CHAPTER 2

RISK AND RESILIENCE IN THE GLOBAL FOREIGN EXCHANGE MARKET

Chapter 2 at a Glance

- The global foreign exchange (FX) market plays a key role in the international monetary and financial system, and its smooth functioning is essential for maintaining global financial stability.
- Structural shifts, such as the increasing involvement of nonbank financial institutions (NBFIs) and growing trade in derivatives, offer benefits but may also raise the global FX market's vulnerability to adverse shocks.
- This chapter finds that increased macrofinancial uncertainty can strain FX market conditions by significantly raising funding costs, impairing liquidity, and amplifying excess exchange rate return volatility.
- The effect of shocks is more pronounced for emerging markets and for currencies with high NBFI participation, concentrated dealer networks, and elevated hedging activity.
- FX market stress can spill over to other asset classes, tightening financial conditions and posing risks to macrofinancial stability—especially in countries with significant currency mismatches and fiscal vulnerabilities.
- Outages in critical payment systems and risk of settlement failure significantly impair market liquidity and increase excess exchange rate return and its volatility, raising the cost of FX transactions.
- Amid elevated uncertainty and a shifting global economic landscape, investor strategies are evolving. Following the US tariff announcements in early April 2025, investors in some countries reduced their US dollar holdings, whereas others maintained exposures, highlighting diverging cross-country responses.

Key Policy Recommendations

- Enhance FX market surveillance through systemic risk monitoring, stress testing, and scenario analysis to capture liquidity shocks and spillovers.
- Close critical FX data gaps by improving reporting and transparency, especially in regard to NBFIs and bilateral exposures outside centralized infrastructures.
- Ensure robust liquidity and capital buffers, backed by effective safeguards, such as access to central bank liquidity with proper oversight, sufficient international reserves, and expanded central bank swap lines.
- Strengthen operational resilience of financial market infrastructures and financial institutions through cyber risk frameworks, contingency planning, and coordinated oversight.
- Reduce settlement risks and market inefficiencies in over-the-counter FX markets by encouraging payment-versus-payment adoption and exploring digital innovations to develop interoperable financial platforms.

Introduction

The global foreign exchange (FX) market is a cornerstone of the international monetary and financial system. With an average daily turnover exceeding $9.6 trillion, the FX market has grown over the years into the largest and most liquid financial market in the world (BIS 2025a; Figure 2.1, panel 1). It facilitates cross-border trade and financial transactions by enabling currency conversion and influencing exchange rates.[1] Cross-border transactions account for about two-thirds of global FX market turnover, with the

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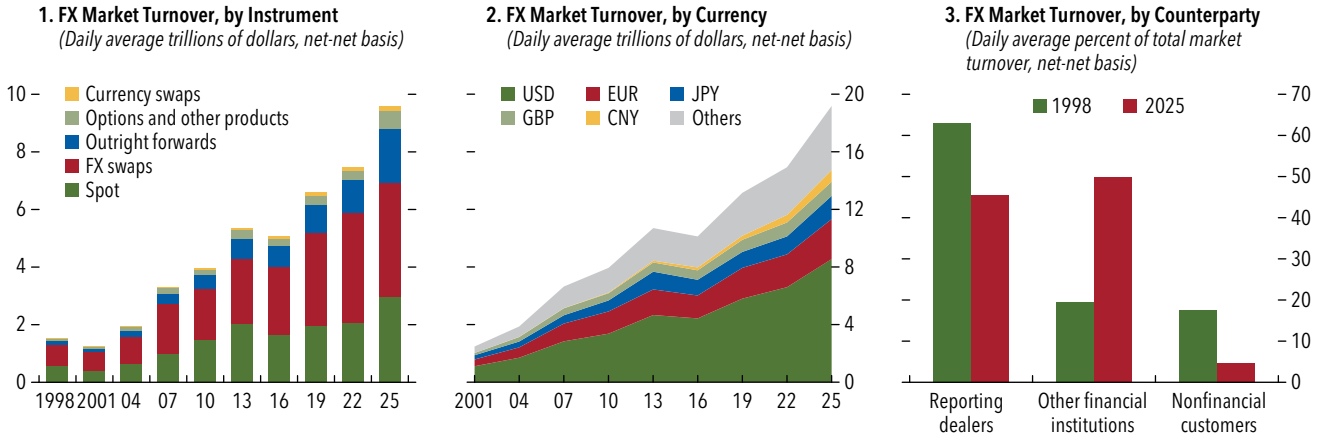
[1]The global FX market is broadly defined as a decentralized global marketplace for trading currencies. It encompasses spot transactions (that is, immediate exchanges of currencies at current rates) and a range of derivative instruments, including outright forwards, FX swaps, currency swaps, and currency options, commonly used for hedging, funding, and speculative purposes. See Online Annex 2.1 for definitions of technical terms.

Figure 2.1. Key Developments in the Global Foreign Exchange Market

The FX market has grown substantially, driven mainly by an increase in swap trades.

The US dollar continues to be the dominant currency in global FX trading.

The shares of participants have shifted, with nonbank financial institutions taking a greater role.



Sources: BIS 2025a; and IMF staff calculations.

Note: Daily averages correspond to April. The BIS Triennial Central Bank Survey (2025a) adjusts figures reported on a net-net basis to correct for double counting in local and cross-border interdealer transactions. In panel 2, because each foreign exchange transaction involves two currencies, the sum of the individual currencies is twice that of the total turnover involved. CNY = Chinese yuan; EUR = euro; FX = foreign exchange; GBP = British pound; JPY = Japanese yen; USD = US dollar.

US dollar being the dominant trading currency (BIS 2022; Figure 2.1, panel 2).

The structure of the global FX market has evolved across multiple dimensions, including the diversification of market participants, the expansion of traded instruments, and broader changes in the FX trading ecosystem (Schrimpf and Sushko 2019; Chaboud, Rime, and Sushko 2023; Chaboud and others 2024). For example, whereas trading in the 1990s took place mostly between large dealers, such as commercial and investment banks, nonbank financial institutions (NBFIs) have since become increasingly important players (Figure 2.1, panel 3).[2] The share of spot trading has declined, whereas the use of derivatives, especially FX swaps, mostly for funding and hedging currency risk, has grown notably (Figure 2.1, panel 1). The number of execution methods and trading platforms has also expanded with the increasing electronification of the market.

These shifts in the FX market have enhanced competition and efficiency but have also introduced challenges for macrofinancial stability. For example, increasing NBFI participation contributes to more diversity in FX markets, potentially increasing liquidity, reducing transaction costs, and strengthening price discovery and risk sharing. However, many NBFIs are subject to less regulatory oversight than traditional banks and may lack access to central bank facilities. NBFI trading strategies, often driven by leverage, short-term arbitrage, and high-frequency trading, can amplify market swings and shift inventory risk onto market-making dealers.[3] Moreover, many NBFIs (such as mutual funds) exhibit liquidity mismatches, funding longer term or less liquid assets with short-term liabilities. This structural fragility can heighten systemic risk during market volatility, as tighter funding conditions and rapid unwinding of positions may amplify liquidity pressures in FX markets (see the October 2022 and April 2023 issues of the *Global Financial Stability Report*; FSB 2025).

The growing use of FX derivatives has enhanced liquidity and risk management by enabling institutions to hedge currency exposures and access foreign currency funding. However, it has also facilitated leveraged investments and increased interconnectedness. During stress, margin calls and forced deleveraging can amplify volatility and liquidity strains (Borio,

[2]The decline in FX activity by nonfinancial firms suggests that trade plays a more limited role than financial flows in driving FX transactions.

[3]Under stress, algorithmic and high-frequency traders often withdraw, reducing liquidity and amplifying volatility (BIS 2020).

McCauley, and McGuire 2022; Nenova, Schrimpf, and Shin 2025). Moreover, the opacity of over-the-counter derivatives markets, which dominate FX trading, complicates risk monitoring for regulators and central banks, potentially obscuring the buildup of systemic risks.[4]

Compounding these challenges are two structural vulnerabilities: high dealer concentration and currency mismatches. Nearly half of global FX turnover is intermediated by a small group of dominant dealers—mostly large, regulated banks—leaving the market exposed should these institutions scale back activity during stress (BIS 2022).[5] Meanwhile, persistent currency mismatches, in which liabilities and assets are in different currencies, drive sustained demand for short-term FX derivatives, increasing rollover and funding risks when conditions tighten (FSB 2022). Disruptions in these markets can sharply raise hedging costs, prompting the unwinding of positions that reinforce volatility and further elevate costs.[6]

In addition to structural fragilities, the global FX market is exposed to a range of external and operational risks. The market's central role in global finance makes it highly sensitive to macroeconomic developments and policy shifts that influence cross-border trade and financial flows and affect currency valuation. For example, an increase in macroeconomic uncertainty can change investor risk sentiment and interest rate expectations, triggering rapid portfolio adjustments, liquidity strains, and volatility (see, for example, Berger, Chaboud, and Hjalmarsson 2009).[7] These shocks can interact with underlying vulnerabilities, such as dealer concentration and currency mismatches, magnifying stress and propagating instability across financial markets. Historical episodes of elevated global macrofinancial uncertainty show that FX funding and market liquidity pressures, reflected in wider cross-currency bases (a measure of deviation from the covered interest parity, or CIP), bid-ask spreads, and excess exchange rate return volatility, tend to rise with uncertainty (Figure 2.2).[8]

These FX market dynamics are especially relevant in today's conditions of elevated policy uncertainty and a shifting global macrofinancial landscape. Structural changes in global trade and financial flows, driven by evolving trade policies, supply chain realignments, and geopolitical considerations, may be reshaping currency demand and FX market behavior (*External Sector Report* 2025; Box 2.1). At the same time, heightened uncertainty around these developments raises the risk of abrupt shifts in investor sentiment and expectations, affecting capital flows and FX market conditions, particularly in economies with less liquid FX markets.

Moreover, the expansion of FX trading has heightened exposure to settlement risk: the possibility that one party will deliver its currency without receiving what the counterparty owes. This risk is particularly acute in cross-border transactions, in which time zone differences and operational delays can lead to failed settlements and trigger liquidity shortfalls and systemic stress. Although certain risk mitigation arrangements, such as payment-versus-payment (PvP), have been adopted over the years, most emerging market currencies remain outside these frameworks.[9] With the growing prominence of emerging market currencies in the global FX market (Figure 2.1, panel 2), their exclusion from such mechanisms leaves a substantial portion of

[4]Other changes in the FX ecosystem, such as trading platform proliferation and increased electronification, have improved market access, speed, and transparency but have also added complexity, fragmentation, and operational risk. For example, algorithms help align prices in stable market conditions, but they can break down during volatility, generating price discrepancies and a flight to more liquid platforms ("liquidity mirage"; BIS 2020). Electronification can also deepen informational asymmetry, giving technologically advanced traders an edge and distorting price discovery (Ranaldo and Somogyi 2021).

[5]During stress episodes, regulatory constraints can limit dealer capacity, further reducing liquidity, raising transaction costs, and impairing trade execution (Aldasoro, Huang, and Tarashev 2021; Huang and others 2025).

[6]See, for example, Borio and others (2016); Barajas, Deghi, Raddatz, and others (2020); Du and Schreger (2022); and Kloks, Mattille, and Ranaldo (2023).

