1. Effect of Geopolitical Tension on International Remittances

*The cost of sending remittances to Europe and Central Asia has increased since Russia's invasion of Ukraine.*

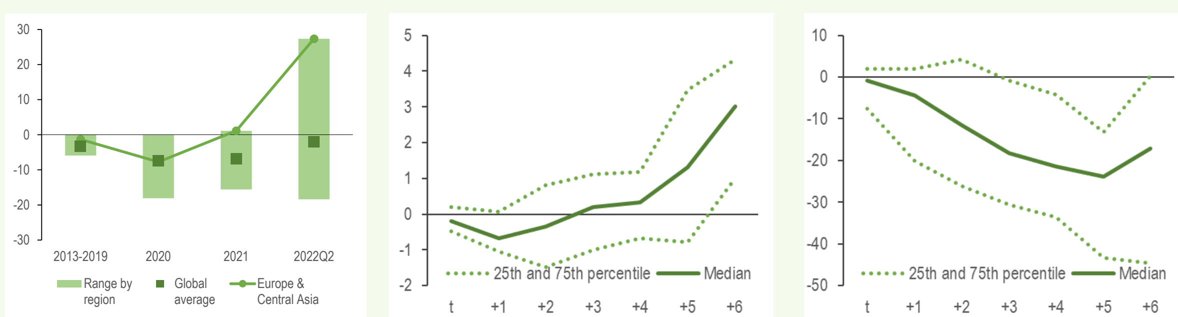
*Financial sanctions increase remittance costs…*

*…and reduce remittance volumes to sanctioned countries.*

**1. Change in Cross-Border Remittance Costs**
(Percent, annual average)

**2. Cumulative Abnormal Change in Remittance Costs after Sanctions**
(Percentage points)

**3. Cumulative Abnormal Growth of Remittance Volume after Sanctions**
(Percent)




Sources: IMF, Balance of Payment Statistics; World Bank, Global Sanctions Database; and IMF staff calculations.

Note: Panel 1 presents the growth rate of regional average remittance costs (when sending 200 US dollars) weighted by the remittance volume (World Bank 2022). The regional grouping based on World Bank (2022) includes six regions: East Asia and Pacific, Europe and Central Asia, Latin America and the Caribbean, Middle East and North Africa, South Asia, and sub-Saharan Africa. The regional grouping of Europe and Central Asia only includes countries in Eastern Europe and Central Asia. The bar indicates the range of the values of these regions. The right bar in panel 1 denotes the change from the fourth quarter of 2021 to the second quarter of 2022. The data do not include any data on corridors originating in Russia in 2022. Panels 2 and 3 show the effect of sanctions on remittance cost ratios and remittance volume after the sanctions. The remittance cost is measured as a ratio of total costs to the remitted 200 US dollars. The analyses do not consider the effect of the sanction on Russia in 2022 because of limited data availability. See Online Annex 3.5 for further details of the empirical analysis.

## Box 3.2. Financial Fragmentation: Loss of Diversification Benefits

Financial fragmentation driven by an escalation of geopolitical tensions can limit international risk diversification opportunities for countries and increase the volatility of key macro-financial variables such as output, consumption, corporate profits, and asset prices. To assess the potential loss of diversification benefits under financial fragmentation relative to full integration, this box considers the case of the Group of Seven (G7) economies and applies a two-country open-economy model with trade in stocks and bonds developed by Coeurdacier, Kollmann, and Martin (2010).

The model is designed to explain the "equity home bias" puzzle—that is, the observed preference of domestic residents to hold local equity relative to foreign equity—in G7 economies. The model also generates plausible macro-financial dynamics after total factor productivity and investment-specific technology shocks. In the model, households can obtain international diversification benefits by investing in foreign equity because of imperfectly correlated total factor productivity and investment efficiency shocks across economies. Home bias arises because wage income and dividends from domestic equity investments are imperfectly correlated, providing some opportunity for risk diversification domestically.[1]

The model is simulated individually for each G7 economy under four scenarios characterized by different degrees of global financial fragmentation. In the "full integration" scenario, G7 economies trade with the rest of the world (comprised of a sample of 53 countries). Under the "moderate" and "extreme" fragmentation scenarios, G7 economies are unable to engage in financial transactions with countries that are geopolitically less similar—that is, their geopolitical distance measure (based on UN voting behavior) in relation to the G7 economies exceeds the top 25th and 50th percentiles of the sample distribution, respectively. Finally, in the "autarkic" scenario, the G7 economies are self-sufficient and financially cut off from all other economies.

The results indicate that financial fragmentation could notably exacerbate the vulnerability of G7 economies to shocks, increasing the volatility of their macro-financial variables. For example, under the moderate and extreme fragmentation scenarios, the median volatility of output increases by 1 and 3 percentage points, respectively, relative to the full integration scenario, while the median volatility of (real) consumption, corporate profits, equity and bond prices increases in the range of 2 to 8 percentage points (Figure 3.2.1, panel 1).

The increase in volatility under fragmentation in turn implies a potentially significant loss of diversification benefits. To quantify this loss, the increase in the volatility of consumption, corporate profits, and stock and bond prices under fragmentation is compared with the increase in the volatility of these variables under the autarky scenario, and the ratio of the changes in volatilities is defined as the diversification benefit. As can be seen from panel 2 of Figure 3.2.1, "moderate" fragmentation implies that about 20 percent of the diversification benefits from financial integration would be lost, while nearly 40 to 50 percent of the benefits would be lost under the "extreme" fragmentation scenario.[2]

While these estimated losses are significant, several caveats to the analysis are warranted. The simulations only focus on the loss of cross-border investment diversification benefits and assume full substitutability of foreign goods production among foreign countries that are available to trade with G7 economies. Alternative assumptions, or broader geoeconomic fragmentation also affecting trade, technology diffusion, and labor migration, could impose additional costs. Neither do the simulations take into account any potential benefits from fragmentation, such as from capital reallocation, or whether financial fragmentation genuinely reduces threats to national or global security.

[1] Online Annex 3.7 presents further details on the structure of the model and its parameterization.

[2] These magnitudes are in line with other studies that have a similar setup and consider a production economy with capital (Coeurdacier, Rey, and Winant 2020) but are smaller than those that consider an endowment economy (Van Wincoop 1999). This is because in a production economy, capital can be used in autarky to smooth the effect of shocks, which reduces the diversification benefit from integration.

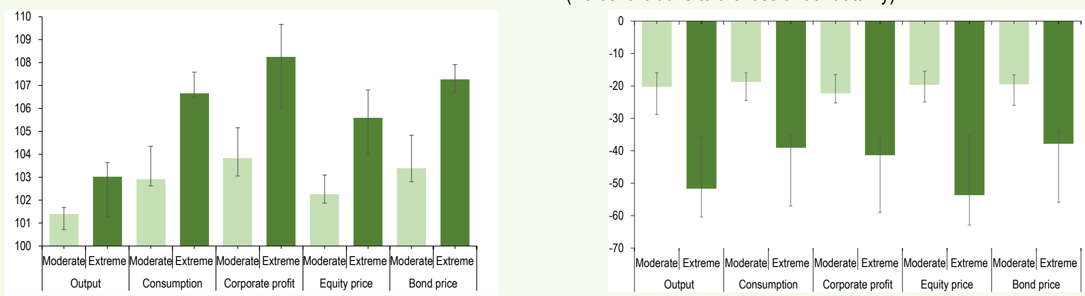
**Figure 3.2.1. Macro-Financial Volatility and Loss of Diversification Benefits in the Group of Seven Economies Under Fragmentation**

*Macro-financial volatility could increase under fragmentation relative to full integration...*

*...and the loss of diversification benefits could be substantial.*

**1. Increase in Macro-Financial Volatility**
(Full integration = 100)

**2. Loss of Diversification Benefit under Fragmentation**
(Percent relative to the loss under autarky)




Source: IMF staff calculations.
Note: Bars in panel 1 show the median volatility (standard deviation) of (real) output, consumption, corporate profits, and equity and bond prices in the home country under two fragmentation scenarios—"moderate" ("extreme"), where the home country does not financially trade with countries to which the bilateral geopolitical distance measure lies in the top 25th (50th) percentile of the sample distribution, respectively. Whiskers indicate the interquartile range of the effect across the Group of Seven economies. Panel 2 shows the loss of diversification benefit under fragmentation, quantified as the difference in volatility for each variable under fragmentation relative to an autarkic scenario. See Online Annex 3.7 for further details of the modeling exercise.

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# Geopolitics and Financial Fragmentation: Implications for Macro-Financial Stability

## Online Annex 3.1. Data Description and Sources

**Online Annex Table 3.1.1. Variable Description and Data Sources**

| Variable | Description | Source |
|---|---|---|
| **Geopolitical variables** | | |
| Bilateral sanction | Dummy variable equal to 1 if a financial/trade/other sanction has been imposed by source country on recipient country | Global Sanctions Database; and Kirilakha and others (2021) |
| Geopolitical distance | Foreign policy disagreement based on countries' voting behavior in the UN General Assembly (multiplied by –1); and alternatively, the countries' ideal point distance measure of Bailey and others (2017) | Signorino and Ritter (1999); Häge (2011); and Bailey and others (2017) |
| Geopolitical risk index | A measure of adverse geopolitical events and associated risks based on a tally of newspaper articles covering geopolitical tensions (index, 1985–2019=100) | Caldara and Iacoviello (2022) |
| Institutional quality | Average of International Country Risk Guide indicators | The International Country Risk Guide database |
| International military conflicts | Defined as at least 25 battle-related deaths in one calendar year | The Uppsala Conflict Data Program |
| **Macro-financial variables** | | |
| Cross-border banking claims | Total cross-border claims on an immediate counterparty basis | Bank for International Settlements, Consolidated Banking Statistics |
| Cross-border banking claims | Total cross-border banking claims (including loans, debt securities or other debt instruments, equity or investment fund shares, and financial derivatives) | Bank for International Settlements, Locational Banking Statistics |
| VIX | Chicago Board Options Exchange's options-implied volatility index for S&P 500 | Bloomberg Finance LP |
| Financial openness | Measuring a country's degree of capital account openness | Chinn and Ito (2006) |
| Investment fund portfolio equity/bond allocations | Share of a recipient country in total cross-border portfolio allocation of a source country (for equity- and bond- funds respectively, aggregated at a country-level | EPFR Global |
| Exchange rate regime | An index indicating the degree of exchange-rate flexibility (with higher values indicating more flexibility) | Ilzetzki and others (2021) |
| Long-term sovereign bond yield | Long-term (10-year or nearest equivalent) government bond yield, in percent | IMF, World Economic Outlook database |
| Current account balance over GDP | Current account balance over GDP, in percent | IMF, Balance of Payments |
| Personal transfers | All current transfers in cash or in kind made or received by resident households from nonresident households | IMF, Balance of Payments |
| Total (net/liability) flows over GDP | Financial liability flows minus financial asset flows excluding reserve asset flows over GDP, in percent | IMF, Balance of Payments |
| Portfolio investment (net/liability) flows over GDP | Portfolio liability flows minus portfolio investment asset flows over GDP, in percent | IMF, Balance of Payments |
| Direct investment (net/liability) flows over GDP | Direct investment inward minus direct investment outward over GDP, in percent | IMF, Balance of Payments |
| Bilateral foreign direct investment assets and liabilities positions | Bilateral data on foreign direct investment positions, 2000–18 | European Commission, FinFlows database |
| Bilateral portfolio investment assets and liabilities positions | Bilateral data on portfolio investment positions, 2000–18 | European Commission, FinFlows database |
| Bilateral foreign direct investment asset and liability positions | Bilateral data on foreign direct investment positions, 2019–21 | IMF, Coordinated Direct Investment Survey |
| Bilateral portfolio investment asset and liability positions | Bilateral data on portfolio investment positions, 2019–21 | IMF, Coordinated Portfolio Investment Survey |
| Real effective exchange rate (deviation from trend) | Log deviation of the real effective exchange rate from trend using an Hodrick-Prescott filter, with penalty parameter 100 | IMF, Global Data Source database |
| Fiscal balance | General government net lending/borrowing, in percent of fiscal year GDP | IMF, World Economic Outlook database |