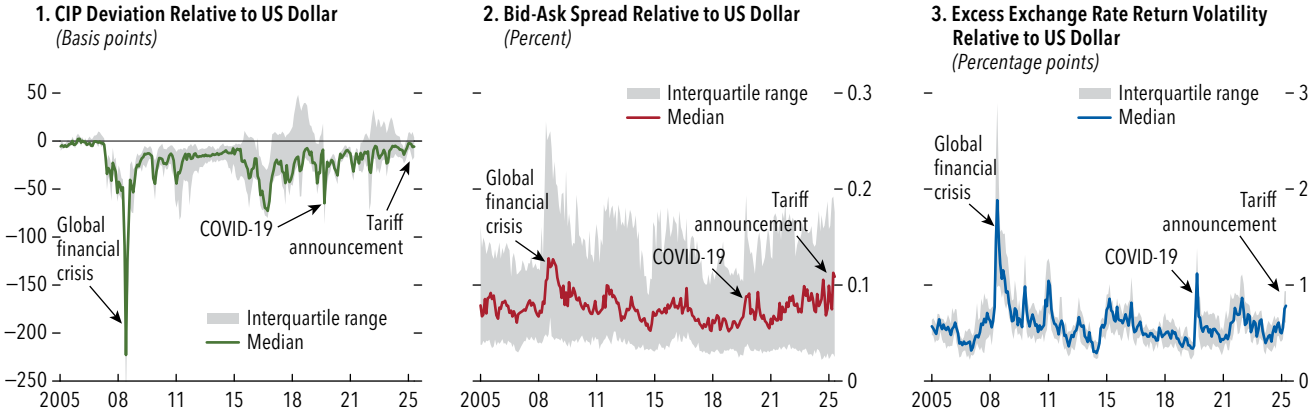
[7]Geopolitical disruptions, such as armed conflicts or sanctions, can also have an impact on FX markets by affecting cross-border trade and financial flows (April 2023 and April 2025 issues of the *Global Financial Stability Report*; Hui 2021; Hossain, Masum, and Saadi 2024).

[8]The cross-currency basis measures the CIP deviation, reflecting the cost of swapping one currency for another; a widening basis signals stress in FX funding markets. The bid-ask spread captures the difference between the prices at which a dealer is willing to buy (bid) and sell (ask) a currency; wider spreads suggest reduced market liquidity and higher transaction costs. Excess exchange rate return volatility reflects the movement in returns unexplained by macroeconomic fundamentals; it captures the influence of factors like shifts in investor sentiment, liquidity conditions, or risk aversion.

[9]The CLS foreign exchange settlement system reduces settlement risk for 18 currencies through its PvP mechanism, which settles both sides of an FX transaction simultaneously. Some regional PvP systems offer similar functionality for select currencies traded against the US dollar but lack global integration, limiting efficiencies. Many currencies remain outside PvP systems because of technical, regulatory, and economic constraints (Glowka and Nilsson 2022).

Figure 2.2. Macrofinancial Uncertainty and Foreign Exchange Market Conditions

Foreign exchange funding and market liquidity conditions deteriorated significantly during the global financial crisis and the COVID-19 market turmoil.



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

Note: In panel 1, CIP deviation is calculated using three-month overnight index swap rates for 12 currencies against the US dollar. A negative widening basis signals stress in dollar funding markets. Panel 2 shows the bid-ask spread calculated as [(ask rate − bid rate)/mid rate] × 100. Wider spreads suggest reduced market liquidity. In panel 3, excess exchange rate return = log(exchange rate at time t/exchange rate at time $t-1$) − log(forward rate at time $t-1$/exchange rate at time $t-1$). In all panels, "tariff announcement" refers to the April 2, 2025, US declaration of new import tariff rates. See Online Annex Figure 2.3.1 for details on the construction of the measures used in this figure and illustrations by country group (that is, advanced economies and emerging market economies). CIP = coverage interest parity.

FX transactions exposed to settlement risk (Box 2.2). This exposure is exacerbated by the risk of operational disruptions to FX market infrastructure: technical failures, cyberattacks, or power outages could impair FX market functioning, generating liquidity strains and volatility and making delayed or failed settlements more likely.[10]

Stress in FX markets can spill over to markets for other asset classes, posing risks to macrofinancial stability. Elevated FX volatility and hedging costs, reflected in wider cross-currency bases, raise uncertainty and the cost of managing currency exposure, potentially affecting yields and risk premiums. Higher funding costs can also erode the intermediation capacity of financial institutions, tighten financial conditions, and amplify systemic stress, triggering an adverse macrofinancial feedback loop (Adrian and Shin 2014).[11]

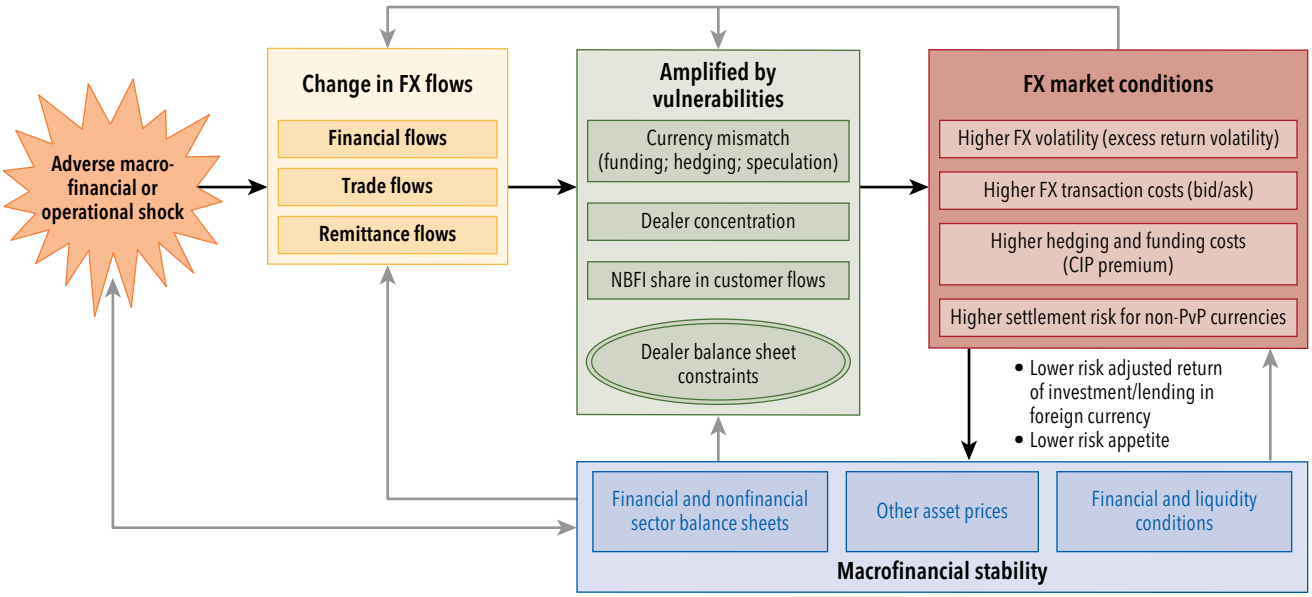
[10]Recent examples of operational disruptions to critical payment infrastructure include the 2018 Fedwire cyber incident and the 2000 and 2025 TARGET2 outages. Even as contingency measures within FX settlement infrastructure helped prevent systemic fallout, these events revealed operational fragilities and the importance of resilient and coordinated backup systems (Khiaonarong, Leinonen, and Rizaldy 2021).

[11]See, for example, Bruno and Shin (2015); Du, Tepper, and Verdelhan (2018); Hofmann, Shim, and Shin (2020); Greenwood and others (2023); and Liao and Zhang (2025) for discussions of the different channels through which tighter FX market conditions may be transmitted to the broader financial system.

Against this backdrop, this chapter explores recent developments, vulnerabilities, and risks in the global FX market and discusses policy options for mitigating the risks. This chapter begins with a conceptual framework for how shocks stemming from macrofinancial uncertainty or operational disruptions can affect FX market conditions and financial stability. It then presents stylized facts on the evolution of FX markets, covering key currencies, participants, and interconnectedness. Next, it empirically analyzes three key questions: (1) How do different macrofinancial uncertainty shocks affect FX trading across market participants? (2) How do these shocks influence FX market conditions, as measured by cross-currency basis, excess exchange rate return volatility, and bid-ask spreads, and are the effects amplified by structural market fragilities? (3) Does FX market stress spill over into other financial markets, such as those for sovereign bonds and equities, with broader implications for financial stability?

To address these three key questions, this chapter draws on a unique data set covering FX spot and swap transactions across major advanced economies and emerging market economies. The data, sourced from CLS Group, provide daily and weekly information from January 1, 2015, to May 31, 2025, on FX flows and pricing for 18 major currencies, disaggregated by four institutional sectors: banks, investment funds, other

Figure 2.3. Shock Transmission to Foreign Exchange Market Conditions and Macrofinancial Feedback Effects



Source: IMF staff.

Note: Black arrows in the figure indicate the direct transmission channels. CIP = covered interest parity; FX = foreign exchange; NBFI = nonbank financial institution; PvP = payment versus payment.

NBFIs, and nonfinancial firms.[12] Macrofinancial uncertainty is captured using three commonly used indicators: the Chicago Board Options Exchange Volatility Index (VIX), the Merrill Lynch Option Volatility Estimate (MOVE) index, and the economic policy uncertainty (EPU) index of Baker, Bloom, and Davis (2016).

Macrofinancial Shocks and the Global Foreign Exchange Market: A Conceptual Framework

The global FX market, as a decentralized, mostly over-the-counter arena, enables continuous and flexible trading across time zones. It draws on a wide range of participants, including dealers (banks and NBFIs that act as market makers), nondealer banks and NBFIs, nonfinancial firms, central banks, and retail investors. It is broadly segmented into spot and derivatives markets, each catering to different investment horizons, risk profiles, and participant needs.

An increase in global macrofinancial uncertainty can trigger significant shifts in cross-border trade and financial activity, with direct implications for FX flows and market conditions (Figure 2.3). For example, a surge in financial uncertainty, often captured by the VIX, which measures option-implied volatility in the US stock market, can dampen investor risk appetite and prompt a flight to quality, with investors reallocating portfolios toward safer assets, such as those denominated in US dollars (Figure 2.3; Caballero and Krishnamurthy 2008).[13]

Rebalancing of this type increases demand for dollar-denominated assets while leading to the unwinding of positions in other currencies. Concurrently, financial institutions outside the United States, such as nondealer banks, investment funds, and insurers, may seek to hedge their increased dollar exposures using FX swap contracts, which involve buying US dollars in the spot leg of a contract while agreeing to sell them back in the forward leg of the contract. Dealer banks that intermediate the transactions involved in these contracts must expand their balance sheets to meet the increased demand, often borrowing dollars

[12]Online Annex 2.2 provides further details on CLSMarketData and the sample of economies included in the analysis.

[13]US-dollar-denominated safe assets have long anchored the international monetary system, reflecting the dollar's central role in global trade and finance. Although geopolitical and economic shifts could affect the use of international reserve currencies and the dollar's status as a global safe asset, evidence of any significant structural change in recent months remains limited (Chapter 1; *External Sector Report* 2025, Chapter 2).

in the process. This can be costly when regulatory constraints limit dealer banks' ability to supply liquidity.[14] As a result, the cost of these swaps rises and the cross-currency bases between the dollar and other currencies widen, effectively placing a limit on the extent of portfolio rebalancing by tightening FX market conditions.[15]

Portfolio rebalancing triggered by a shock can create a vicious cycle. In addition to their use for hedging, FX swaps are used for speculation, such as carry trades, and for short-term dollar funding of longer-term asset positions, a form of maturity transformation (October 2019 *Global Financial Stability Report*). When the US dollar–foreign currency basis widens, it signals rising costs and reduced availability of dollar funding, particularly for institutions outside the United States. The funding strains imposed by these changes can force unhedged exposures or asset sales, increasing market volatility. Heightened volatility, in turn, may fuel investor risk aversion and flight to safety, intensifying demand for safe assets and FX swaps, further widening the cross-currency basis and deepening funding stress (Huang and others 2025).[16] The resulting feedback loop pressures dealer balance sheets and constrains dealers' ability to absorb risk, amplifying systemic risk and disrupting global financial intermediation. Such transmission effects can be mitigated by requiring financial institutions to hold adequate foreign currency liquidity buffers and stable dollar funding such as customer deposits. In addition, historical episodes of high macrofinancial uncertainty, such as the global financial crisis and the COVID-19 market turmoil, have highlighted the importance of central bank interventions, including those through dollar liquidity swap lines, for breaking cycles generated by shock-induced portfolio rebalancing and restoring market functioning (Barajas, Deghi, Fendoglu, and Xu 2020; Aizenman and others 2021).