| | | |
|---|---|---|
| Inflation | Change in the Consumer Price Index | IMF, World Economic Outlook database |
| International reserves adequacy | Total reserve assets, which includes reserve position at the IMF (BPM6), in percent of GDP | IMF, World Economic Outlook database |
| Real GDP growth | Real GDP growth, in percent | IMF, World Economic Outlook database |
| Real GDP per capita | Log of real GDP per capita | IMF, World Economic Outlook database |
| Real interest rate differential | Difference in real interest rates between domestic economy and the United States, in percentage points | International Financial Statistics database |
| Market capitalization | Free float-adjusted domestic stock market capitalization, in percent of free float-adjusted global market capitalization | Morgan Stanley Capital International database |
| Total factor productivity | Welfare-relevant total factor productivity at constant national prices (2017=1) | Penn World Table, version 10.0 (Feenstra and others 2015) |
| Consumption | Household consumption expenditure (including nonprofit institutions serving households) at current prices in national currency and at constant 2015 prices in national currency | United Nations, The National Accounts Main Aggregates Database |
| GDP, real | At constant 2015 prices in national currency and at constant 2015 prices in US dollars | United Nations, The National Accounts Main Aggregates Database |
| GDP, nominal | Nominal GDP (in US dollars) | United Nations, The National Accounts Main Aggregates Database |
| Imports | Imports of goods and services at constant 2015 prices in national currency and at constant 2015 prices in US dollars | United Nations, The National Accounts Main Aggregates Database |
| Import partner share | Import partner share (percent) | World Bank, World Integrated Trade Solution |
| Investment | Gross fixed capital formation (including Acquisitions less disposals of valuables) at current prices in national currency and at constant 2015 prices in national currency | United Nations, The National Accounts Main Aggregates Database |
| Cost of remittance | Total transaction cost in percentage of the amount sent for sending 200 US dollars charged by each single remittance service provider | World Bank, Remittance Prices Worldwide database |
| Financial Development Index | Financial Development Index (aggregate) | IMF, Financial Development Index database |
| Net foreign assets-to-GDP ratio | Net foreign assets relative to GDP | IMF, World Economic Outlook database; and IMF staff calculations |
| International reserves-to-GDP ratio | Total reserve assets (including reserve position at the IMF) relative to GDP | IMF, World Economic Outlook database |
| **Bank-level variables** | | |
| Capital ratio | Total equity/total assets | Fitch Connect; and IMF staff calculations |
| Cost of funding | Total interest expense-to-total interest-bearing liabilities | Fitch Connect; and IMF staff calculations |
| Profits | Operating profits normalized by total assets | Fitch Connect; and IMF staff calculations |
| Liquidity ratio | Liquid assets-to-total assets ratio | Fitch Connect; and IMF staff calculations |

| | | |
|---|---|---|
| Nonperforming loan ratio | Nonperforming loans-to-outstanding gross loans | Fitch Connect; and IMF staff calculations |
| Real loans | Log of gross loans outstanding (converted into domestic currency and deflated by annual average consumer price index) | Fitch Connect; and IMF staff calculations |
| Size | Log of total assets (in US dollars) | Fitch Connect; and IMF staff calculations |

**Online Annex Table 3.1.2. Advanced Economies and Emerging Market and Developing Economies Included in the Sample**

| Advanced Economies | Emerging Market and Developing Economies |
|---|---|
| Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong SAR, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, San Marino, Singapore, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Taiwan Province of China, United Kingdom, United States | Afghanistan, Albania, Algeria, Angola, Anguilla, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, The Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Bulgaria, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Comoros, Democratic Republic of the Congo, Republic of Congo, Costa Rica, Croatia, Côte d'Ivoire, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, The Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Iran, Iraq, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kosovo, Kuwait, Kyrgyz Republic, Lao P.D.R., Lebanon, Lesotho, Liberia, Libya, former Yugoslav Republic of Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia, Moldova, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Qatar, Romania, Russia, Rwanda, Samoa, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Solomon Islands, Somalia, South Africa, South Sudan, Sri Lanka, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sudan, Suriname, Swaziland, Syria, São Tomé and Príncipe, Tajikistan, Tanzania, Thailand, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Türkiye, Turkmenistan, Tuvalu, Uganda, Ukraine, United Arab Emirates, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe |

Source: IMF staff.
Note: The exact sample composition varies across empirical analyses based on data availability.

## Online Annex 3.2. Construction of Key Variables

### Geopolitical Distance Measures

***Measures based on UN voting behavior***. To measure the geopolitical distance between countries, the chapter relies primarily on countries' observable behavior on foreign policy issues, such as disagreements in their voting behavior in the United Nations General Assembly (UNGA). To construct this measure, the UNGA voting dataset (Voeten 2013, version 29) is used. The dataset includes roll-call votes in the UNGA sessions 1-76 and covers the 1946–2021 period.

The literature offers different ways to map the observed voting behaviors of countries into bilateral geopolitical distance measures (see, for example, Gartzke 1998; Signorino and Ritter 1999; Häge 2011; and Bailey and others 2017). The baseline measure of geopolitical distance used in the chapter is the *S* score in Häge (2011), which is based on Signorino and Ritter (1999). As subsequently explained, this measure calculates the average disagreement in UNGA voting based on the squared sum of the distance between two countries and normalizes the value such that 1 and –1 represent complete disagreement and agreement, respectively.

Computing the *S* score consists of three steps: (a) assigning numerical values to voting behavior in UNGA (excluding absences as these could be due to temporary lack of government), (b) calculating the disagreement as the sum of squared differences of these values, and (c) normalizing it. Hence:

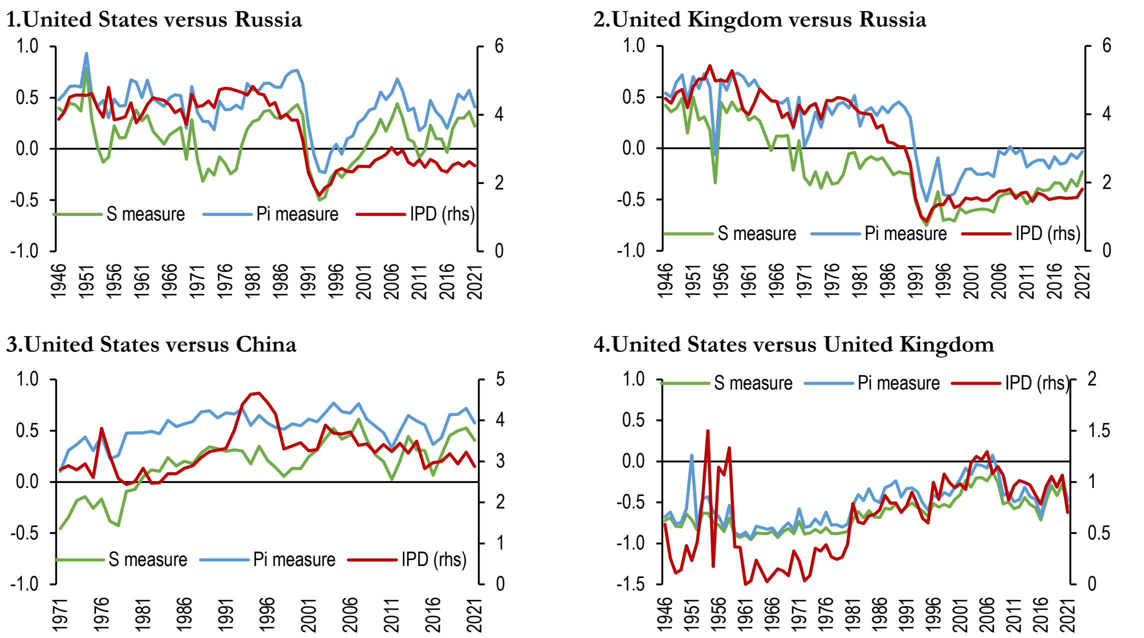
$$Geopolitical\ Distance\ (GPD)_{a,b} = (-1) * \overbrace{\left[1 - \frac{\sum_v (X_{av} - X_{bv})^2}{\frac{1}{2}\sum_v (d_{max})^2}\right]}^{S\ score} \quad (1),$$

where $X_{av}$ denotes voting behavior (*v*) of country *a*, $X$ refers to votes (yea=1, abstain=2, and nay=3), and *v* indexes voting during sessions in a calendar year (adjusted for sessions toward the end of the year that could potentially run into January of the n year). The time dimension (year) is subsumed in the aforementioned formula. $d_{max}$ stands for the maximum possible distance between the country pairs (which is 3–1=2 in this case). For instance, for a country pair with one voting yea and the other nay in a session, the implied distance would be 1. If the two countries voted the same, then the distance would be –1. The normalization factor in the *S* score can also be interpreted as a "chance correction" (Häge 2011) as it reflects the dissimilarity expected by chance, which is constant at ½. Häge (2011) offers an alternative measure, π (pi), that improves the "chance correction" and cost of forming ties. Häge (2011) argues that the π measure has more desirable distributional properties and passes some key face validity tests. Bailey and others (2017) offer a further alternative to *S*, the ideal point distance (IPD), by estimating a discrete choice model with latent preferences.

Overall, the three measures—*S*, pi, and IPD—are highly correlated, with the correlation ranging from 0.66 (pi versus IPD) to 0.84 (*S* versus IPD) and evolve quite similarly over time for country pairs (Online Annex Figure 3.2.1). The chapter relies mainly on the *S* measure in the empirical analysis because it is a commonly used measure in the literature and conducts robustness of the results to the other two measures, pi and IPD, proposed by Häge (2011) and Bailey and others (2017), respectively.[1]

[1] *S* and pi measures were based on UN voting data from 1946 to 2015. Both measures were expanded by using Erik Voeten's database, which is a dataset of roll-call votes in the UN General Assembly from 1946 to 2021 (sessions 1-76). The database contains information on 196 economies.

**Online Annex Figure 3.2.1. Geopolitical Distance Measures Based on UN Voting Behavior**




Sources: Häge (2011); Bailey and others (2017); and IMF staff calculations.
Note: Higher values indicate greater geopolitical distance. IPD = ideal point distance (from Bailey and others 2017).

***Measures based on bilateral arms trade and financial sanctions.*** In addition to the geopolitical distance measures based on UNGA voting patterns, the chapter uses the following measures for robustness purposes:

1. **Bilateral arms trade**. Arms trade between countries can be a useful proxy for geopolitical proximity as military cooperation tends to occur between countries that have a close strategic relationship. To capture this relation, the following measure is constructed:

$$ArmsTradeToGDP_{i,j,t} = \frac{ExportArms_{i,j,t} + ImportArms_{i,j,t}}{\sqrt{GDP_{i,t} \cdot GDP_{j,t}}}, \quad (2)$$

where $ArmsTradeToGDP_{i,j,t}$ is the ratio of total arms trade between countries *i* and *j* (in US dollars) in time *t*, divided by the (geometric) mean of the nominal GDPs of countries *i* and *j* (in US dollars). $ExportArms_{i,j,t}$ ($ImportArms_{i,j,t}$) are the exports (imports) of arms and ammunitions from (to) country *i* to (from) country *j*. The data on bilateral arms trade are available at an annual frequency from the World Integrated Trade Solution database, which draws on UN COMTRADE data.

The overall correlation of the bilateral arms trade variable with our preferred geopolitical distance measure, *S*, is small (0.03). This appears to be the case because for some country pairs, arms trade is quite significant despite a low similarity in foreign policy outlook as captured by UN voting behaviors (Online Annex Figure 3.2.2, panel 1).[2]

2. **Bilateral sanctions**. Sanctions against geopolitically rival countries are a common tool and hence could be a good proxy for geopolitical distance. This measure is constructed as a dummy variable taking a value of 1 if a source country has a type of sanction (financial, trade, or other) imposed on a recipient country. In addition, the use of sanctions has increased over time (Online Annex Figure 3.2.2, panel 2), and they are more likely to be imposed on countries with greater disagreement in UNGA voting (Online Annex Figure 3.2.2, panel 3).

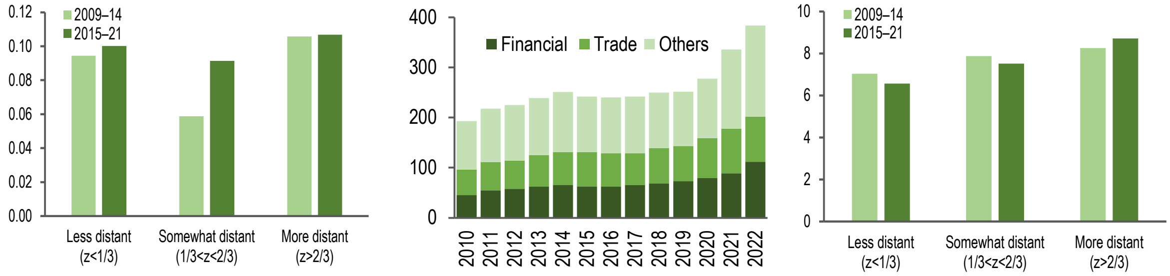
[2] Such pairs include, for example, North America countries and several countries in the Middle East.