In addition to raising the cost of FX swaps, an increase in uncertainty can make the global FX market less liquid and volatile. As financial uncertainty increases, it can become more costly for dealers to hold foreign currencies, raising the cost of facilitating trades in the global FX market. This is partly because the rising risk of large losses from adverse exchange rate movements requires banks to hold more capital as a safety buffer.[17] The expense of holding this additional capital is passed on to customers through wider bid-ask spreads: the gap between the prices at which dealers can buy and sell foreign currencies. Wider spreads make trading more expensive, discouraging participation and making markets less liquid. With fewer trades taking place, prices can swing more sharply in response to even small orders. This can lead to another vicious cycle: higher volatility leads to wider spreads, which reduces trading and amplifies market volatility.

Structural market fragilities can amplify the transmission of global shocks to FX market conditions (Figure 2.3). For example, when market making is concentrated among a small number of dealers, regulatory constraints arising from sharp declines in asset prices are more likely to lead to funding and liquidity stress, with broader market implications. Similarly, when market participants have smaller liquidity buffers or greater leverage, as some types of NBFIs often do, they are more likely to engage in procyclical market behavior, which can amplify the impact of a shock on FX market conditions. In addition, larger underlying FX mismatches across institutions increase the latter's reliance on FX swaps for hedging, resulting in more pronounced portfolio adjustments when cross-currency bases widen.[18]

Stress in FX markets can be transmitted to the broader financial system and the real economy through various channels. Elevated FX funding costs, reflected in a widening of cross-currency bases, can reduce the profitability of financial institutions facing capital

[14]During periods of broad market volatility, dealer banks may face tighter balance sheet constraints because of a rise in demand for intermediation and a decline in asset values, making it harder for them to meet regulatory requirements for leverage and limiting their ability to support FX swap markets.

[15]In addition, informational asymmetries in FX markets, in which some participants know more than others, mean that large customer trades can signal valuable information. Dealers may interpret the flows involved in these trades as reflecting private insights or strategic intent, prompting them to adjust prices or positions, which can trigger broader market reactions, increasing volatility, widening spreads, and reducing liquidity.

[16]When volatility rises, arbitrage mechanisms that normally keep prices aligned across venues and instruments can break down. Tighter balance sheet constraints increase the cost of providing liquidity and deter arbitrage, allowing price gaps to persist, distorting pricing, and amplifying market pressure.

[17]Specifically, the increased risk of sharp exchange rate losses can raise dealer banks' value-at-risk estimates—measures of how much a portfolio could lose over a set time period with a given level of confidence—which are used to calculate regulatory capital requirements.

[18]Eguren-Martin, Busch, and Reinhardt (2024) find that UK banks with greater currency mismatches—that is, those more reliant on FX swaps for US dollar funding and hedging of exchange rate risk—respond to a widening cross-currency basis by cutting back cross-border foreign currency lending more aggressively than banks with matched exposures.

constraints such as leverage ratio requirements. As capital constraints tighten, such institutions may respond by deleveraging, contracting their balance sheets and selling risky assets, including stocks and corporate bonds in local currencies.[19] A wider cross-currency basis also implies a higher cost of hedging FX risk embedded in long positions of US-dollar-denominated assets, prompting institutions to reduce their hedge ratios—the proportion of their foreign currency risk exposure covered by hedging instruments—and take on greater FX risk. Market participants may mitigate this risk through self-insurance strategies, increasing their holdings of safer and more liquid assets. As a result, demand for sovereign bonds, particularly those of short duration, can increase, especially in countries with stronger fiscal fundamentals. This increased demand can exert downward pressure on bond yields.[20]

Market liquidity and exchange rate volatility are also important in the transmission of FX market stress. As noted earlier, higher transaction costs, reflected in wider bid-ask spreads, can discourage market participation and impair the functioning of FX and related asset markets. For financial institutions and firms engaged in cross-border trade and investment, this can translate into reduced access to hedging instruments and trade finance, dampening economic activity. Similarly, excess exchange rate return volatility can increase uncertainty around asset valuations and macroeconomic outcomes, undermining investor confidence and prompting portfolio rebalancing away from riskier assets.[21] In addition, excess volatility can tighten banks' balance sheet constraints, potentially reducing domestic credit provision. Such dynamics would reinforce the feedback loop between FX market stress and broader financial instability.

[19]When risk-weighted capital requirements become more binding, financial institutions may shift toward safer assets, increasing demand for sovereign bonds, which typically carry zero risk weights. In contrast, when leverage constraints tighten, FX market stress is more likely to push local currency sovereign bond yields higher, as institutions face broader funding pressures rather than incentives to rebalance toward low-risk assets.

[20]These dynamics can also spill over into stock and other asset markets through the actions of leveraged investors and financial intermediaries, such as hedge funds, pension funds, and insurers. For example, pension funds with internationally diversified portfolios and local currency defined-benefit liabilities typically hedge FX risk to manage asset-liability mismatches. However, as hedging cost rises, these entities may choose to unwind their foreign positions, transmitting stress from FX markets to other markets, amplifying volatility across asset classes.

[21]Excess exchange rate volatility may also complicate monetary policy transmission, affecting macrofinancial stability.

Beyond macrofinancial uncertainty, operational disruptions can significantly impair FX market functioning and amplify volatility. Outages in trading platforms, messaging systems, or payment and settlement infrastructure can delay trade execution and settlement, increasing market illiquidity and counterparty risk. Although the global FX market's decentralized structure and high substitutability across platforms have implied that disruptions to individual trading platforms, including interdealer platforms, have not been systemic to date, simultaneous outages across multiple platforms, such as those from cyber incidents or power outages, could trigger systemic stress by cutting off access to liquidity and risk management tools (Box 2.3). Similarly, prolonged disruptions to payment systems and settlement infrastructures (for example, CLS; TARGET2; Fedwire; and the Clearing House Automated Payment System) are inherently more disruptive and require robust safeguards and backup arrangements to contain systemic risks.

The Evolving Landscape of the Global Foreign Exchange Market

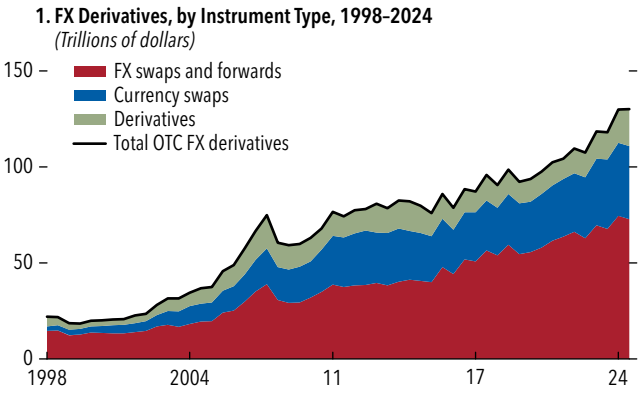
The global FX market has expanded, with average daily trading volumes increasing fivefold since the late 1990s. Growth in FX swap and spot transactions has driven this expansion and accounts for the bulk of trading activity (Figure 2.1, panel 1). FX swap activity has risen notably in recent years, reflecting increased NBFI participation (Figure 2.4, panels 1 and 2). A majority of these swaps are of short duration, typically with tenors up to three months (Figure 2.4, panel 3), highlighting the continuous hedging needs of institutions and the market's role in short-term liquidity management.

The US dollar remains the dominant trading currency in spot and swap markets. About one-fourth of transactions involve the euro against the US dollar, and one-fifth involve the Japanese yen, underscoring the importance of these two currencies among major currency pairs (Figure 2.4, panel 4). However, the euro–US dollar share of total transactions has declined from about one-third in 2015, whereas the share of other currencies relative to the dollar has increased, reflecting a gradual diversification in trading activity.[22]

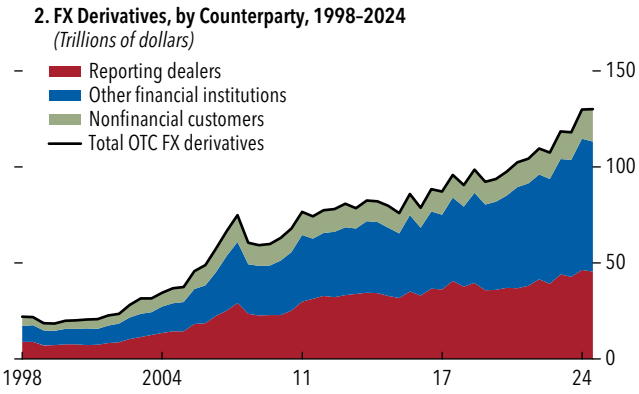
[22]Figure 2.4, panel 4, is based on CLS data and covers FX transactions settled by CLS. As shown in Figure 2.1, panel 2, the share of other currencies, particularly the Chinese yuan, has increased over time. The share of the yuan, however, remains well below China's share in global output and trade.

Figure 2.4. Structure and Trends in the Global Foreign Exchange Market

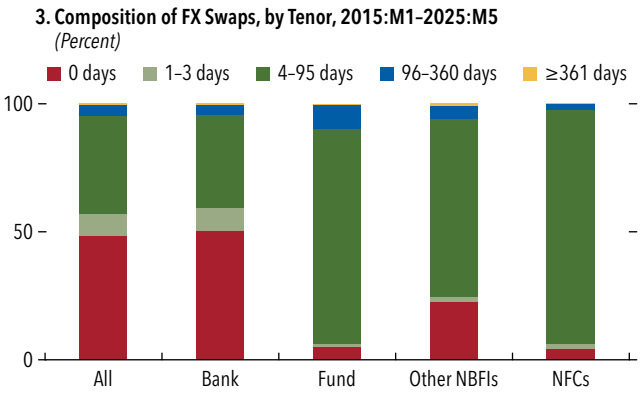
Trading activity in FX swaps and forwards has surged in recent years ...



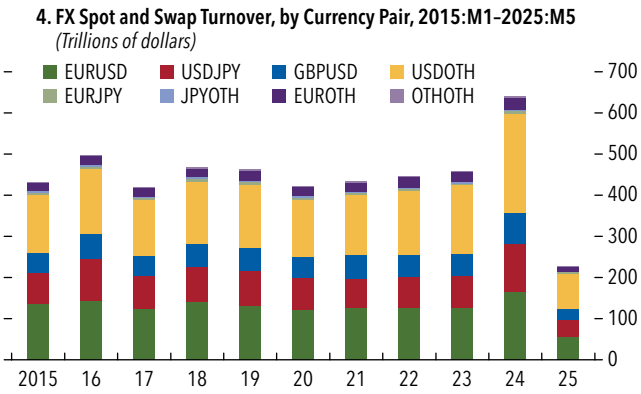
... with the increase driven largely by NBFIs.



A large share of FX swaps have short maturities: three months or less.



The euro and yen dominate FX trading against the US dollar, but the share of other currencies has been rising.



Sources: Bank for International Settlements, OTC Derivatives Statistics; CLS Group; and IMF staff calculations.

Note: Panels 1 and 2 are based on the Bank for International Settlements' OTC Derivatives Statistics and reflect the FX derivatives outstanding by instrument type and counterparty, respectively. Panels 3 and 4 are based on CLSMarketData by CLS Group. Panel 3 indicates the composition of FX swaps by tenor for all swap transactions and transactions disaggregated by market participant, aggregating all swap flow data from January 2015 to May 2025. Panel 4 shows the composition of FX spot and swap transactions aggregated annually by currency pair. EUR = euro; FX = foreign exchange; GBP = British pound; JPY = Japanese yen; M = month; NBFIs = nonbank financial institutions; NFCs = nonfinancial corporation; OTC = over-the-counter; OTH = other currencies; USD = US dollar.

The dollar's relative importance seems to have remained stable through May 2025, with no major shift after the US tariff announcements in early April 2025 (Box 2.1).