**Online Annex Figure 3.2.2. Alternative Measures of Geopolitical Tensions**

**1. Arms Trade to GDP and Geopolitical Distance**
(Basis point)

**2. Number of Countries with Sanctions**

**3. Share of Financial Sanctions and Geopolitical Distance**
(Percent)




Sources: UN COMTRADE; Global Sanction Database; World Economic Outlook database; Häge (2011); Signorino and Ritter (1999); and IMF staff calculations.
Note: Panel 1 shows the average bilateral arms trade relative to GDP as defined in equation (2), grouped by bilateral geopolitical distance (as defined in equation 1) between countries. The "z" represents the percentile of the geopolitical distance variable. Panel 2 shows the total number of countries subject to different types of sanctions over the years. Panel 3 shows the share of countries that are sanctioned grouped by the geopolitical distance measure.

***Measures of financial concentration.*** To measure the concentration of international financial exposures, Herfindahl–Hirschman Index (HHI) is computed using the share of bilateral total exposure (sum of assets and liabilities of each pair of counterparties relative to the sum of the total assets and liabilities of the reporting country). Specifically, it is computed as the sum of squares of each reporting country's bilateral exposure to all counterparties.

$$HHI_{it} = \sum_{j=1,j\neq i}^{m} \left(Share_{i,j,t}\right)^2 \text{ where } Share_{i,j,t} = \frac{Assets_{ijt} + Liabilities_{ijt}}{\sum_{l=1,l\neq i}(Assets_{ilt} + Liabilities_{ilt})}, \quad (3)$$

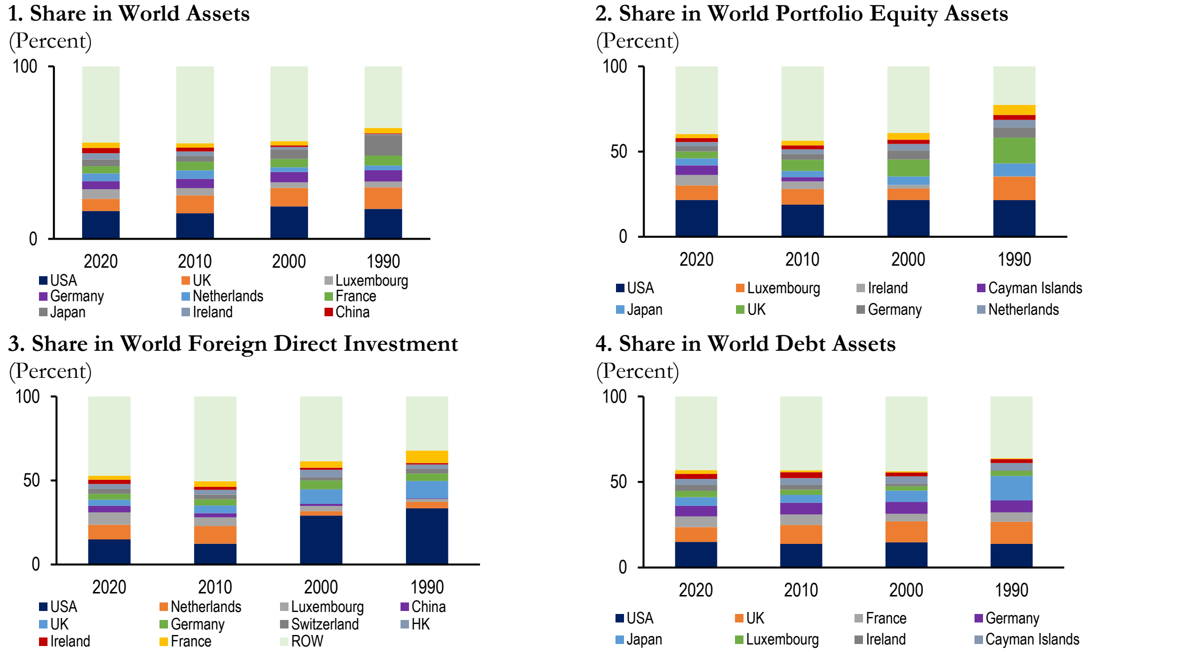
where $Assets_{ijt}$ denotes the assets of country $i$ in country $j$ at time $t$, $Liabilities_{ijt}$ denotes the liabilities of country $i$ owed to country $j$ at time $t$, and $m$ is the number of countries. The HHI is also computed using countries' bilateral liabilities only as follows:

$$HHI_{it}^{L} = \sum_{j=1,j\neq i}^{m} \left(\frac{Liabilities_{ijt}}{\sum_{l=1,l\neq i} Liabilities_{ilt}}\right)^2. \quad (4)$$

Data on bilateral foreign direct and portfolio investment cover the 2000–18 period for about 60 countries and are taken from the FinFlows database provided by the Joint Research Centre of the European Commission (Zeugner and others 2020). This dataset is extended to 2021 using the IMF's Coordinated Portfolio Investment Survey and the IMF's Coordinated Direct Investment Survey.

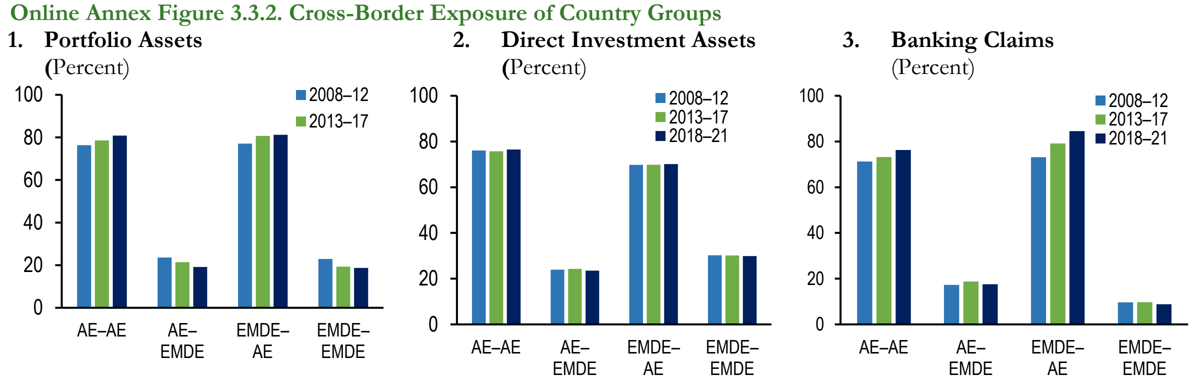
## Online Annex 3.3. Additional Stylized Facts

### Online Annex Figure 3.3.1. Countries with Largest Share in Global External Assets




Sources: Lane and Milesi-Ferretti (2018); and IMF staff calculations.
Note: The bars represent the evolution of the share of external assets in total world assets of countries with the largest share in 2020. ROW = rest of the world.

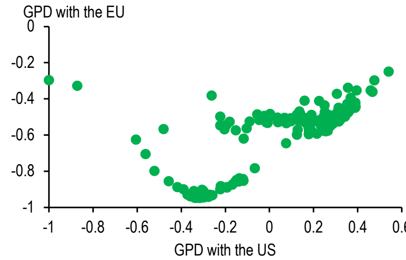
### Online Annex Figure 3.3.2. Cross-Border Exposure of Country Groups



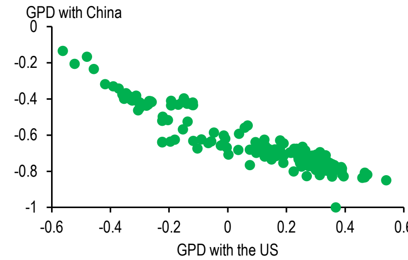

Sources: Bank for International Settlements, Locational Banking Statistics; IMF, Coordinated Direct Investment Survey; IMF, Coordinated Portfolio Investment Survey; and IMF staff calculations.
Note: Bars represent the share of claims of advanced economies on advanced economies (AE–AE), of advanced economies on emerging market and developing countries (AE–EMDE), of emerging market and developing economies on advanced economies (EMDE–AE) and of emerging market and developing economies on emerging market and developing economies (EMDE–EMDE).

**Online Annex Figure 3.3.3. Clustering of Geopolitical Disagreements**

**1. Disagreement with the United States and the European Union in UNGA Voting, 2016–21**



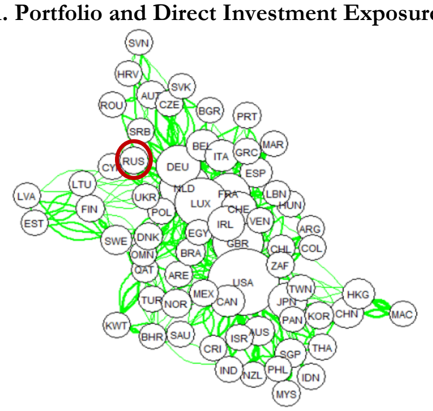

**2. Disagreement with the United States and China in UNGA Voting, 2016–21**



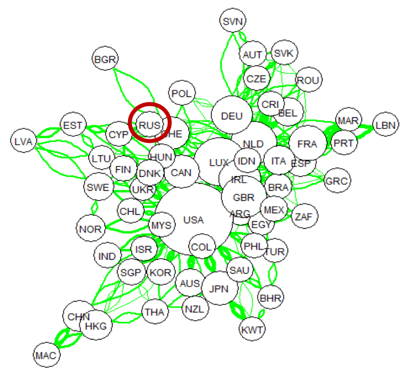

Sources: Häge (2011); Signorino and Ritter (1999); and IMF staff calculations.
Note: GPD = geopolitical distance measure given in (1) formula. The chart shows the distribution of countries' geopolitical distance to the United States, the European Union, and China, and shows that countries that disagree with the United States often disagree with the European Union, and countries that degree with China tend to disagree with the United States and the European Union.

**Online Annex Figure 3.3.4. Cross-Border Financial Network**

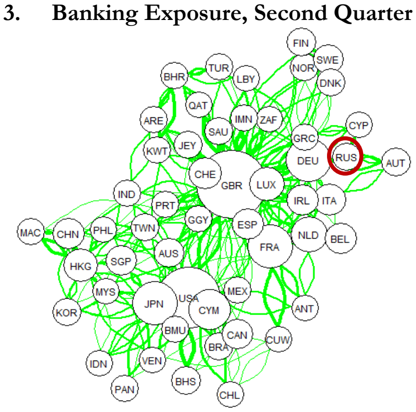
**1. Portfolio and Direct Investment Exposure, 2013**



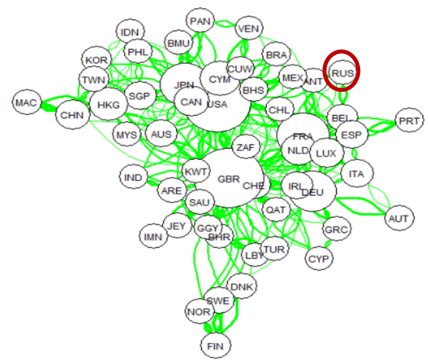

**2. Portfolio and Direct Investment Exposure, 2021**




**3. Banking Exposure, Second Quarter of 2013**



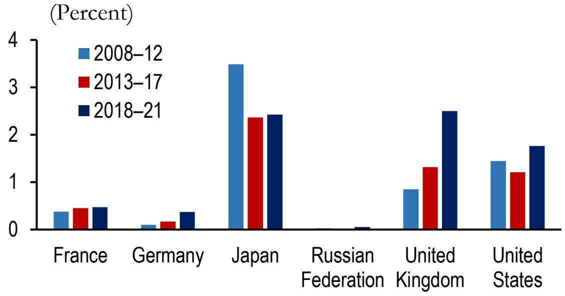

**4. Banking Exposure, Second Quarter of 2022**



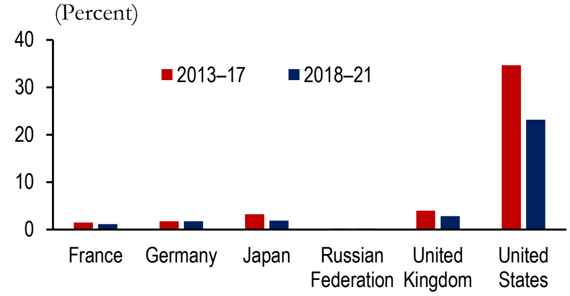

Sources: Bank for International Settlements, Locational Banking Statistics; FinFlows; IMF, Coordinated Direct Investment Survey; IMF, Coordinated Portfolio Investment Survey; and IMF staff calculations.
Note: The charts compare the global financial network for 2013 (before financial sanctions on Russia were imposed for its invasion of Crimea) and for the most recent available year (2021 for portfolio and direct investment and the second quarter of 2022 for banking claims). The width of the edges of the network represents the average share of the bilateral cross-border exposure (=sum of bilateral asset and liability relative to the total exposure of foreign asset and foreign liability positions). Edges smaller than 5 percent are trimmed. The red node represents Russia. The size of the nodes represents the share of each country in world total. Panels use International Organization for Standardization (ISO) country codes.