A large share of FX transactions takes place between banks (Figure 2.5, panel 1). Among NBFIs, investment funds dominate FX trading, reflecting the funds' growing use of FX instruments for portfolio diversification and risk management (BIS 2025b). Banks remain central to the FX ecosystem, as evident from their high degree of interconnectedness with other market participants (Figure 2.5, panels 2 and 3). Banks in major economies, especially the United States, form the core of the global FX network, whereas their financial and nonfinancial clients typically operate at the periphery.[23]

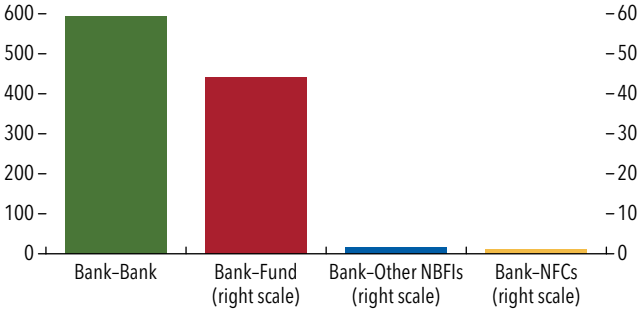
Bank participation in FX trading varies considerably across currency pairs. For example, euro–US dollar transactions are intermediated by US banks as well as by banks in some other major markets, such as France, Germany, and the United Kingdom (Figure 2.5, panel 2). However, yen–US dollar transactions are

[23]Because CLS membership largely comprises major banks, each transaction in the data set is recorded relative to the banking sector. The data thus do not capture the interconnectedness between other institutional sectors, such as that between NBFIs and nonfinancial firms.

Figure 2.5. Bank and Nonbank Financial Institutions' Presence in the Global Foreign Exchange Market

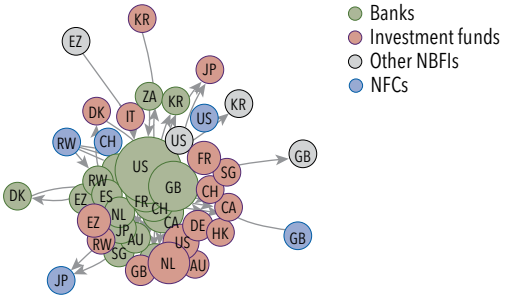
Interbank transactions account for most FX market activity.

1. FX Spot and Swap Turnover, by Counterparty, 2024
(Trillions of dollars)



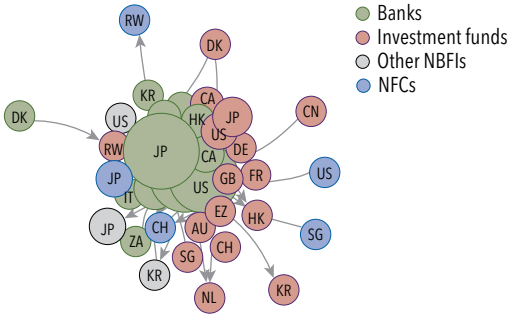
Banks in the United States and in major European economies are dominant in euro–US dollar trades ...

2. Network of Spot Euro–US Dollar Sectoral Trading Activity, 2024
(Share)



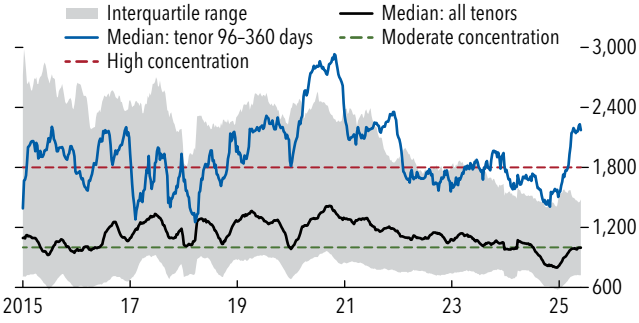
... whereas Japanese and US banks dominate yen–US dollar trades.

3. Network of Spot Yen–US Dollar Sectoral Trading Activity, 2024
(Share)



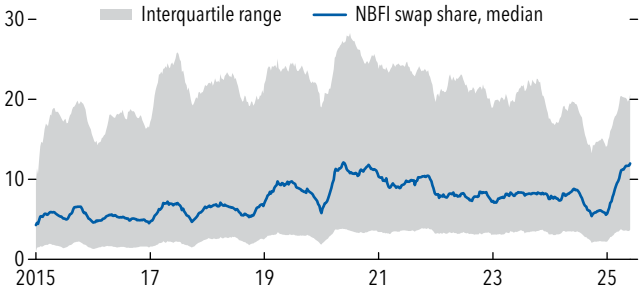
Dealer bank concentration thus varies across currency pairs and instruments.

4. Dealer Concentration in FX Swaps, 2015:M1–2025:M5
(Index)



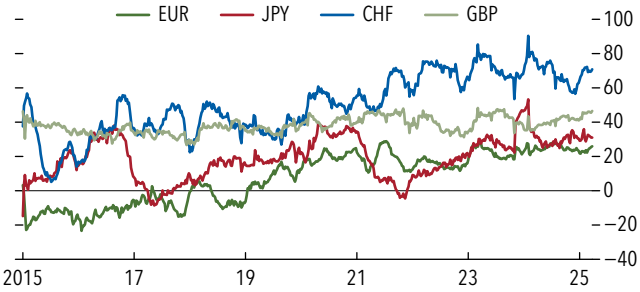
The share of NBFI trading activity also varies by currency pairs ...

5. Share of NBFIs in FX Swaps, by Currency Pair, 2015:M1–2025:M5
(Percent)



... as does NBFI hedging activity.

6. NBFIs' Hedging Pressure, by Currency
(Percent)



Sources: CLS Group; and IMF staff calculations.

Note: Panel 1 shows the total spot and swap flow turnover by counterparty sector for 2024 across all currencies. Panels 2 and 3 show the structure of euro–US dollar and yen–US dollar networks, respectively, depicting average net flow from each country-sector in the pair to the other country-sector in 2024. The size of the node represents the market share of gross flows. The arrows represent the direction of net inflows. Data labels in panels 2 and 3 use International Organization for Standardization (ISO) two-digit country codes. Panel 4 measures bank dealer concentration across currency pairs by computing the Herfindahl-Hirschman Index. The index scale ranges from 0 to 10,000. The horizontal lines refer to the Bank for International Settlements' benchmarks for concentration in FX markets. Panel 5 shows the share of NBFIs by currency pair and indicates the median and interquartile range of the distribution. In panel 6, hedging pressure is computed as the difference between short and long swap outstanding positions of various currencies relative to the US dollar, normalized by the total outstanding FX swap positions. A positive hedging pressure reflects an imbalance in NBFIs' demand for hedging in the FX swap market. The measure is shown as a three-month rolling average (see Online Annex 2.3 for details). CHF = Swiss franc; EUR = euro; EZ = euro area countries excluding France, Germany, Italy, The Netherlands, and Spain; FX = foreign exchange; GBP = British pound; JPY = Japanese yen; M = month; NBFI = nonbank financial institution; NFC = nonfinancial corporation; RW = rest of the world.

predominantly facilitated by banks in Japan and the United States (Figure 2.5, panel 3). There are thus different degrees of dealer bank concentration, defined here as the extent to which banks in specific jurisdictions dominate trading activity in a particular currency pair, with some currency pairs showing higher degrees of concentration, as reflected by the upper range of the interquartile distribution in Figure 2.5, panel 4.[24] The degree of dealer concentration is also high in swap markets with longer tenors, suggesting that even though the global FX market is broadly diversified, certain segments remain reliant on a concentrated group of dealers. This reliance can amplify systemic risk in the event of financial or operational disruptions affecting these key institutions.

The trading activity of NBFIs also varies significantly across currency pairs. Over the past decade, the median share of NBFIs in FX trading activity has averaged about 8 percent (Figure 2.5, panel 5). However, some currency pairs, such as euro–US dollar, have had a significantly higher participation share, exceeding 15 percent in recent years. This variation reflects differences in market structure, liquidity, and the importance of specific currency pairs to institutional investors. Moreover, hedging of currency exposures among NBFIs, measured by their net FX swap positions against the US dollar in various currencies, has generally been on an increasing trend (Figure 2.5, panel 6).[25] Notably, this measure appears to be positively correlated across major currencies, suggesting a synchronized need for dollar hedging ("hedging pressure") that can strain liquidity and amplify volatility, particularly in times of market stress.[26]

[24]Dealer bank concentration is measured using the Herfindahl-Hirschman Index, which reflects the share of trading activity in specific currency pairs in key financial jurisdictions—Canada, France, Germany, Japan, Switzerland, the United Kingdom, and the United States—conducted by banks classified as dealer banks. Banks in all other jurisdictions are treated as nondealer banks (see Online Annex 2.3 for details).

[25]Specifically, hedging pressure is defined as the net short swap position of NBFIs in specific currencies with respect to the US dollar relative to the total outstanding market swap position (Bräuer and Hau 2023). This measure reflects both demand-side factors (for example, rollover needs of NBFIs) and supply-side constraints (for example, dealer balance sheet limitations). Subsequent empirical analysis attempts to disentangle these two channels.

[26]Hedging pressure from NBFIs across countries tends to be strongly correlated with these institutions' net bond investment positions with respect to the United States, suggesting that greater exposure to US fixed-income assets is associated with higher demand for FX hedging (see Online Annex 2.3; BIS 2025b).

Nonresident NBFIs typically increase their holdings of safe haven assets during periods of elevated macrofinancial uncertainty. For example, net purchases of US dollars in both spot and swap markets tend to rise with spikes in the VIX or the US EPU index (Figure 2.6, panels 1 and 2).[27] Similarly, net spot purchases of other safe haven currencies, such as the euro and the Swiss franc, by nonresident NBFIs also react strongly to these shocks (Online Annex Figure 2.3.5).

In the recent episode of uncertainty triggered by US tariff announcements in early April 2025, nonresident NBFIs increased their purchases of safe haven assets. However, overall net spot purchases of US dollars by both non-US banks and non-US NBFIs were relatively subdued compared with those in previous episodes, such as the 2020 COVID-19 shock (see Box 2.1).[28] Demand for US dollar swaps by non-US NBFIs rose sharply, suggesting a shift to hedge previously unhedged exposures. Despite the magnitude of the shock, stress in the FX market remained limited, with no major disruption.

Macrofinancial Uncertainty and FX Trading Dynamics

This section formally examines how an increase in global macrofinancial uncertainty affects FX trading activity, focusing on cross-border transactions involving major currencies against the US dollar. The analysis considers several uncertainty measures, including financial market volatility, monetary policy uncertainty, and broader economic policy uncertainty.[29] These measures capture different dimensions of risk and may influence market behavior and demand for the dollar through distinct but related channels: financial volatility, proxied by the VIX, often triggers immediate liquidity needs and safe haven flows, as investors reallocate their investments into assets with cash-like

[27]In general, both US and non-US NBFIs are net buyers of US dollars. Among banks, US institutions typically supply US dollars to their non-US counterparts in the spot market (Online Annex 2.3). In the FX swap market, behavior varies by tenor: US banks rely on short-tenor swaps for their FX funding, which non-US banks provide. For longer tenors, US banks provide hedges to non-US institutions (Kloks and others 2023; Kloks, Mattille, and Ranaldo 2024).

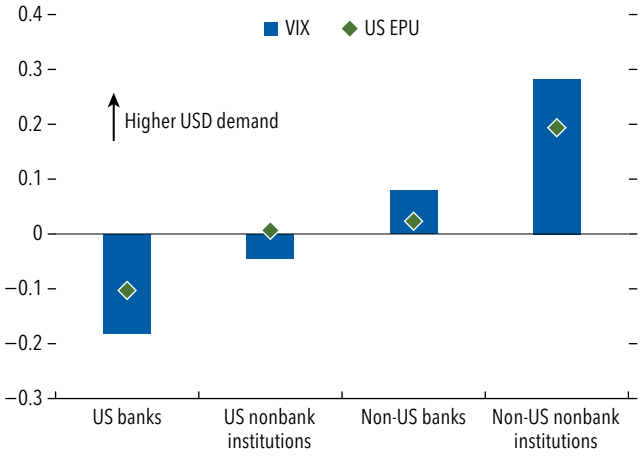
[28]These observations are supported by data on portfolio flows into the United States among nonresident investment funds, which show a slowdown during April and May (Online Annex Figure 2.7.1). Bond fund flows especially declined, reflecting in part weaker demand for US Treasuries (Grothe and others 2025; Jiang and others 2025).

[29]See Online Annex 2.4 for further details on empirical methodology and results for the analysis presented in this section.

Figure 2.6. Net Purchase of US Dollars and Macrofinancial Uncertainty

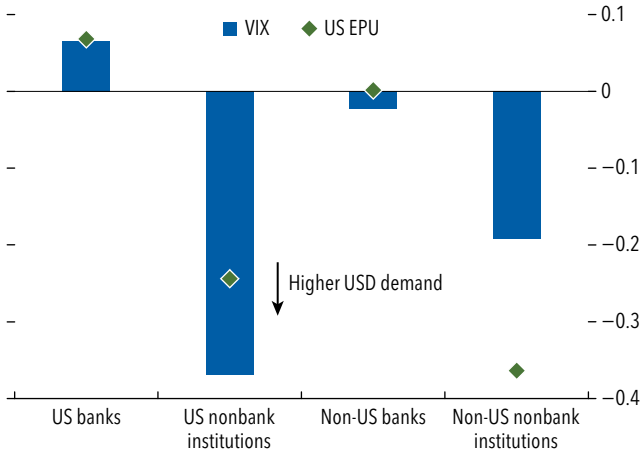
Non-US nonbank financial institutions increase their purchase of dollars as uncertainty rises ...

1. Net US Dollar Spot Flows versus VIX and EPU, 2015:M1–2025:M5
(Weekly correlation in four-week moving averages)



... whereas US banks act as net lenders.

2. Net US Dollar Swap Flows versus VIX and EPU, 2015:M1–2025:M5
(Weekly correlation in four-week moving averages)



Sources: CLS Group; Haver Analytics; and IMF staff calculations.

Note: The figure displays the unconditional correlations between net US dollar spot and swap flows and various uncertainty measures across different country sectors. EPU = economic policy uncertainty index; M = month; USD = US dollar; VIX = Chicago Board Options Exchange Volatility Index.

properties; monetary policy uncertainty (measured by the MOVE index's signal of volatility in the bond market) may affect expectations and funding costs; and broader economic policy uncertainty, captured by the EPU index, can weigh on longer-term investment decisions and influence demand for the dollar.

An increase in uncertainty tends to raise nonresident demand for US dollars. The effects are particularly pronounced after large shocks to the VIX or the MOVE index, defined here as unexpected changes in the values of those indices exceeding two standard deviations (Figure 2.7, panel 1).[30] The estimated effects are economically meaningful: uncertainty shocks of the magnitude observed during episodes like the 2020 COVID-19 turmoil can raise weekly spot trading growth by up to 24 percentage points. Additional analysis for flows into other safe haven currencies—such as the euro, Japanese yen, and the Swiss franc—confirms that these currencies also attract inflows during periods of heightened global uncertainty (Online Annex Figure 2.4.2). These results remain robust when the sample is restricted to the period preceding the 2025 US tariff announcements, a time marked by unusually high levels of economic policy uncertainty (Online Annex Figure 2.4.5).[31]

NBFIs, particularly investment funds, respond more strongly to global uncertainty shocks than do banks or nonfinancial firms. After a spike in the VIX or the MOVE index, weekly growth rates in trading volumes of nonresident NBFIs rise by about 40 percentage points, on average, compared with a 15 percentage point increase in the rates for dealer and nondealer banks (Figure 2.7, panels 2 and 3). This sectoral asymmetry could reflect that NBFIs are more exposed to market-driven risks and operate with tighter liquidity and margin constraints. Unlike banks, NBFIs rely more heavily on market funding and collateralized borrowing, making them more vulnerable to asset price volatility and margin calls (Aramonte and Avalos 2021; FSB 2022).

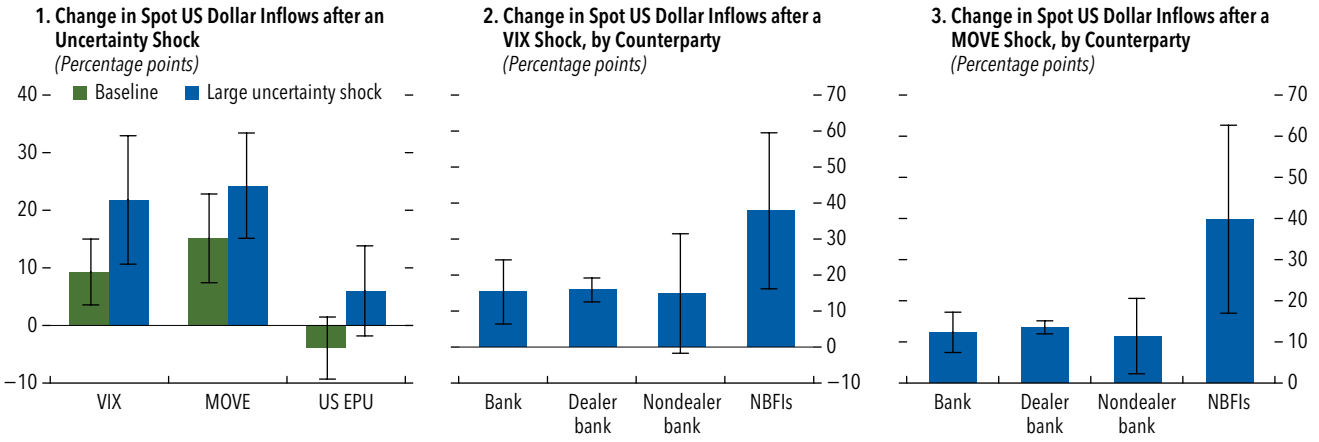
Similar dynamics are evident in the FX swap market, in which NBFIs account for a growing share of

[30]Using an alternative measure of monetary policy uncertainty derived from the EPU index yields similar results (see Online Annex Figure 2.4.1).

[31]Although these findings highlight strong demand for safe haven currencies during major uncertainty shocks, caution is warranted in extrapolating the patterns observed to future episodes. Deepening global fragmentation that triggers major shifts in the use of international currencies may alter traditional flight-to-safety dynamics. Moreover, the nature of a particular shock matters: more localized episodes, such as a rise in US-specific macroeconomic uncertainty without a broader surge in global macrofinancial uncertainty, may reduce nonresident demand for US dollars (see Online Annex 2.4; Grothe and others 2025).

Figure 2.7. Effect of Macrofinancial Uncertainty on Foreign Exchange Spot Activity

After a spike in macrofinancial uncertainty, demand for US dollars among nonresident institutions, especially NBFIs, tends to rise.



Sources: Baker, Bloom, and Davis 2016; Bloomberg Finance L.P.; CLS Group; LSEG Datastream; and IMF staff calculations.

Note: "US dollar inflows" refers to spot transactions by non-US financial and nonfinancial institutions in 15 jurisdictions. The figure displays the impacts of various uncertainty shocks on weekly changes in dollar inflows using a panel model. The model controls for a range of global and domestic macrofinancial factors, including the Federal Reserve Bank of Chicago's National Financial Conditions Index, a commodity price index, the US term spread, domestic term spreads in other countries, and the spot exchange rate. The specification also includes country-sector fixed effects and country-time fixed effects. In panel 1, "Baseline" refers to the effects of a one-standard-deviation increase in uncertainty measures on the outcome variable. "Uncertainty shocks" are defined as dummy variables equal to 1 when the first-order autoregression residual of the underlying indicator exceeds two standard deviations. Whiskers show the 90 percent confidence intervals. EPU = economic policy uncertainty index; MOVE = Merrill Lynch Option Volatility Estimate index; NBFIs = nonbank financial institutions; VIX = Chicago Board Options Exchange Volatility Index.

short-term US dollar funding and hedging. During episodes of elevated uncertainty, NBFIs increase FX swap usage to secure liquidity or hedge currency exposures. The response is especially pronounced for longer-dated transactions (those of more than seven days) (Figure 2.8, panel 1), which are more indicative of hedging, than for short-term trading or arbitrage flows (Du, Tepper, and Verdelhan 2018; Bräuer and Hau 2023).[32] Quantitatively, a VIX shock raises FX swap activity by about 5 percentage points among banks but nearly twice as much among NBFIs, which is consistent with patterns observed in spot market flows (Figure 2.8, panel 2). A similar response follows shocks to the MOVE index, which captures expected volatility in US interest rates. However, the response appears somewhat weaker in this case, presumably because the regression model includes the term-spread differential as a control variable, which may absorb part of the impact of the MOVE index on US dollar swap inflows (Kumar and others 2023).

FX exposures notably drive the hedging behavior of participants, making currency mismatches a key amplifier of global shocks. Institutions holding substantial open positions in foreign currencies, particularly the US dollar, face heightened amounts of valuation and rollover risk during periods of volatility, prompting a surge in hedging activity. The analysis shows that countries whose banks have larger dollar funding gaps tend to exhibit stronger responses to uncertainty shocks (Figure 2.8, panel 3). Net international investment positions in the dollar also help explain cross-country differences in hedging behavior, as US and non-US investors often face opposing hedging needs (Figure 2.8, panel 4).[33] These findings align with studies showing that net hedging activity is proportional to a country's net investment position in the corresponding currency (Gabaix and Maggiori 2015; Devereux and Yu 2020; Liao and Zhang 2025).[34]

[32]Most sub-seven-day trades are used by banks and money market desks to square books, fund inventories, or arbitrage rate differentials. These flows roll over daily and serve intraday liquidity needs rather than strategic hedging purposes. Short-dated swaps are concentrated in the interdealer market for intraday liquidity management or maturity transformation, in which banks use short-dated interbank swaps to fund longer-dated dollar lending (Kloks and others 2023).

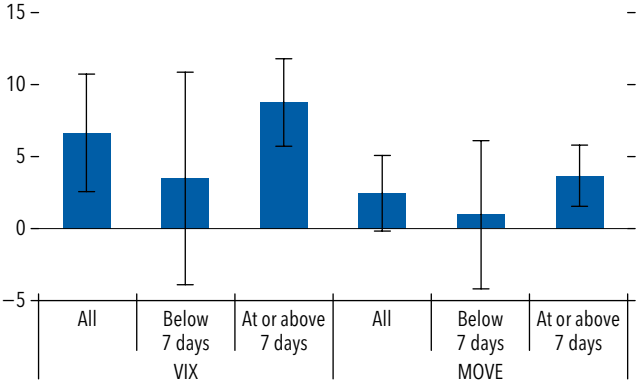
[33]For instance, a country with a large long position in US dollar assets—such as holdings of US Treasuries—would face a greater incentive to hedge FX risk when volatility rises, typically by selling dollars forward.

[34]The banking sector's US dollar FX mismatch is measured as the ratio of dollar-denominated assets minus dollar-denominated liabilities, normalized by dollar-denominated assets. Similarly, the net investment position is defined as the difference between dollar long-term debt held by foreign investors and foreign long-term debt held by US institutions, normalized by the total amount of outstanding long-term debt among US and foreign investors.

Figure 2.8. Effect of Macrofinancial Uncertainty on Foreign Exchange Swap Flows

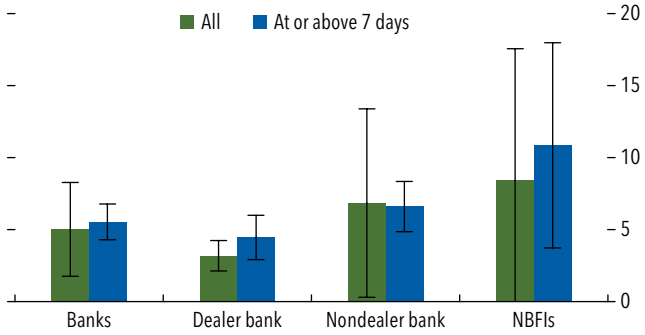
Heightened uncertainty raises FX swap activity in longer maturities, indicating stronger hedging rather than interdealer activity ...