**Online Annex Figure 3.3.5. Selected Countries Financial Linkages with China**

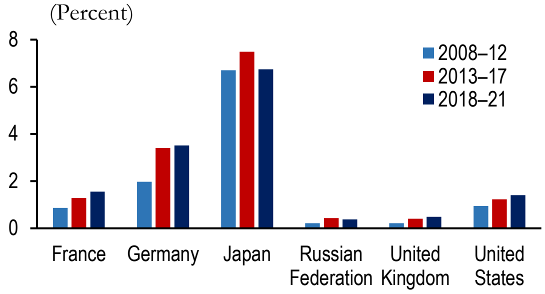
**1. Selected Countries' Portfolio Investment in China**
(Percent)



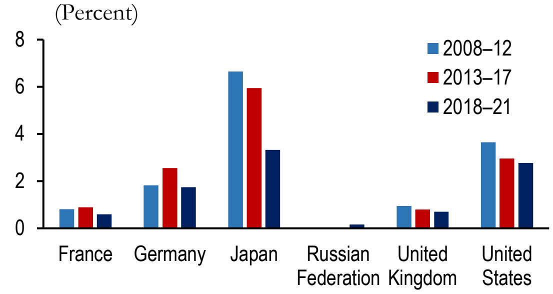

**2. Selected Countries' Portfolio Investment from China**
(Percent)




**3. Selected Countries' Outward Direct Investment to China**
(Percent)




**4. Selected Countries' Inward Direct Investment from China**
(Percent)




Sources: IMF, Coordinated Direct Investment Survey; IMF, Coodinated Portfolio Investment Survey; and IMF staff calculations.
Note: In panels 1 and 3, the bars represent the share of the specified country's investment in China. In panels 2 and 4, the bars represent the share of Chinese investment in the specified countries.

## Online Annex 3.4. Geopolitical Factors and Cross-Border Capital Allocation

To examine whether geopolitical factors matter for cross-border capital allocation, a "gravity" model is estimated following Portes and Rey (2005), Coeurdacier and Rey (2013), and Okawa and van Wincoop (2012),[3] and the following model is estimated as a baseline:

$$\log(X_{c,c',t}) = \beta \cdot Geopolitical\ Distance_{c,c',t-1} + \delta \cdot Gravity\ Controls\ _{c,c'} + +\nu_{c',t} + \nu_{c,t} + \epsilon_{c,c\prime,t} \quad (5),$$

where $X_{c,c\prime,t}$ is the portfolio share of recipient country *c* in the total cross-border allocation of source country *c'* at time *t*; $Geopolitical\ Distance_{c,c',t-1}$ is the (lagged) *S* measure of geopolitical distance of countries *c* and *c'*, based on their voting behavior in the UNGA (Signorino and Ritter 1999; Häge 2011),[4] and $Gravity\ Controls\ _{c,c'}$ include a large set of bilateral (country-pair-specific) variables that may reflect the degree of access to local information or affect the cost of financial transactions between the source and recipient countries, including (a) (log of) geographical distance (that is, distance in kilometers between the most populated cities in each country), (b) contiguity (a dummy variable equal to one if the countries share a common border), (c) common colonial history (a dummy variable equal to 1 if the countries share a common colonizer after 1945 and 0 otherwise); (d) common language (a dummy variable equal to one if the countries share a common language spoken by at least nine percent of the population, and 0 otherwise), (e) common religion (through an index variable bounded between 0 and 1 that is increasing if the country pair has a common religion by vast majority of populations)).[5] $\nu_{c',t}$ denote source country-time fixed effects to account for relevant time-varying characteristics of source country *c'*. $\nu_{c,t}$ denote recipient-country-time fixed effects to capture any relevant time-varying recipient country-specific factors. $\epsilon$ is an random error term. The model is estimated using ordinary least squares, and standard errors are clustered at the country-pair level (source-recipient country).

If source countries allocate a smaller share of their cross-border investment to countries that are geopolitically more distant, after controlling for bilateral gravity controls, then $\beta < 0$ holds.

Equation (5) is estimated using (a) bilateral country-level portfolio equity/bond fund investment data from the EPFR Global database at monthly or annual frequency[6]; (b) overall bilateral cross-border portfolio investment from the FinFlows/Coordinated Portfolio Investment Survey database, available at annual frequency;[7] and (c) quarterly bilateral cross-border claims of banks in country *c'* on country *c* (on all segments: banks, nonbank financials, nonfinancial corporations, households, and general government of country *c*; and in all currencies), provided by the Bank for International Settlements' Locational Banking Statistics.[8]

**Empirical Results**

***Equity and bond fund flows.*** Estimating equation (5) for portfolio equity and bond fund allocations shows that a higher geopolitical distance is associated with significantly lower fund cross-border allocation (Online Annex Table 3.4.1). The estimated effect is on average stronger for emerging market and developing economies compared to advanced economies, and robust to using alternative geopolitical distance measures. The results are not only statistically significant, but also economically relevant. An increase of one standard deviation in geopolitical distance of a recipient country to a source country (magnitude of which corresponds to the increase in foreign policy dissimilarity between the United States and China during trade tensions) is associated with a 25 percent decline in the share of the recipient country in the source country's cross-border equity or bond portfolio, as shown in columns (1) and (6), respectively.[9] The results are robust to several alternative specifications (available upon request): (1) controlling for bilateral trade; (2) controlling for recipient country macroeconomic fundamentals (while dropping recipient country-time fixed effects and including recipient country fixed effects), (3) excluding offshore financial centers from the source countries for which measuring bilateral geopolitical distance in relation to ultimate lenders is not feasible,

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[3] Okawa and van Wincoop (2012), in particular, provides theoretical foundations for gravity-type models in international finance, and links (log) of portfolio shares to bilateral information frictions (potentially reflected by, for example, differences in language and regulatory systems).
[4] The geopolitical distance measure is lagged to mitigate potential endogeneity concerns, for example, countries may adjust their UN voting.
[5] Gravity controls are obtained from CEPII Gravity Database (Conte, Cotterlaz, and Mayer 2022). Note that depending on the underlying data source, equation (5) may use variables with different frequencies. For example, portfolio shares are available at monthly frequency in the EPFR Global database, whereas geopolitical distances are available at yearly frequency. The way variables are lagged is compatible with the frequency of the variables. For instance, geopolitical distance is lagged by one year. The results are robust to using annual data consistently across all the variables.
[6] The EPFR Global database covers a large subset of cross-border portfolio investors, mainly mutual funds, exchange traded funds, closed-end funds, variable annuity funds, and insurance-linked funds. Koepke and Paetzold (2020) show that EPFR Global data have significant predictive content for balance of payment–based portfolio flows, rendering forecast errors that are on average 80–90 percent lower compared with an autoregressive model. The EPFR Global data also perform well in capturing stocks. For example, total allocation of EM-dedicated cross-border investment funds covered by the EPFR Global Research database accounts for one-third to one-half of the total stock of external portfolio liabilities of emerging markets (where external liabilities are obtained from External Wealth of Nations database of Lane and Milesi-Ferretti (2018), available at https://www.brookings.edu/2021/09/16/the-external-wealth-of-nations-september-2021-update/).
[7] It covers cross-border portfolio positions involving equity or debt securities, excluding cross-border direct investment or reserve assets.
[8] The data includes not only portfolio investments but also loans and equity ownership. Claims include loans, debt securities or other debt instruments, equity or investment fund shares, and financial derivatives.
[9] The estimated coefficient multiplied by the standard deviation of geopolitical distance (S measure) (which is equal to 0.30) implies 25.1 percent decline in portfolio equity share, and 24.51 percent decline in portfolio bond share. Also, gravity controls appear to have intended effect on portfolio shares (for example, similar in sign to the related literature), with lower geographic distance or closer cultural ties implying higher portfolio shares.

and (4) excluding the United States from the source countries (the largest portfolio investor country other than offshore financial centers;[10]

As noted, the results are also robust to using alternative measures of geopolitical distance, namely Häge (2011)'s pi and Bailey and others (2017)'s ideal point distance (IPD) measures (columns (4) and (5) for equity, and columns (9) and (10) for bonds), and imply effects of a similar magnitude.

**Online Annex Table 3.4.1. The Effect of Geopolitical Distance on Cross-Border Portfolio Equity and Bond Allocations**

| | Equity | | | | | Bond | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Recipients: | All | AEs | EMDEs | All | All | All | AEs | EMDEs | All | All |
| Geopolitical Distance Measure: | Baseline (S) | | | Pi | IPD | Baseline (S) | | | Pi | IPD |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Geopolitical Distance$_{ij,t-1}$ | -0.832*** | -0.404** | -0.945*** | -0.552*** | -0.315*** | -0.813*** | -0.321 | -0.399*** | -0.574*** | -0.311*** |
| | (0.148) | (0.177) | (0.257) | (0.101) | (0.053) | (0.141) | (0.348) | (0.139) | (0.097) | (0.051) |
| Distance$_{ij}$ | -0.358*** | -0.314*** | -0.584*** | -0.335*** | -0.349*** | -0.373*** | -0.431*** | -0.411*** | -0.340*** | -0.365*** |
| | (0.044) | (0.053) | (0.063) | (0.044) | (0.044) | (0.039) | (0.065) | (0.053) | (0.039) | (0.038) |
| Common Language$_{ij}$ | 0.312*** | 0.315*** | 0.280*** | 0.294*** | 0.306*** | 0.059 | 0.132* | -0.000 | 0.043 | 0.054 |
| | (0.060) | (0.073) | (0.073) | (0.060) | (0.060) | (0.053) | (0.079) | (0.055) | (0.053) | (0.053) |
| Common Colonial History$_{ij}$ | 0.544** | 0.282 | 0.294 | 0.485** | 0.480** | 0.099 | 0.292 | 0.194 | 0.020 | 0.013 |
| | (0.216) | (0.309) | (0.225) | (0.224) | (0.220) | (0.241) | (0.390) | (0.282) | (0.249) | (0.247) |
| Common Religion Index$_{ij}$ | -0.114 | -0.177 | -0.052 | -0.123 | -0.119 | 0.150 | 0.205* | 0.145** | 0.147 | 0.145 |
| | (0.106) | (0.125) | (0.122) | (0.105) | (0.105) | (0.114) | (0.110) | (0.067) | (0.114) | (0.114) |
| Contiguity$_{ij}$ | 0.089 | -0.088 | 0.139 | 0.108 | 0.101 | -0.038 | -0.220* | 0.061 | -0.009 | -0.025 |
| | (0.138) | (0.127) | (0.220) | (0.137) | (0.137) | (0.132) | (0.120) | (0.211) | (0.130) | (0.131) |
| Source Country x Month Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Recipient Country x Month Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 358,841 | 134,912 | 223,929 | 358,841 | 358,340 | 331,166 | 106,523 | 224,643 | 331,166 | 331,108 |
| R-squared | 0.892 | 0.859 | 0.902 | 0.892 | 0.893 | 0.864 | 0.861 | 0.925 | 0.865 | 0.864 |

Source: IMF staff calculations.

Note: The dependent variable is (log) share of country i in country j's total cross-border portfolio investment (for equity (columns (1) to (5)) and bonds (columns (6) to (10)), separately). Standard errors are clustered at source-recipient country, and provided in parantheses. Significance levels: 10 percent indicated by *, 5 percent indicated by **, 1 percent indicated by ***. "Yes" indicates that corresponding fixed effects are included. AE = advanced economy, EMDE = emerging market and developing economy.

***Overall portfolio flows.*** Estimating the model in equation (5) with FinFlows and Coordinated Portfolio Investment Survey data (which have broader coverage of investors but are sampled at annual frequency) leaves the qualitative conclusions broadly unchanged (Online Annex Table 3.4.2, columns 1 through 5). Numerically, the results suggests that an increase of one standard deviation in geopolitical distance of a recipient country to a source country is associated with a 14 percent decline in the share of the recipient country in the source country's international portfolio (Online Annex Table 3.4.2, column 1). Because this magnitude is lower than the 25 percent estimated previously for investment funds, other portfolio investors seem to be less responsive to changes in the geopolitical landscape than investment funds. One important difference to the baseline results is that the estimated coefficient on geopolitical distance is not significant when the model is estimated for emerging market and developing economies only—although it continues to be negative. The results are also robust to using alternative geopolitical distance measures (Online Annex Table 3.4.2, columns 4 and 5).

***Cross-border banking.*** Previous results hold qualitatively for cross-border banking claims (Online Annex Table 3.4.2, columns 6 through 10). The results are robust to using alternative geopolitical distance measures (Online Annex Table 3.4.2, columns 9 and 10).

[10] Offshore financial centers are jurisdictions that provide financial services disproportionate to its size and the financing of the domestic economy. Based on a measure of corporates with few or no employees, little or no production in the host economy, and little or no physical presence, Damgaard and others (2018) provide the following list of offshore financial centers: Bermuda, British Virgin Islands, Cayman Islands, Hong Kong SAR, Ireland, Luxembourg, The Netherlands, and Singapore. For a wider list and criteria and further discussion, see also IMF (2000).

**Online Annex Table 3.4.2. Geopolitical Distance: Overall Portfolio Investment and Banking Claims**

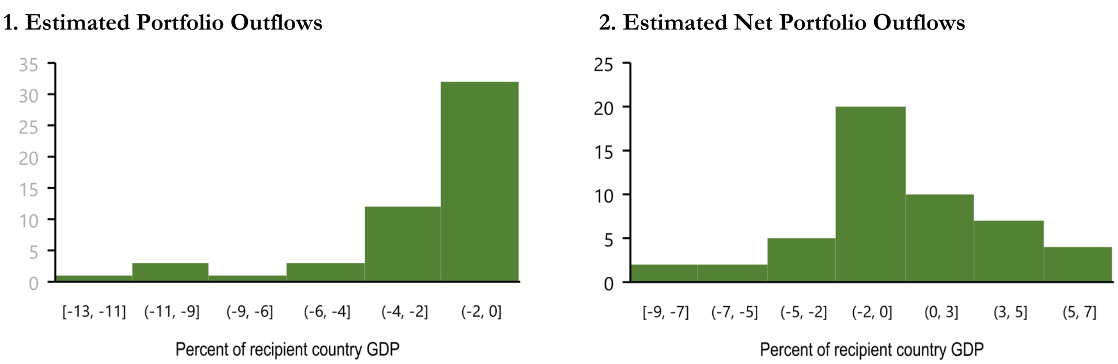
| | Overall Cross-border Portfolio Allocations (FINFLOWS/CPIS) | | | | | Cross-border Banking Claims Allocation (BIS-LBS) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Recipients: | All | AEs | EMDEs | All | All | All | AEs | EMDEs | All | All |
| Geopolitical Distance Measure: | Baseline (S) | | | Pi | IPD | Baseline (S) | | | Pi | IPD |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Geopolitical Distance$_{ij,t-1}$ | -0.449** | -0.928*** | -0.196 | -0.517*** | -0.162*** | -0.531* | -0.474 | -0.220 | -0.655*** | -0.252** |
| | (0.190) | (0.334) | (0.328) | (0.121) | (0.062) | (0.318) | (0.511) | (0.628) | (0.234) | (0.123) |
| Distance$_{ij}$ | -0.706*** | -0.628*** | -0.904*** | -0.669*** | -0.704*** | -1.281*** | -1.038*** | -1.739*** | -1.249*** | -1.279*** |
| | (0.041) | (0.058) | (0.066) | (0.043) | (0.042) | (0.084) | (0.121) | (0.114) | (0.086) | (0.085) |
| Common Language$_{ij}$ | 0.617*** | 0.597*** | 0.534*** | 0.601*** | 0.613*** | 0.796*** | 0.447** | 1.137*** | 0.774*** | 0.792*** |
| | (0.084) | (0.115) | (0.132) | (0.083) | (0.084) | (0.126) | (0.184) | (0.142) | (0.127) | (0.126) |
| Common Colonial History$_{ij}$ | 0.261 | 0.822* | -0.077 | 0.136 | 0.230 | -- | -- | -- | -- | -- |
| | (0.267) | (0.488) | (0.356) | (0.278) | (0.270) | | | | | |
| Common Religion Index$_{ij}$ | 0.778*** | 1.001*** | 0.728*** | 0.773*** | 0.776*** | 1.098*** | 2.023*** | 0.154 | 1.106*** | 1.100*** |
| | (0.135) | (0.155) | (0.194) | (0.135) | (0.135) | (0.239) | (0.302) | (0.264) | (0.239) | (0.239) |
| Contiguity$_{ij}$ | -0.023 | -0.176 | 0.204 | -0.000 | -0.018 | -0.570** | -0.324 | 0.292 | -0.552* | -0.565** |
| | (0.143) | (0.153) | (0.272) | (0.141) | (0.142) | (0.286) | (0.283) | (0.398) | (0.285) | (0.286) |
| Source Country x Month Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Recipient Country x Month Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 22,094 | 11,147 | 10,947 | 22,094 | 22,047 | 77,283 | 27,465 | 49,818 | 77,283 | 77,103 |
| R-squared | 0.813 | 0.812 | 0.763 | 0.814 | 0.813 | 0.790 | 0.769 | 0.746 | 0.790 | 0.790 |

Source: IMF staff calculations.

Note: The dependent variable is (log) share of country *i* in country *j*'s total cross-border investment. Standard errors are clustered at source-destination country, and provided in parantheses. Significance levels: 10 percent indicated by *, 5 percent indicated by **, 1 percent indicated by ***. "Yes" indicates that corresponding fixed effects are included. Columns 6 through 10 exclude offshore financial centers (for example, Damgaard and others 2018) from source countries (Bermuda, British Virgin Islands, Cayman Islands, Hong Kong SAR, Ireland, Luxembourg, The Netherlands, and Singapore). AE = advanced economy, EMDE = emerging market and developing economy.

***Predicting the effect on aggregate capital outflows from changes in bilateral capital allocation.*** Previous results suggest that higher geopolitical distance is associated with smaller portfolio investment allocation by source countries. This could potentially translate into significant outflows from recipient countries relative to the size of these economies. To assess the possible magnitude of such outflows, the estimates obtained in Online Annex Tables 3.4.1 and 3.4.2 are used (Online Annex Figure 3.4.1).[11] In particular, if a recipient country becomes one-standard-deviation geopolitically more distant to the source countries that were already relatively distant (that is, those source countries that were above the median geopolitical distance measure), the reduction in portfolio investment amounts to about 3 percent of GDP on average. The effect is highly heterogeneous and could be as large or more than 10 percent of GDP (Online Annex Figure 3.4.1, panel 1) and could be lower in case recipient country gets geopolitically closer to some source countries, in particular to those that are below the median distance (Online Annex Figure 3.4.1, panel 2).

**Online Annex Figure 3.4.1. Predicted Portfolio Outflows**
(Number of countries)




Sources: IMF staff calculations.

Note: Panel 1 plots the estimated portfolio outflows in response to an increase of one standard deviation in geopoliticaly distance in relation to lenders that were above-median distance before the shock (using the estimated coefficient in Online Annex Table 3.4.2, panel 1, column 1), normalized by recipient country GDP. Panel 2 plots the estimated net portfolio outflows, assuming in addition that the recipient country gets geopolitically closer to the lenders that were below-median distance before the shock (using the same estimated coefficient in panel 1).

***Further robustness tests.*** The aforementioned results are also qualitatively robust to using logistic transformation of portfolio share; using the Poisson Pseudo-Maximum Likelihood estimation; using end-of-the-year portfolio allocations (for databases with higher frequency than annual); and studying emerging markets rather than EMDEs (results available upon request). They are also broadly robust to using bilateral arms trade is an alternative measure of geopolitical distance (Online Annex Figure 3.4.2).

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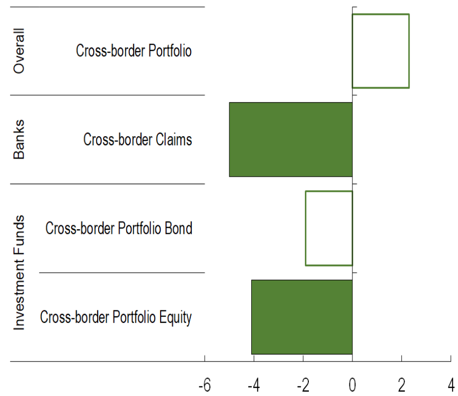
[11] To translate the estimated percent change in portfolio allocations into the amount of outflows, the estimated percent change in the allocation is multiplied by the bilateral portfolio allocation and the standard deviation of geopolitical distance. This measure is then divided by recipient country nominal GDP. The results are broadly robust to using bilateral country group-specific standard deviations of geopolitical distances (AEs in relation to AEs, AEs in relation to EMDEs, EMDEs in relation to EMDEs).

***Is geopolitical distance more relevant recently?*** Estimating equation (5) for two periods (2000–15 and 2015–21) shows that geopolitical distance matters more in the recent years for cross-border portfolio bond investment compared to earlier periods. This result is robust across geopolitical distance measures. Yet, the evidence for equity investment poses a mixed picture, where the effect of geopolitical distance is lower in the recent period. Considering overall portfolio investment, there is some evidence that geopolitical distance matters particularly in the recent period (based on the *S* and IPD measures), though the difference does not seem to be statistically significant and does not hold for the pi measure (results available upon request).

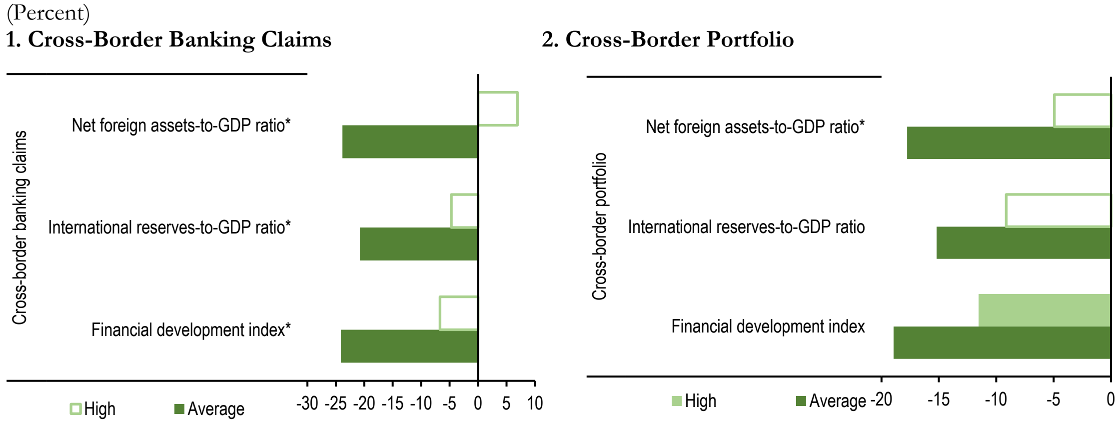
***Country heterogeneity.*** To assess whether results differ across different types of recipient countries, equation (5) is augmented with interaction terms of the geopolitical distance variable with (lagged) recipient country characteristics (keeping all else constant in the empirical framework). The recipient country characteristics considered for this exercise are the financial development index, international reserves and net financial assets relative to GDP. The results suggest that lenders reduce their cross-border capital allocations more strongly for (ex ante) less financially developed countries, or countries with low international reserves and net foreign assets.

**Online Annex Figure 3.4.2. Change in Cross-Border Capital Allocation After a Decline of One Standard Deviation in Bilateral Arms Trade**
(Percent)




Source: IMF staff calculations.
Note: The bars show the estimated percent change in portfolio investments and banking claims by the source country in response to a decline of one standard deviation in arms trade between the source and the recipient countries, where arms trade is normalized by the geometric mean of the countries' GDPs. The solid bars indicate statistical significance at the 10 percent or lower level.

**Online Annex Figure 3.4.3. Country Heterogeneity**
(Percent)




Source: IMF staff calculations.
Note: Panel 1 plots the percent change in cross-border banking claims allocation, depending on whether the recipient country is ex ante at the upper quartile of the distribution of financial development, international reserves-to-GDP ratio, or net foreign assets-to-GDP ratio ("high") or at the lowest three quartiles ("average" for the sake of brevity). Panel 2 plots results from a similar exercise, based on overall portfolio allocation using FinFlows/Coordinated Portfolio Investment Survey. The solid bars indicates statistical significance at 10 percent. The asterisk next to an indicator means the difference between average and high is statistically significant at 10 percent.