1. Change in US Dollar Swap Inflows after an Uncertainty Shock
(Percentage points)



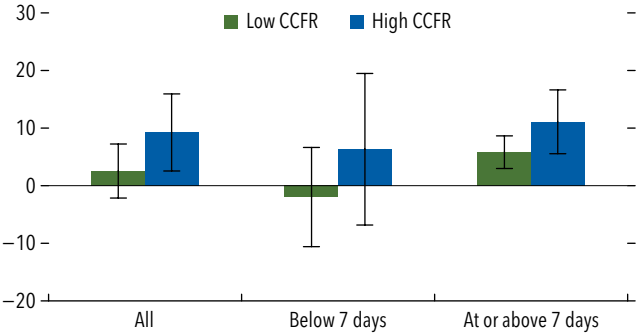
... especially among NBFIs, likely reflecting tighter balance sheet constraints and greater sensitivity to global shocks.

2. Change in US Dollar Swap Inflows after a VIX Shock, by Counterparty
(Percentage points)

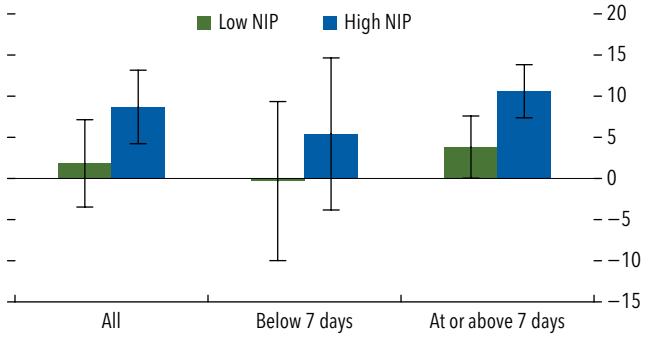


Hedging demand tends to rise with FX mismatches, as institutions with larger currency gaps—measured by the bank funding gap or net foreign investment positions—face greater exposure to exchange rate fluctuations.

3. Change in US Dollar Swap Inflows after a VIX Shock, by CCFR
(Percentage points)



4. Change in US Dollar Swap Inflows after a VIX Shock, by NIP
(Percentage points)



Sources: Baker, Bloom, and Davis 2016; Bloomberg Finance L.P.; CLS Group; LSEG Datastream; and IMF staff calculations.

Note: "US dollar swap flows" refers to swap transactions by non-US financial and nonfinancial institutions. FX swap transaction volumes are smoothed, with the four-week average of weekly flows taken. The figure displays the impacts of different uncertainty shocks on weekly changes in dollar inflows using panel models with fixed effects. The models control for global and domestic macrofinancial factors, including the Federal Reserve Bank of Chicago's National Financial Conditions Index, a commodity price index, the US term spread, domestic term spreads, the three-month overnight index swap covered interest parity deviation, and the spot exchange rate. The specification also includes country-sector fixed effects and country-time fixed effects. An "uncertainty shock" is defined as a dummy variable equal to 1 if the first-order autoregression residual of the underlying indicator exceeds two standard deviations. The banking sector's US dollar FX mismatch is the ratio of its net to its total dollar-denominated assets. The dollar net investment position is the difference between foreign holdings of US long-term debt and US holdings of foreign long-term debt, scaled by total outstanding holdings of long-term debt. High (low) CCFR or NIP refers to economies with vulnerability levels above (below) the quarterly sample median. Whiskers show the 90 percent confidence intervals. CCFR = cross-currency funding gap ratio; FX = foreign exchange; MOVE = Merrill Lynch Option Volatility Estimate index; NBFIs = nonbank financial institutions; NIP = net (foreign) investment position; VIX = Chicago Board Options Exchange Volatility Index.

Uncertainty Shocks and Stress in Foreign Exchange Markets

The effects of global uncertainty shocks on FX trading dynamics can translate into FX market stress. To evaluate these effects, three key measures of FX market conditions are considered here: (1) the cross-currency basis (through CIP deviation), (2) annualized excess spot-return volatility, and (3) quoted bid-ask spreads.[35]

The baseline analysis uses a panel of 11 major pairs of the US dollar with other currencies for which disaggregated data are available from CLS. In addition, an alternative sample that includes a broader set of emerging market currencies is used to assess the impact of uncertainty shocks on FX markets in that group of countries.[36]

[35]See Online Annex 2.5 for methodological details.

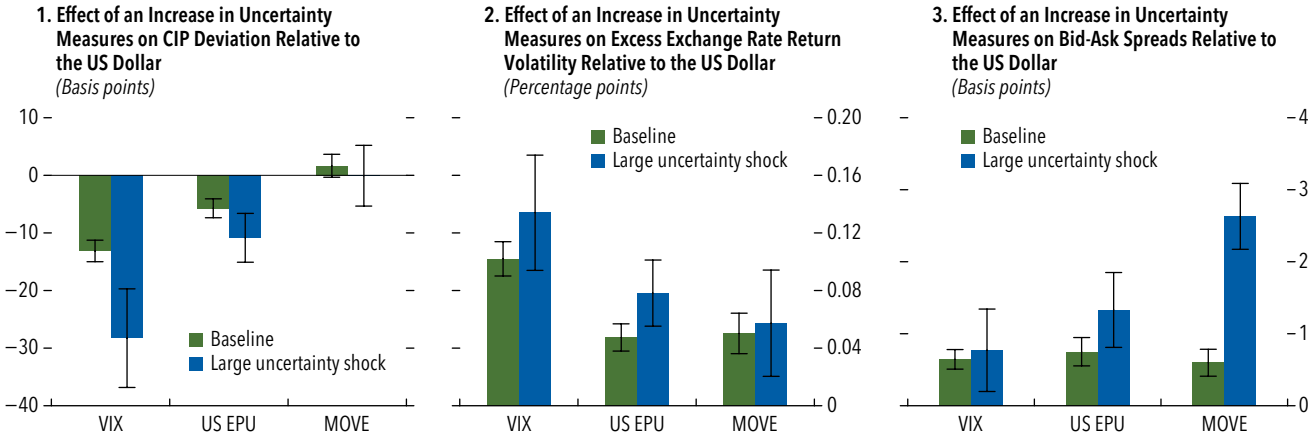
[36]The emerging market sample includes 16 currencies, with coverage varying across regressions due to data availability (see Online Annex 2.5 for details).

Figure 2.9. Effect of Global Macrofinancial Uncertainty Shocks on Foreign Exchange Market Conditions

Uncertainty shocks widen CIP deviations, signaling increased US dollar funding stress ...

... while also increasing excess exchange rate return volatility ...

... and widening bid-ask spreads.



Sources: Baker, Bloom, and Davis 2016; Bloomberg Finance L.P.; CLS Group; LSEG Datastream; and IMF staff calculations.

Note: The figure shows the effects of one-standard-deviation increases in each uncertainty indicator and high uncertainty shocks on the three-month overnight index swap CIP deviation, excess exchange rate return volatility, and bid-ask spreads over a one-week horizon. Large uncertainty (VIX, US EPU, or MOVE) shocks are represented as dummy variables equal to 1 when the first-order autoregression residuals of the underlying indicators exceed two standard deviations. The effects are economically significant: The standard deviation is about 40 basis points for CIP deviations, 0.3 percentage point for excess exchange rate return volatility, and 0.06 percent for bid-ask spreads (normalized by the mid-rate). Whiskers show the 90 percent confidence intervals. CIP = covered interest parity; EPU = economic policy uncertainty index; MOVE = Merrill Lynch Option Volatility Estimate index; VIX = Chicago Board Options Exchange Volatility Index.

Uncertainty shocks are a key driver of cross-currency bases relative to the dollar. A one-standard-deviation increase in global macrofinancial uncertainty indicators, such as the VIX or the EPU index, widens the three-month basis by up to 13 basis points over a week (Figure 2.9, panel 1). The effect of changes in the MOVE index is not statistically significant once the effect of term-spread differentials is controlled for, consistent with the view that US interest rate volatility transmits mainly through the yield curve (Kumar and others 2023). Large uncertainty shocks—those exceeding twice the standard deviation—produce disproportionately larger effects, indicating a nonlinear response.

Elevated uncertainty also impairs FX market liquidity and increases volatility. In response to shocks to the VIX, EPU, and MOVE indices, weekly excess exchange rate return volatility increases by about 5–10 basis points, while bid-ask spreads widen by 1–3 basis points—equivalent to about half a standard deviation, on average. These effects persist for up to three months, peaking about four weeks after the shock (Figure 2.9, panels 2 and 3; Online Annex Figure 2.5.2).

Notably, the effects of shocks are larger for emerging market currencies. When the analysis is extended to include emerging market currencies in the sample, the results show that these tend to experience somewhat stronger and more persistent effects after uncertainty shocks, across all measures of FX market conditions (Online Annex Figure 2.5.3). Cross-currency bases and bid-ask spreads widen, on average, more than twice the amounts estimated for advanced economies, and the estimated effects on excess exchange rate return volatility also increase notably. These results are aligned with those of earlier studies (for example, Du and Schreger 2016, 2022; Dao and Gourinchas 2025; and Dao, Gourinchas, and Itskhoki 2025) that find greater sensitivity of emerging market currencies to global shocks, possibly as a result of structural factors like shallower markets, greater reliance on foreign currency financing, and more limited access to dollar liquidity backstops.[37]

[37]Because data on the CIP deviation of overnight index swaps are not available for many emerging markets, the analysis comparing advanced economies and emerging market economies uses the Treasury CIP deviation, which is the difference between the yield on a US Treasury bond and the synthetic yield obtained by swapping a foreign government bond into dollars through the FX swap market. Because much of the variation in Treasury CIP deviations could reflect credit risk, the regressions include measures of expected default frequency in the banking sector or sovereign credit default swap spreads. See Online Annex 2.3 for details.

Effect of Foreign Exchange Market Fragilities

The impact of uncertainty shocks on FX markets is shaped by underlying market fragilities. In the banking sector, US dollar funding needs amplify the effect of uncertainty on CIP deviations when the cross-currency funding ratio (CCFR) is large, that is, above the sample median, reflecting a significant shortfall of dollar-denominated liabilities relative to dollar-denominated assets that must be covered using FX swaps (Figure 2.10, panel 1). Elevated CCFR levels also amplify the effect on FX market volatility, with excess exchange rate return volatility rising in response to uncertainty shocks when the CCFR is large (Figure 2.10, panel 2). A second amplification channel arises from hedging pressure linked to currency mismatches on the balance sheets of NBFIs. As noted earlier, during periods of heightened macrofinancial uncertainty, NBFIs increase their dollar hedging activity, typically by selling dollars forward in FX swaps. As a result, hedging pressure tightens synthetic dollar funding conditions and amplifies deviations from CIP (Figure 2.10, panel 3).

Excess exchange rate return volatility is sensitive to dealer concentration and the share of NBFI activity (Figure 2.10, panel 4). In concentrated markets, as reflected in a high Herfindahl-Hirschman Index, fewer dealers dominate, potentially reducing competition and market depth. This raises transaction costs and limits the market's capacity to absorb shocks. Similarly, a sizable presence of price-taking NBFIs (for example, real-money investors or macro funds) may increase order flow imbalances during stress, raising market volatility. These institutions typically demand liquidity without providing it, contributing to wider spreads and higher levels of execution risk. Unlike hedging pressure, which affects valuations, dealer concentration and the NBFI share in a currency's trade appear to affect market outcomes more through intermediation and liquidity provision channels.[38]

[38]The distinction lies in the transmission channels: hedging pressure affects valuation—the pricing of forward rates relative to interest differentials—whereas dealer and investor structure affects liquidity and intermediation capacity. CIP reflects a valuation arbitrage condition among spot, forward, and interest rates. When hedging demand outpaces dealers' ability to supply synthetic US dollars, forward prices deviate from arbitrage-consistent levels. This distorts relative pricing without necessarily affecting transactional liquidity. As a result, CIP deviations are more responsive to FX mismatches and hedging imbalances, whereas spreads and volatility reflect frictions in liquidity provision.

Dealer balance sheet constraints represent another key friction shaping the transmission of uncertainty shocks to FX markets. Beyond demand-driven forces, FX market dysfunctions can arise as systematic responses to market frictions that intensify under elevated uncertainty. As outlined in the conceptual framework (Figure 2.3), increased market volatility can constrain dealers' balance sheet capacity, limiting their ability to intermediate FX swaps and contributing to CIP deviations (see, for example, Du, Tepper, and Verdelhan 2018; Dao, Gourinchas, and Itskhoki 2025; and Kubitza, Sigaux, and Vandeweyer 2025).[39] To formally assess this mechanism, the analysis interacts uncertainty shocks with a proxy for dealer balance sheet strength: specifically, the capital ratio of primary dealer banks, following He, Kelly, and Manela (2017). A higher capital ratio, reflecting stronger equity buffers, is associated with greater capacity to supply derivatives and absorb risk. The findings suggest that stronger capital positions help mitigate the effects of uncertainty shocks, improving overall FX market functioning by reducing CIP deviations and excess exchange rate return volatility (Figure 2.11, panels 1 and 2).[40]

Role of Policy Factors

Policy backstops are critical for stabilizing the global FX market during adverse shocks. Among the most effective tools are the Federal Reserve's US dollar liquidity swap lines, which provide selected foreign central banks with direct access to dollar funding. These arrangements ease dollar funding stress, limiting CIP deviations and helping to stabilize FX swap markets. During the 2020 COVID-19 turmoil, the Federal Reserve expanded its swap lines to additional central banks and introduced the Foreign and International Monetary Authorities Repo Facility, offering temporary liquidity against US Treasury collateral. Analysis shows that newly activated swap lines reduced CIP deviations by up to 30 basis points, nearly offsetting the entire impact of the initial VIX shock, and significantly lowered excess exchange rate

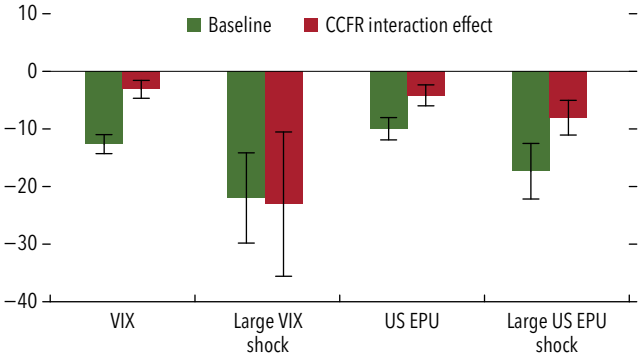
[39]Dealer balance sheets have not kept pace with the expansion of the US Treasury supply since the global financial crisis (Online Annex Figure 2.5.1).

[40]The results support the idea that tighter dealer constraints reduce dealers' ability to intermediate (He, Kelly, and Manela 2017; Duffie 2023).

Figure 2.10. Foreign Exchange Market Fragilities as Amplifiers of Shock Transmission

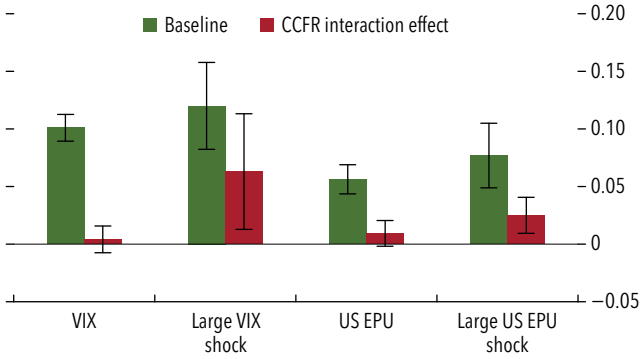
Banks' FX mismatches increase the cost of US dollar funding through swaps ...

1. Effect of an Increase in Uncertainty on CIP Deviation Relative to the US Dollar Conditional on Banks' FX Mismatch
(Basis points)



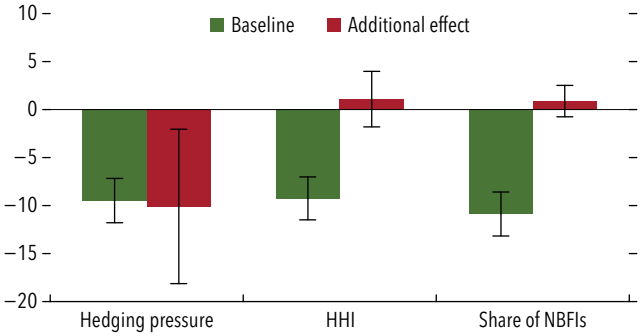
... and amplify the impact of uncertainty shocks on excess exchange rate return volatility.

2. Effect of an Increase in Uncertainty on Excess Exchange Rate Return Volatility Conditional on Banks' FX Mismatch
(Percentage points)



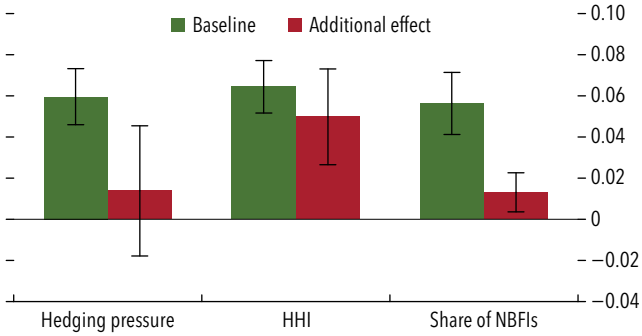
Increased NBFI hedging activity amplifies the effect of financial uncertainty on CIP deviation ...

3. Effect of an Increase in the VIX on CIP Deviation Relative to the US Dollar Conditional on Market Fragilities
(Basis points)



... whereas dealer concentration and greater participation of NBFIs in a currency's trading amplify excess exchange rate return volatility.

4. Effect of an Increase in the VIX on Excess Exchange Rate Return Volatility Conditional on Market Fragilities
(Percentage points)



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

Note: The figure shows the effects of one-standard-deviation increases in each uncertainty indicator and high-uncertainty shocks on three-month overnight index swap covered interest parity deviations and excess exchange rate return volatility, along with the amplification effects due to various FX market vulnerability measures over a one-week horizon. Large uncertainty (VIX or US EPU index) shocks are represented as dummy variables equal to 1 when the first-order autoregression residuals of the underlying indices are two standard deviations above average. The CCFR measures a country's banking sector's US dollar mismatch as the difference between its US dollar assets and US dollar liabilities, divided by US dollar assets, using quarterly Bank for International Settlements data. "Additional effect" refers to the additional impact of uncertainty shocks when vulnerabilities are one standard deviation above their averages. "Hedging pressure" measures the net hedging activity of NBFIs and is calculated as the difference between their aggregate short and long FX swap (forward) positions, scaled by the global average of outstanding US dollar contracts. The HHI is the sum of the squared market shares of all bank dealers. "Share of NBFIs" captures the proportion of non-interdealer swap market activity accounted for by NBFIs. The three vulnerability measures are computed for each currency area. Whiskers show the 90 percent confidence intervals. See Online Annex 2.3 for details on variable construction. CCFR = cross-currency funding ratio; CIP = covered interest parity; EPU = economic policy uncertainty index; FX = foreign exchange; HHI = Herfindahl-Hirschman Index; NBFI = nonbank financial institution; VIX = Chicago Board Options Exchange Volatility Index.

return volatility (Figure 2.12, panels 1 and 2). These outcomes underscore the importance of swap lines in mitigating market dysfunction.[41]

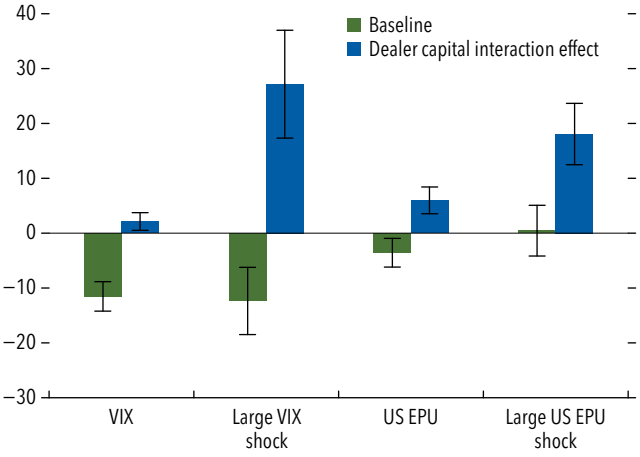
International reserves are a stabilizing force during stress episodes. Central banks can use reserves to provide domestic dollar liquidity when private funding dries up, whereas larger reserve buffers may also enhance a sovereign's perceived creditworthiness and help mitigate flight-to-quality pressures, thereby mitigating FX market stress. The analysis here shows that economies with stronger reserve buffers—about one standard deviation above the average—experience notably smaller CIP deviations and lower excess exchange rate return volatility following macrofinancial uncertainty shocks (Online Annex Figure 2.5.4, panels 1 and 2).

[41]The stabilizing effect of these new swap lines is consistent with Barajas, Deghi, Fendoglu, and Xu (2020); Barajas, Deghi, Raddatz, and others (2020); Aizenman and others (2021); and Bahaj and Reis (2022).

Figure 2.11. Dealers' Constraints and Foreign Exchange Market Conditions

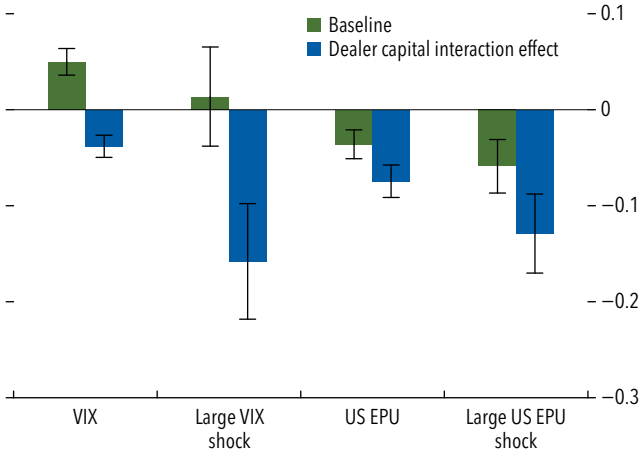
A higher capital ratio boosts dealers' capacity to supply FX liquidity, limiting CIP deviation ...

1. Effect of an Increase in Uncertainty on CIP Deviation Conditional on Dealers' Capital Ratios
(Basis points)



... whereas a lower ratio limits dealers' willingness to intermediate, worsening FX market conditions.

2. Effect of an Increase in Uncertainty on Excess Exchange Rate Return Volatility Conditional on Dealers' Capital Ratios
(Percentage points)



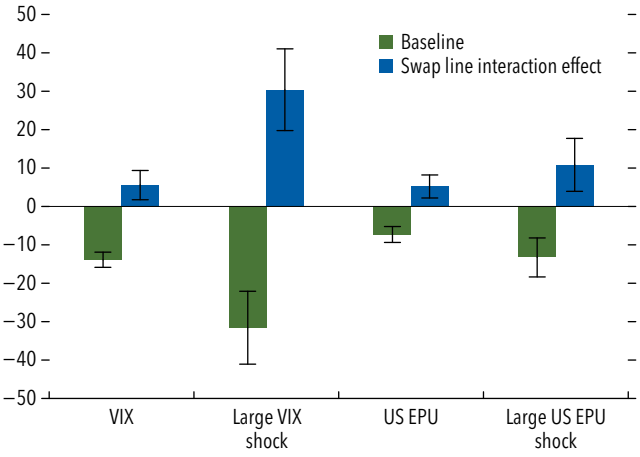
Sources: Bloomberg Finance L.P.; LSEG Datastream; and IMF staff calculations.

Note: The figure shows the effects of one-standard-deviation increases in the VIX and the US EPU index and their associated uncertainty shocks on FX market conditions, along with the mitigating effects of a proxy of dealer balance sheet strength. Large uncertainty (VIX or US EPU) shocks are represented as dummy variables equal to 1 when the first-order autoregression residuals of the underlying indices are two standard deviations above the average. Dealer balance sheet strength is proxied by the capital ratio of primary dealer banks from He, Kelly, and Manela (2017). Whiskers show the 90 percent confidence intervals. CIP = covered interest parity; EPU = economic policy uncertainty index; FX = foreign exchange; VIX = Chicago Board Options Exchange Volatility Index.