## Online Annex 3.5. The Effect of Geopolitical Tensions on Capital Flows and Remittances

### Country-Level Analysis of Cross-Border Capital Flows

By altering investor preferences and bilateral cross-border asset allocation, geopolitical shocks could adversely affect aggregate (net) capital flows to recipient countries. To empirically examine whether this is the case, the following regression is estimated:

$$y_{c,t} = \beta\, AGPD_{c,t-1} + \mu_c + v_t + Macro\ Controls_{c,t-1} + e_{c,t} \quad (6)$$

where $y_{c,t}$ denotes total net capital flows to GDP (alternatively net portfolio flows to GDP, portfolio liability flows to GDP, net FDI flows to GDP, FDI liability flows to GDP) in country *c* at time *t*. $\mu_c$ and $v_t$ denote country-fixed and time effects, respectively.

$AGPD_{c,t}=\sum_{c'}(CBLE_{c,c',t-1} \cdot Geopolitical\ Distance_{c,c',t})$ is the average change in geopolitical distance, calculated as the weighted average of bilateral disagreement in the UNGA between countries *c* and *c'*, with weights defined by $CBLE_{c,c',t-1}$. $CBLE_{c,c',t-1}$ are the (lagged) cross-border liability exposure of country *c* to country *c'* normalized by the total cross-border liabilities of country *c*.[12]

$Macro\ Controls_{c,t-1}$ include (lagged) country-level variables that could affect capital flows, such as real GDP growth, log of real GDP per capita, real interest rate differential against the United States, real exchange rate deviation from the trend, exchange rate regime (flexibility), institutional quality, and financial openness.[13] If capital flows to the recipient country are disrupted by geopolitical shocks, then $\beta < 0$.

Annual data on (net) capital inflows are obtained from the IMF Balance of Payment Statistics. Data for all other variables are obtained from the World Economic Outlook database, International Financial Statistics, World Development Indicators, and Haver. The data on financial openness, institutional quality, and exchange rate flexibility come from the Chinn-Ito Index (Chinn and Ito 2006), the ICRG database, and the dataset of Ilzetzki, Reinhart, and Rogoff (2019), respectively. The sample covers 56 countries for the 2001–21 period.[14] The regression results for the effect of geopolitical shocks on net capital flows to GDP and net/liability portfolio flows to GDP are presented in Figure 3.8 in the main text.[15]

### The Effect on Cross-Border Remittances

To assess the effect of geopolitical tensions on cross-border remittances (Box 3.1), the effect of financial sanctions on the cost and volume of remittances to sanctioned countries (relative to changes observed globally) is examined through cumulative abnormal returns (CAR) analysis. Specifically, the following model is estimated at the country level:

$$\Delta Cost_{i,t} = \alpha_i + \beta_i \Delta Cost_{global,t} + \Gamma_i Controls_{i,t-1} + \epsilon_{i,t}^{Cost} \quad (7)$$

where $\Delta Cost_{i,t}$ is the change in the remittance cost ratio of total cost to the remitted 200 US dollars to country $i$, $\Delta Cost_{global,t}$ is the change in the global remittance cost ratio (average across all countries), and $Controls_{i,t-1}$ denotes control variables such as domestic real GDP growth rate, the change in nominal exchange rates, inflation rate, current account balance to GDP, and the unemployment rate.

For each sanction event, the estimated coefficients ($\widehat{\alpha_i}, \widehat{\beta_i}, \widehat{\Gamma_i}$) in equation (7) are used to compute the expected change in the remittance cost ratio $\tau$ quarters after sanctions are imposed, as follows: $\hat{\mu}_{i,t,\tau}^{\Delta Cost} = \widehat{\alpha_i} + \widehat{\beta_i}\Delta Cost_{global,t} + \widehat{\Gamma_i}\ Controls_{i,t}$. The corresponding abnormal change in cost ratio is given by $AC_{i,t,\tau} = \Delta Cost_{i,t} - \hat{\mu}_{i,t,\tau}^{\Delta Cost}$, and the cumulative abnormal change is computed by summing up the abnormal changes for up to six quarters after the sanction is imposed. A similar procedure is carried out to calculate the abnormal growth of remittance volume.

To estimate equation (7), quarterly remittance cost data is obtained from the World Bank Remittance Prices Worldwide database and covers the period between the fourth quarter of 2012 and the second quarter of 2022. This includes 367 country corridors worldwide with 105 receiving countries and 48 sending countries. The quarterly (aggregate) remittance volume data is obtained from the IMF Balance of Payment Statistics and spans the period between the first quarter of 1980 and the second quarter of 2022 for 55 recipient countries. The data on financial sanctions is obtained from the Global Sanctions Database by Kirilakha and others (2021). The annual data of the Global Sanctions Database is converted to quarterly frequency by identifying the timing of sanctions using the announcement of the sanctions by authorities including the UN Security Council, US Treasury, US State Department, EUR-Lex, and information from EU Sanctions Map and various news articles. For countries with missing announcements, it is assumed that all sanctions were imposed in the fourth quarter of the specified year.

[12] When the dependent variable is net portfolio flows over GDP or portfolio liability flows over GDP, the weights are given by the portfolio liability exposure of the reference country to all other countries. When the dependent variable is net FDI flows over GDP or FDI liability flows over GDP, the weights are given by the FDI liability exposure of the reference country to all other countries.

[13] See, for example, Ghosh and others (2014).

[14] Missing data points regarding financial openness (in 2021) and exchange rate regimes (after 2019) are extrapolated with previous values. The results are robust without extrapolation.

[15] The full set of results (with all control variables) for this exercise is available upon request.

## Online Annex 3.6. Geopolitical Tensions and Banking Stability

To assess the effect of geopolitical shocks on banking sector stability, the analysis uses unconsolidated annual bank-level financial statements data from Fitch Connect for 30 advanced and 20 emerging and developing countries from 2001 to 2021. The Bank for International Settlements' Locational Banking Statistics are used to calculate a measure of gross cross-border exposures of these countries to a large set of source economies (through banking claims), and the following specification is estimated:

$$Y_{b,c,t} = \beta_1 \cdot AGPD_{c,t-1} + \beta_2 \cdot AGPD_{b,c,t-1} * HIGH(AGPD_{c,t-1}) + BankControls_{b,c,t-1} + MacroControls_{c,t-1} + \rho Y_{b,c,t-1} + \mu_b + \nu_t + \epsilon_{b,c,t} \quad (8)$$

where $Y_{b,c,t}$ denotes the following bank outcome variables: cost of funding (=total interest expenses relative to total average interest-bearing liabilities); profitability (=(log) operating profits relative to total assets); and banks' lending (=(log) outstanding real loans (gross loans in local currency terms divided by domestic consumer price index), of bank *b* in country *c* at year *t*.

$AGPD_{c,t} = \sum_{c'}(CBBE_{c,c',t-1} \cdot Geopolitical\ Distance_{c,c',t})$ denotes the weighted-average bilateral geopolitical distance between countries *c* and *c'*, with $CBBE_{c,c',t-1}$ indicating the weights defined as the (lagged) size of bilateral cross-border claims on country *c* of the banking sector in country *c'*, normalized by the total cross-border bank claims on country *c* (based on the Bank for International Settlements' Locational Banking Statistics). To explore any nonlinear effects of geopolitical distance on the banking sector, $AGPD_{c,t-1}$ is interacted with a dummy variable, $HIGH\left(AGPD_{c,t-1}\right)$, which takes a value one if $AGPD_{c,t-1}$ is higher than the 75th percentile of the distribution of $AGPD_{c,t-1}$ (the thresholds estimated separately for EMDEs and AEs) (considered as highly geopolitically distant financial partners), and 0 otherwise.

$BankControls_{b,c,t-1}$ are bank (log) total assets (measured in US dollars), bank capital ratio (equity-to-total assets ratio), liquidity ratio (liquid assets-to-total assets), asset quality (nonperforming loans-to-gross loans ratio), and profitability (operating profits-to-total assets), all measured with a one-period lag. $MacroControls_{c,t-1}$ include country-level variables such as real GDP growth, economic size (log nominal GDP in US dollars), inflation (consumer price index–based annual inflation), net capital flows-to-GDP ratio, short-term deposit rates, long-term government bond yields, and institutional quality index (comprising of measures of bureaucracy quality, corruption, democratic accountability, government stability and law and order from the International Country Risk Guide database). $\mu_b$ and $\nu_t$ denote bank and time fixed effects, respectively.

If following an increase in geopolitical distance of country *c* in relation to its lenders, banks in country *c* are adversely affected, through higher funding costs and lower profitability, and reduce bank lending, then $\beta_1 < 0$. If the effect of geopolitical shocks is larger at higher levels of geopolitical distance, then $\beta_2 < 0$. Equation (8) is estimated separately for a sample of advanced and emerging and developing economies. In addition, to assess whether the effect of geopolitical shocks varies according to bank capitalization, equation (8) is estimated separately for less (more) well-capitalized banks, defined as those with equity-to-total assets ratio below (above) the 75th percentile of equity-to-total assets ratio of banks within a country in a given year.

The results show that after an increase in geopolitical distance in relation to nonresident lenders, banks' funding costs (interest expenses-to-interest-bearing liabilities) increase and profits decline. In line with this finding, bank lending contracts. The estimated effects are stronger for emerging market and developing economies compared to advanced economies, and suggest the presence of nonlinear effects, particularly for bank lending (Online Annex Table 3.6.1). The effect is also more pronounced for less well-capitalized banks relative to more well-capitalized banks in emerging and developing economies (Online Annex Table 3.6.2).

**Online Annex Table 3.6.1. The Effect of Higher Geopolitical Distance on Bank Stability**

| Dependent Variable: | Cost of Funding | Profitability | Real Gross Loans | Cost of Funding | Profitability | Real Gross Loans |
|---|---|---|---|---|---|---|
| Sample: | EMDEs | | | AEs | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $AGPD_{c,t-1}$ | 0.023*** | -0.496*** | -0.267*** | 0.005*** | -0.422*** | 0.132*** |
| | (0.005) | (0.174) | (0.094) | (0.001) | (0.082) | (0.028) |
| $AGPD_{c,t-1}$ * I(High Distance)$_{c,t-1}$ | -0.005** | -0.018 | -0.284*** | 0.003*** | 0.057** | 0.029*** |
| | (0.002) | (0.104) | (0.046) | (0.000) | (0.026) | (0.009) |
| Bank Controls | Included | Included | Included | Included | Included | Included |
| Country Macro Fundamentals | Included | Included | Included | Included | Included | Included |
| Bank Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 11,334 | 10,311 | 12,041 | 39,930 | 34,708 | 40,521 |
| R-squared | 0.861 | 0.602 | 0.999 | 0.900 | 0.729 | 0.998 |
| # of banks | 1404 | 1340 | 1417 | 4,188 | 4,037 | 4,209 |
| # of countries | 20 | 20 | 20 | 30 | 30 | 30 |

Sources: IMF staff calculations.

Note: Standard errors are clustered at the bank level. All columns include lagged dependent variable. Significance levels: 10 percent indicated by *, 5 percent indicated by **, 1 percent indicated by ***. Expanded set of results are available upon request.

**Online Annex Table 3.6.2. The Effect of Higher Geopolitical Distance on Less versus More Well-Capitalized Banks in Emerging Market and Developing Economies**

| Sample: | High Capital Ratio Banks | | | Low Capital Ratio Banks | | |
|---|---|---|---|---|---|---|
| Dependent Variable: | Cost of Funding | Profitability | Real Gross Loans | Cost of Funding | Profitability | Real Gross Loans |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $AGPD_{c,t-1}$ | 0.015 | -0.175 | 0.032 | 0.024*** | -0.703*** | -0.279*** |
| | (0.010) | (0.443) | (0.242) | (0.004) | (0.160) | (0.081) |
| $AGPD_{c,t-1}$ * I(High Distance)$_{c,t-1}$ | -0.010* | -0.020 | -0.153 | -0.006** | -0.152 | -0.259*** |
| | (0.005) | (0.223) | (0.118) | (0.002) | (0.100) | (0.040) |
| Bank Controls | Included | Included | Included | Included | Included | Included |
| Country Macro Fundamentals | Included | Included | Included | Included | Included | Included |
| Bank Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 2,735 | 2,428 | 2,935 | 10,618 | 9,548 | 11,205 |
| R-squared | 0.852 | 0.681 | 0.998 | 0.864 | 0.598 | 0.999 |
| # of banks | 569 | 521 | 590 | 1,417 | 1,341 | 1,445 |
| # of countries | 19 | 18 | 19 | 20 | 20 | 20 |

Sources: IMF staff calculations.

Note: Standard errors are clustered at the bank level. All columns include lagged dependent variable. Significance levels: 10 percent indicated by *, 5 percent indicated by **, 1 percent indicated by ***. Expanded set of results are available upon request.

## Online Annex 3.7. Financial Fragmentation and Macro-Financial Volatility

### The Effect of External Shocks on Capital Flows

To examine whether financial fragmentation increases a country's exposure to adverse external shocks, the effect of a change in the foreign monetary policy rate—defined as the monetary policy rate of a country's major financial partner—on net capital flows (to GDP) is estimated for countries with a high and low degree of concentration in their international financial positions, through the following equation:[16]

$$FlowsToGDP_{i,t+h} = \mu_i + \zeta_h^* InterestRate_{it}^* + \kappa' Control_{it} + v_t + e_{i,t+h}, \qquad (9)$$

where $FlowsToGDP_{it}$ is total net capital flows to GDP for country *i* at time *t+h* (where h=1, 2…*H*), $InterestRate_{it}^*$ is the interest rate in country $i$'s largest financial partner, and $Control_{it}$ is a vector of controls (lagged domestic real GDP growth, domestic interest rate spread relative to the United States, the Chinn-Ito financial openness measure, domestic real effective exchange rate deviation from trend, and domestic current account balance to GDP.[17] $\mu_i$ are country-specific fixed-effects and $v_t$ are time-fixed effects to capture the effect of common shock across countries. Equation (9) is estimated through the local projections method, and $\zeta_h^*$ is the impulse response at horizon $h$ for $h = 1, \ \ldots, H$ of the dependent variable to the interest rate of country $i$'s largest financial partner. $\kappa$ is a vector of coefficients on the control variables, and $e_{i,t+h}$ is an error term.

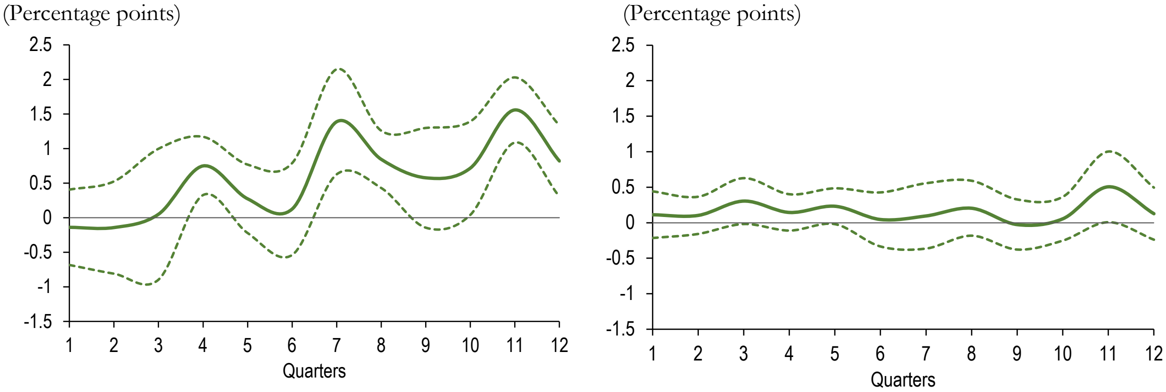
The panel local projections are estimated using quarterly data from the first quarter of 2000 to the fourth quarter of 2021 for 24 advanced economies and 18 emerging market economies. Equation (8) is separately estimated for countries with HHI of international investment positions greater (lower) than the sample median to capture high (low) degree of concentration, where the HHI is computed using equation (3).

As shown in Figure 3.10 in the main text, the results suggest that net capital inflows (in percent of GDP) to emerging market economies with a high degree of concentration decline significantly after an increase in foreign interest rates, but those to countries with a low degree of concentration are not significantly affected. Net capital flows to advanced economies do not appear to be significantly affected, irrespective of the concentration of their international investment portfolios (Online Annex Figure 3.7.1).

**Online Annex Figure 3.7.1. Cumulative Impulse Response of Net Capital Flows to GDP to an Increase in Foreign Interest Rates**

**1. Advanced Economies with a High Degree of Concentration**
(Percentage points)

**2. Advanced Economies with a Low Degree of Concentration**
(Percentage points)




Source: IMF staff calculations.
Note: In panels 1 and 2, the horizontal axis indicates the number of quarters after an increase in foreign monetary policy rate (defined as the policy rate of a country's largest financial partner) of 100 basis points. The dotted lines represent 95 percent confidence bands.

### The Effect of Foreign Exposure Concentration on Net Capital Flow Volatility

The increase in concentration of foreign liability exposures could increase the volatility of capital flows because of limited risk diversification opportunities for recipient countries in the face of external shocks. To study if this is the case, the following regressions are estimated:

$$Net\ Capital\ Inflows/GDP_{c,t} = \mu_c + v_t + \alpha' Controls_{c,t-1} + e_{c,t}, \qquad (10)$$

[16] High concentration could be driven by geopolitical factors, but also other factors (such as closer historical ties). It is possible that higher concentration driven because of reducing exposure to geopolitical rival countries that could become a source of future shocks may lower capital flow volatility in the longer-term.
[17] Lags are taken to mitigate potential endogeneity concerns between the control variables and the dependent variable. As the data is at quarterly frequency, four lags of each control variable are used.

$$|e|_{c,t} = \mu_c^e + v_t^e + \beta HHI_{c,t-1}^L + \epsilon_{c,t}, \qquad (11)$$

where $Net\ Capital\ Inflows/GDP_{c,t}$ is total net capital flows to GDP of country $c$ at time $t$, $\mu_c$ and $\mu_c^e$ denote country-fixed effects, $v_t$ and $v_t^e$ denote time effects, $Controls_{c,t-1}$ include (lagged) country-level variables that could potentially affect capital flows such as domestic real GDP growth, real interest rate differential against the United States, current account balance to GDP, real exchange rate deviation from the trend, exchange rate regime, institutional quality, and financial openness, and $e_{c,t}$ and $\epsilon_{c,t}$ are error terms. In equation (11), $|e|_{c,t}$ is the absolute value of the residuals from the country-specific mean, and $HHI_{c,t-1}^L$ is the (lagged) HHI of cross-border liability exposures to partner countries computed using equation (4). Equations (10) and (11) are estimated for a sample of 56 advanced and emerging market economies covering the period from 2001 to 2020.[18] If capital flow volatility is amplified by an increase in the concentration of cross-border liability exposures, then $\beta > 0$. The full set of regression results is summarized below in Online Annex Table 3.7.1.[19]

**Online Annex Table 3.7.1. Concentration of Cross-Border Exposures and Capital Flow Volatility**

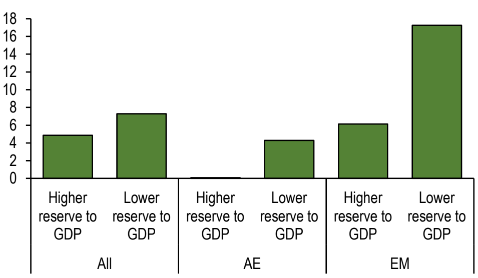
Dependent variable: **total net flows to GDP**

| | (1) total net flows to GDP | (2) absolute value of the residuals in (1) (from the country-specific mean) | (3) absolute value of the residuals in (1) (from the country-specific mean) |
|---|---|---|---|
| Financial openness (Chinn-Ito Index) | -1.148*** | | |
| Exchange rate regime (degree of flexibility) | 0.357 | | |
| Institutional quality | 0.405 | | |
| Current account over GDP (deviation from trend) | -0.334*** | | |
| Real GDP growth | 0.267** | | |
| Real effective exchange rate (deviation from trend) | -0.029 | | |
| Real interest rate differentials (domestic - USA) | -0.064 | | |
| **HHI (cross-border liability exposure)** | | **5.459*** ** | |
| **x Advanced Economies** | | | **2.885*** |
| **x Emerging Market Economies** | | | **6.491*** ** |
| Country fixed effects | Yes | Yes | Yes |
| Time fixed effects | Yes | Yes | Yes |
| Countries | 56 | 56 | 56 |
| Observations | 1,058 | 1,058 | 1,058 |
| R squared | 0.58 | 0.29 | 0.29 |

Source: IMF staff calculations.
Note: All explanatory variables are one-year lagged. Standard errors are clustered at the country level. Significance levels: 10 percent indicated by *, 5 percent indicated by **, 1 percent indicated by ***.

**Online Annex Figure 3.7.2. The Effect of Concentration of Portfolio Liabilities on Capital Flows Volatility and the Role of Reserve Adequacy**

(Percent of GDP)




Sources: FinFlows; Coordinated Direct Investment Survey; Coordinated Portfolio Investment Survey; and IMF staff calculations.
Note: The panel shows the effect of an increase in the foreign portfolio concentration measure (captured by the Herfindahl–Hirschman Index of portfolio and direct investment liability exposures) from 0 (full diversification) to 1 (full concentration). Countries with reserve assets to GDP ratio higher than top two thirds (lower than bottom one third) of the sample are classified as higher (lower) reserve to GDP. AE = advanced economies; EM = emerging market economies. The solid bars indicate statistical significance at the 10 percent level or lower.

### The Role of International Reserve Adequacy

The effect of concentration on capital flow volatility could be conditional on the stock of international reserve assets held by countries. To examine the potential effect of reserves in mitigating the effect of financial concentration on capital flow volatility, equation (11) is estimated for two subsamples: countries with (lagged) reserves-to-GDP ratio that falls in the top two-thirds of the entire distribution of reserves to GDP, and countries with (lagged) reserves-to-GDP ratio in the bottom one-third of the sample distribution.

The results presented below suggest that the effect of higher concentration (high HHI) is more pronounced when countries have lower reserves-to-GDP in both advanced and emerging market economies (Online Annex Figure 3.7.2).

[18] Safe-haven advanced economies such as Germany, Japan, Switzerland, and the United States are excluded from this analysis, but the results remain broadly robust if these countries are included. The end of the sample period is 2020 because a proxy for exchange rate regime (Ilzetzki, Reinhart, and Rogoff 2021) is available only until 2019.

[19] One of the factors that could affect volatility of capital flows is the volatility of macro-financial variables (such as output) in the source countries (and its correlation with the volatility of macro-financial variables in the recipient country). If this volatility (correlation) is stable over time or across countries, this effect is captured in the individual country or time fixed effects, respectively.

**Financial Fragmentation and Macro-Financial Volatility in G7 Economies**

To estimate the effect of financial fragmentation on macro-financial volatility and the resultant loss of diversification benefits in the Group of Seven (G7) economies (Box 3.2), the two-country open economy model of Coeurdacier, Kollmann, and Martin (2010) is applied. The approach is as follows:

***Scenarios***. The two-country open economy model of Coeurdacier, Kollmann, and Martin (2010) is applied by considering the home country as any of the G7 economies and the foreign country as the rest of the world. In the "full integration" scenario, the rest of the world is composed of other G7 economies and the 53 largest (non-G7) economies—ranked based on nominal GDP in 2021. In the "moderate" and "extreme" fragmentation scenarios, countries are ordered according to the average of their bilateral geopolitical distance from the (G7) home country and excluded from being a trading partner if their distance to the home country exceeds the top 25th and 50th percentiles of the cross-country distribution, respectively.[20] Online Annex Table 3.7.2 lists the economies that are included under each scenario.

**Online Annex Table 3.7.2. Economies Included in Different Scenarios**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | United States | XXX | 16 | Mexico | XX | 31 | Nigeria | XX | 46 | Romania | XXX |
| 2 | China | X | 17 | Indonesia | X | 32 | Egypt | X | 47 | Czech Republic | XXX |
| 3 | Japan | XXX | 18 | Netherlands | XXX | 33 | United Arab Emirates | X | 48 | Portugal | XXX |
| 4 | Germany | XXX | 19 | Saudi Arabia | X | 34 | South Africa | XX | 49 | New Zealand | XXX |
| 5 | United Kingdom | XXX | 20 | Türkiye | XXX | 35 | Bangladesh | X | 50 | Peru | XX |
| 6 | India | X | 21 | Switzerland | XXX | 36 | Denmark | XXX | 51 | Greece | XXX |
| 7 | France | XXX | 22 | Poland | XXX | 37 | Singapore | XX | 52 | Iraq | X |
| 8 | Italy | XXX | 23 | Sweden | XXX | 38 | Philippines | XX | 53 | Ukraine | XXX |
| 9 | Canada | XXX | 24 | Belgium | XXX | 39 | Malaysia | XX | 54 | Kazakhstan | XX |
| 10 | Korea | XXX | 25 | Thailand | XX | 40 | Hong Kong SAR | X | 55 | Hungary | XXX |
| 11 | Russia | XX | 26 | Ireland | XXX | 41 | Vietnam | X | 56 | Qatar | X |
| 12 | Australia | XXX | 27 | Israel | XXX | 42 | Pakistan | X | 57 | Algeria | X |
| 13 | Brazil | XX | 28 | Argentina | XX | 43 | Chile | XX | 58 | Morocco | XX |
| 14 | Islamic Republic of Iran | X | 29 | Norway | XXX | 44 | Colombia | XX | 59 | Kuwait | X |
| 15 | Spain | XXX | 30 | Austria | XXX | 45 | Finland | XXX | 60 | Slovak Republic | XXX |

Sources: Häge (2011); and IMF staff calculations.
Note: The order of the listed economies corresponds to the ranking in terms of 2021 nominal output, based on the October 2022 *World Economic Outlook*. "XXX" represents partner economies for G7 economies under all scenarios. "XX" represents partner economies for G7 economies only under full integration and 25 percentile (moderate fragmentation) scenarios. "X" represents partner economies for G7 economies only under the full integration scenario.

***Numerical parameterization.*** While in Coeurdacier, Kollmann, and Martin (2010), all model parameters are calibrated, in this chapter some parameters are estimated (Online Annex Table 3.7.3).[21] The estimated parameters—which determine the inverse elasticity of intertemporal substitution and the elasticities of substitution in consumption and investment between domestic and foreign goods—are critical to improve the fitness of the model simulations to the data on consumption, investment, and output volatility in each of the G7 economies under "full integration."[22] The remaining parameters are calibrated, as in Coeurdacier, Kollmann, and Martin (2010), but using longer time series that include more recent data. Specifically, home biases in consumption and investment are updated based on historical import ratios for the 1992–2019 period. Also, the parameters of total factor productivity (TFP) and investment efficiency processes are updated based on estimates with extended series (for the 1994–2019 period). The estimation of parameters corresponding to home biases in consumption and investment, TFP, and investment efficiency processes in the "foreign" country depends on the scenario (Online Annex Table 3.7.4)—and TFP and investment efficiency represent average TFP and investment efficiency across foreign country groups.[23]

***Fit of the model to data.*** Online Annex Table 3.7.5 compares the volatility (standard deviation), cyclicality (correlation with output), and cross-country correlation of key macroeconomic variables (output, consumption, and investment) generated by model simulations with their empirical counterparts (for the 1992–2019 period).[24] The model performs well: it replicates closely the observed volatility of the key variables and their correlation with output—although it is less successful in explaining observed cross-country correlations. In addition, the degree of equity home bias implied by the model closely matches the bias observed in G7 economies.

[20] Pairwise geopolitical distances (between G7 economies and non-G7 countries) are measured with the average *S* score (Signorino and Ritter 1999) based on countries' voting in the UNGA during the 2012–21 period. Note that China's geopolitical distances to G7 economies are also assigned to Hong Kong SAR. In addition, the Taiwan Province of China (ranked 22nd in terms of 2021 real output) is excluded from the sample.
[21] The estimation and calibration exclude the observation during the COVID-19 pandemic from the samples after 2019.
[22] Specifically, the parameters are estimated by Bayesian estimation using yearly data from 1992 to 2019. The data set consists of three Hodrick-Prescott filtered variables (smoothing parameter is 100, the same applies to the other Hodrick-Prescott–filtered variables) in home country: (real) consumption and output.
[23] Home bias in consumption and investment under fragmentation scenarios are calculated by assuming that currently imported goods from countries that are excluded from trading partners are produced by home country and countries that remain included in trading partners, in proportion to the current ratio of the production by home and those countries, based on import shares in 2019. Country-specific TFP series are obtained from the Penn World Table version 10 (Feenstra and others 2015). Country-specific investment efficiency series are calculated as the ratio of the country's consumption deflator to the investment deflator, which are obtained from the UN's National Accounts Main Aggregates Database. These series are first detrended using the Hodrick-Prescott filter and aggregated across countries (as weighted averages based on real GDPs in US dollars) to obtain the "foreign" TFP and investment efficiency series. These series are then used to estimate the "foreign" AR(1) processes for TFP and investment efficiency.
[24] Empirical statistics are based on Hodrick-Prescott filtered variables. The variables for foreign country are calculated as the sum of the variables in US dollars basis.

## Online Annex Table 3.7.3. Parametrization of the Model

| parametrization | United States | Japan | Germany | United Kingdom | France | Italy | Canada |
|---|---|---|---|---|---|---|---|
| Calibration (Coeurdacier, Kollmann, and Martin 2010) | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 | 0.96 |
| Estimation (prior distribution: Uniform [1,2]) | 1.04 | 1.01 | 1.01 | 1.03 | 1.02 | 1.01 | 1.06 |
| Calibration (Coeurdacier, Kollmann, and Martin 2010) | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Estimation (prior distribution: Uniform [0.6,1.5]) | 0.77 | 0.90 | 1.26 | 0.75 | 0.76 | 0.66 | 0.95 |
| Estimation (prior distribution: Uniform [0.6,1.5]) | 0.90 | 1.01 | 1.14 | 0.89 | 0.87 | 0.75 | 1.03 |
| Calibration (Coeurdacier, Kollmann, and Martin 2010) | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Calibration (Coeurdacier, Kollmann, and Martin 2010) | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 | 0.10 |

Source: IMF staff calculations.
Note: Parameters are common between home and foreign countries. Estimated parameters show the posterior mean.

## Online Annex Table 3.7.4. Parametrization of Home Bias in Consumption and Investment, TFP, and Investment Efficiency Processes

| | United States | | | Japan | | | Germany | | | United Kingdom | | | France | | | Italy | | | Canada | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) | (a) | (b) | (c) |
| home bias in consumption and investment | 0.87 | 0.90 | 0.93 | 0.85 | 0.91 | 0.94 | 0.70 | 0.73 | 0.75 | 0.76 | 0.79 | 0.80 | 0.75 | 0.78 | 0.80 | 0.77 | 0.80 | 0.81 | 0.70 | 0.73 | 0.76 |
| standard deviation of home TFP shock | 0.67 | | | 0.72 | | | 0.67 | | | 0.86 | | | 0.63 | | | 0.92 | | | 0.78 | | |
| standard deviation of foreign TFP shock | 0.61 | 0.70 | 0.58 | 0.54 | 0.63 | 0.59 | 0.53 | 0.63 | 0.58 | 0.52 | 0.60 | 0.55 | 0.52 | 0.61 | 0.57 | 0.52 | 0.61 | 0.56 | 0.51 | 0.61 | 0.57 |
| correlation of home and foreign TFP shocks | 0.17 | 0.17 | 0.55 | 0.27 | 0.41 | 0.36 | 0.30 | 0.36 | 0.40 | 0.39 | 0.56 | 0.76 | 0.58 | 0.69 | 0.74 | 0.47 | 0.48 | 0.61 | 0.67 | 0.65 | 0.38 |
| persistence of home TFP process | 0.84 | | | 0.69 | | | 0.59 | | | 0.85 | | | 0.74 | | | 0.76 | | | 0.54 | | |
| persistence of foreign TFP process | 0.72 | 0.50 | 0.64 | 0.72 | 0.67 | 0.79 | 0.72 | 0.67 | 0.78 | 0.70 | 0.62 | 0.76 | 0.69 | 0.64 | 0.77 | 0.71 | 0.65 | 0.77 | 0.69 | 0.65 | 0.78 |
| standard deviation of home inv. efficiency shock | 0.60 | | | 0.34 | | | 0.42 | | | 0.90 | | | 0.40 | | | 0.50 | | | 0.76 | | |
| standard deviation of foreign inv. efficiency shock | 0.52 | 0.55 | 0.32 | 0.47 | 0.47 | 0.43 | 0.46 | 0.45 | 0.41 | 0.46 | 0.43 | 0.39 | 0.46 | 0.45 | 0.40 | 0.46 | 0.44 | 0.40 | 0.45 | 0.43 | 0.39 |
| correlation of home and foreign inv. efficiency shocks | 0.27 | 0.56 | 0.63 | 0.19 | 0.16 | 0.15 | 0.29 | 0.38 | 0.37 | 0.34 | 0.42 | 0.32 | 0.29 | 0.30 | 0.41 | 0.20 | 0.38 | 0.38 | 0.28 | 0.50 | 0.58 |
| persistence of home inv. efficiency process | 0.76 | | | 0.81 | | | 0.87 | | | 0.58 | | | 0.81 | | | 0.69 | | | 0.78 | | |
| persistence of foreign inv. efficiency process | 0.87 | 0.81 | 0.77 | 0.87 | 0.79 | 0.75 | 0.88 | 0.81 | 0.78 | 0.87 | 0.80 | 0.77 | 0.87 | 0.80 | 0.77 | 0.87 | 0.80 | 0.77 | 0.87 | 0.80 | 0.77 |

Sources: IMF staff calculations.
Note: Home bias in consumption and investment is common between home and foreign countries. The (a) columns represent the parameters for simulation to replicate the current state of the economy (full integration scenario), the (b) columns represent the parameters for 25 percentile (moderate fragmentation) scenario, and the (c) columns represent the parameters for 50 percentile (extreme fragmentation) scenario. The shock processes are estimated based on Hodrick-Prescott filtered (smoothing parameter: 100) TFP and investment efficiency series. The series for foreign country are calculated as the weighted average of each country by real output (US dollars). TFP = total factor productivity.

## Online Annex Table 3.7.5. Fit of the Model to Data

| | United States | | Japan | | Germany | | United Kingdom | | France | | Italy | | Canada | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Model | Data | Model | Data | Model | Data | Model | Data | Model | Data | Model | Data | Model | Data |
| Standard deviations (percent) | | | | | | | | | | | | | | |
| Output | 1.99 | 1.43 | 1.60 | 1.31 | 1.43 | 1.21 | 2.51 | 1.57 | 1.51 | 1.22 | 2.15 | 1.68 | 1.66 | 1.29 |
| Consumption | 1.53 | 1.54 | 1.05 | 0.75 | 0.88 | 0.86 | 1.83 | 1.90 | 1.04 | 1.10 | 1.49 | 1.74 | 1.03 | 0.80 |
| Investment | 4.31 | 4.78 | 3.90 | 3.20 | 4.14 | 2.68 | 6.34 | 3.81 | 3.67 | 3.16 | 5.06 | 5.07 | 5.88 | 3.53 |
| Correlation with domestic Output | | | | | | | | | | | | | | |
| Consumption | 0.86 | 0.94 | 0.83 | 0.69 | 0.74 | 0.60 | 0.84 | 0.95 | 0.84 | 0.82 | 0.87 | 0.88 | 0.68 | 0.50 |
| Investment | 0.81 | 0.93 | 0.86 | 0.82 | 0.74 | 0.83 | 0.69 | 0.92 | 0.81 | 0.96 | 0.82 | 0.96 | 0.68 | 0.53 |
| Cross Country Correlation | | | | | | | | | | | | | | |
| Output | 0.29 | 0.33 | 0.33 | 0.69 | 0.35 | 0.63 | 0.58 | 0.61 | 0.66 | 0.66 | 0.63 | 0.60 | 0.60 | 0.60 |
| Consumption | 0.44 | 0.27 | 0.51 | 0.22 | 0.86 | 0.20 | 0.79 | 0.59 | 0.81 | 0.70 | 0.74 | 0.63 | 0.88 | 0.81 |
| Investment | 0.17 | -0.12 | 0.18 | 0.46 | -0.05 | 0.50 | 0.00 | 0.45 | 0.36 | 0.43 | 0.33 | 0.21 | -0.11 | 0.69 |
| Asset Portfolio | | | | | | | | | | | | | | |
| Equity home bias | 0.63 | 0.59 | 0.59 | 0.68 | 0.28 | 0.37 | 0.39 | 0.49 | 0.38 | 0.60 | 0.41 | 0.30 | 0.28 | 0.49 |

Source: IMF staff calculations.
Note: Empirical statistics are based on Hodrick-Prescott filtered variables (smoothing parameter: 100). The equity home bias of country *i* is calculated as 1 minus share of foreign equities in the country's equity holdings/share of foreign equities in the world market portfolio in the year 2019. Regarding the missing market capitalization data for several countries (2015 for the United Kingdom and Italy; 2019 for France), the value is extrapolated by assuming that the changes in market capitalization follows those in Germany.

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