Figure 2.12. Policy Mitigating Factors

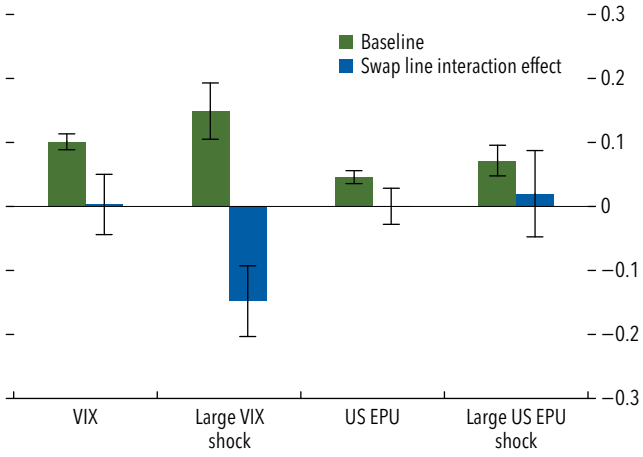
FX swap lines help reduce CIP deviations ...

1. Mitigating Effect of FX Swap Lines on CIP Deviations after External Shocks
(Basis points)



... and lower excess exchange rate return volatility.

2. Mitigating Effect of FX Swap Lines on Excess Exchange Rate Return Volatility after External Shocks
(Percentage points)



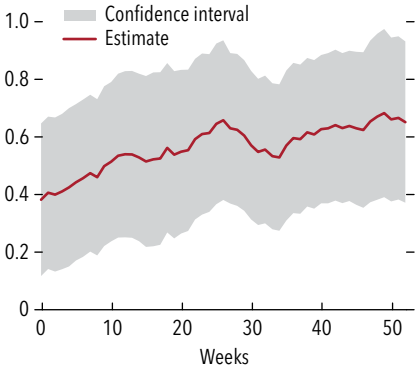
Sources: Bloomberg Finance L.P.; LSEG Datastream; and IMF staff calculations.

Note: The figure shows the effects of a one-standard-deviation increase in the VIX and the US EPU index and their associated uncertainty shocks on FX market conditions, along with the mitigating effects of policy backstops like new central bank swap lines. Large uncertainty (VIX or US EPU) shocks are represented as dummy variables equal to 1 when the first-order autoregression residuals of the underlying indices are two standard deviations above the average. Currencies in the sample with new swap lines are the Danish krone, the Norwegian krone, the Singapore dollar, and the Swedish krona. Whiskers show the 90 percent confidence intervals. CIP = covered interest parity; EPU = economic policy uncertainty index; FX = foreign exchange; VIX = Chicago Board Options Exchange Volatility Index.

Figure 2.13. Financial Spillovers of Foreign Exchange Market Stress

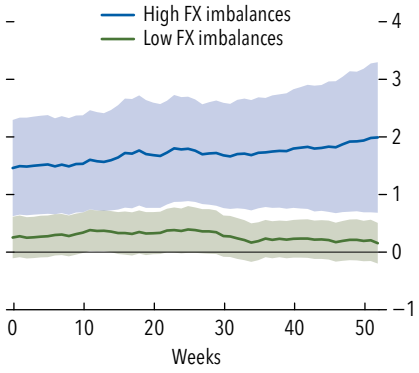
FX funding stress can tighten financial conditions ...

1. Effect of Cross-Currency Bases on Financial Conditions
(Standard deviations)



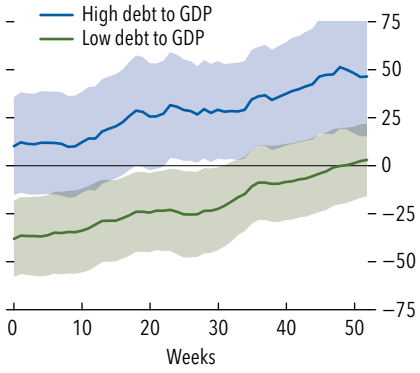
... particularly when currency mismatches are large.

2. Effect of Cross-Currency Bases on Financial Conditions with FX Mismatches
(Standard deviations)



Fiscal vulnerabilities can amplify the spillover of FX funding stress onto sovereign bond yields.

3. Public Debt and the Effect of Cross-Currency Bases on Five-Year Sovereign Bond Yields
(Basis points)



Sources: Bloomberg Finance L.P.; CLS Group; LSEG Datastream; and IMF staff calculations.

Note: Panel 1 shows estimates from regressions of financial conditions on the cross-currency bases of local currencies against the US dollar. Panel 2 shows estimates from regressions of financial conditions on the cross-currency bases and on the cross-currency bases interacted with a dummy variable equal to 1 when FX mismatches in a country are above the sample median for the period. Panel 3 shows estimates from regressions of five-year local currency sovereign bond yields on the cross-currency bases and on the cross-currency bases interacted with a dummy variable that takes the value 1 when the debt-to-GDP ratio of a country is above the sample median for the period. In all panel regressions, a granular instrumental variables approach is used in which the cross-currency bases are instrumented with variables that capture idiosyncratic shocks to demand for dollar funding in the FX swap market for three different tenors (less than 7 days, between 7 and 35 days, and more than 35 days). The cross-currency basis and the idiosyncratic demand shocks are standardized for each currency and tenor. The shaded areas represent 90 percent confidence intervals, obtained using Driscoll-Kraay standard errors, with the number of lags equal to $\sqrt[4]{T}$, in which T denotes the number of time periods in the sample. The specifications include time and currency effects. The currencies in the sample are the euro, the Japanese yen, the British pound, the Swiss franc, the Canadian dollar, the Australian dollar, the New Zealand dollar, the Swedish krona, and the Norwegian krone, trading against the US dollar. FX = foreign exchange. See Online Annex 2.6 for further details.

Spillovers of Foreign Exchange Market Stress to Other Asset Classes

Stress in the global FX market, given its size and deep linkages with other financial markets, can trigger cross-market spillover effects. To identify these spillover effects, the analysis employs panel regressions and a granular instrumental variables approach. The results show that a widening of cross-currency bases triggers a flight-to-quality, which compresses local currency sovereign bond yields and reduces stock prices (Online Annex Figure 2.6.1). Specifically, a one-standard-deviation widening (about 25 basis points) reduces longer-term sovereign bond yields by about 25 basis points, with effects lasting up to three months.[42] Shorter-term yields fall even more sharply, reflecting increased demand for less interest-rate-sensitive assets.

[42]This is an economically meaningful effect, considering, for example, that the five-year US Treasury yield fell by about 50 basis points in the week following the collapse of Silicon Valley Bank in March 2023.

FX market stress tightens overall financial conditions. Shocks that widen cross-currency bases drive down risky asset prices, tightening aggregate financial conditions. A one-standard-deviation widening tightens financial conditions by 0.4 to 0.7 standard deviations over the following year. This is a sizable effect, about half the tightening observed during the dash-for-cash episode induced by COVID-19 in March 2020, and highlights the potential systemic implications of FX market dislocations for credit spreads, equity prices, and funding costs (Figure 2.13, panel 1).

The transmission of FX market shocks to broader financial conditions is amplified by vulnerabilities, such as currency mismatches on the balance sheets of financial institutions or elevated public debt (Figure 2.13, panel 2). In economies with a low level of FX mismatches, the effect of a cross-currency basis widening is negligible because the spillover effects of an increased cost of funding or hedging using FX swaps are likely to be smaller. In contrast, countries with a high level of mismatches experience a tightening of financial conditions by as much as two standard deviations following a one-standard-deviation shock

to cross-currency bases. Fiscal vulnerabilities also play a role: the effect of cross-currency basis widening on five-year sovereign bond yields is greater for economies with high public debt relative to GDP (Figure 2.13, panel 3), consistent with flight to quality favoring fiscally sound economies.[43]

These findings underscore the systemic importance of FX markets, in which stress can transmit into tighter financial conditions, exacerbating downside tail risks to real GDP growth and threatening macrofinancial stability (Adrian, Boyarchenko, and Giannone 2019; October 2024 *Global Financial Stability Report*).

Conclusion and Policy Recommendations

The global FX market has expanded significantly over time. This growth has been accompanied by notable structural changes, including a rising presence of NBFIs and increased reliance on FX swaps for liquidity management and currency risk hedging. These developments present opportunities and challenges for market resilience and policy frameworks. This chapter's analysis shows that the global FX market reacts strongly to macrofinancial shocks despite its deep liquidity. Heightened risk aversion tends to increase demand for safe assets, straining FX market and funding liquidity conditions, particularly in emerging markets. Structural vulnerabilities, such as high dealer concentration, the growing role of NBFIs, and intensified FX hedging and funding pressures, can amplify these effects. Moreover, operational disruptions in FX market infrastructure can restrict trading and impair liquidity, which exacerbates market stress. Given the central role of FX markets in the financial system, such stress can spill over into debt and equity markets, tightening overall financial conditions and posing risks to macrofinancial stability.

The findings also highlight that FX settlement risk remains a material concern, particularly for economies that cannot access robust risk mitigation infrastructure. The adoption of simultaneous settlement systems, such as PvP platforms, significantly reduces excess FX returns and volatility and can thereby reduce settlement uncertainty and currency risk premiums.

A shifting global macrofinancial landscape underscores the need to strengthen FX market resilience. To address vulnerabilities and mitigate associated risks, policy actions could focus on three key areas.

Strengthening Surveillance to Monitor Systemic Risk Arising from FX Market Stress

Although stress testing and systemic risk monitoring have advanced, the role of FX markets as a conduit for risk transmission and cross-border spillovers remains underappreciated. A more structured surveillance approach is needed to better capture FX market vulnerabilities and their potential to disrupt macrofinancial stability. Enhancing FX liquidity stress tests is essential to assess the sectoral resilience to funding shocks and sudden tightening in spot and swap market conditions. Systemwide stress tests should incorporate scenarios involving heightened volatility, as well as wider bid-ask spreads and cross-currency bases, while factoring in FX market vulnerabilities, to assess how FX market disruptions could transmit across the financial system. Monitoring and mitigating rollover and liquidity risks from short-tenor FX swap positions, which are widely used for funding and hedging, is also essential, as these can amplify stress during market disruptions.

Scenario analysis is crucial to evaluate the impact of operational disruptions on FX market functioning and broader financial stability. The scenarios employed in such analysis should include severe and persistent technical failures in primary trading venues and critical payment systems, cyberattacks, physical disasters, and defaults by major FX dealers, and consider the availability of contingency measures. Cyberattacks, in particular, pose growing risks, with the potential to impair liquidity, delay settlements, and trigger systemic stress across markets (April 2024 *Global Financial Stability Report*).

Closing data gaps is essential to strengthen the monitoring of FX market risks. The decentralized nature of FX trading makes comprehensive and timely data collection a persistent challenge. Key gaps in data availability include limited visibility into bilateral exposures, settlement practices, intraday trading, and counterparty concentrations, particularly for transactions carried on outside centralized infrastructures like PvP systems. Much of this information is held privately by NBFIs or embedded in bilateral dealer relationships not subject to reporting requirements. Addressing these gaps through enhanced regulatory reporting and improved data sharing is essential to strengthen surveillance and support resilient FX markets.

[43]Similar results for sovereign bond yields are obtained when fiscal vulnerability is proxied by sovereign credit default swap spreads (Online Annex 2.6).

Ensuring Adequate Capital and Liquidity Buffers at Financial Institutions, Supported by a Robust Crisis Management Framework

Regulatory and supervisory agencies should ensure that financial institutions with a dominant and systemic role in FX markets maintain adequate hedges and capital and liquidity buffers. Strengthening access to intraday central bank liquidity and credit facilities, including for NBFIs, alongside stronger regulatory and supervisory oversight to limit moral hazard (April 2023 *Global Financial Stability Report*), can help prevent payment gridlocks during market stress.[44] Moreover, supervisors and banks should effectively monitor and manage liquidity risks in significant currencies.

Economies relying heavily on external financing should maintain sufficient international reserve buffers to safeguard against external shocks (IMF 2016). Strengthening and expanding the network of central bank swap lines can enhance global FX liquidity backstops and help reduce contagion risks. Notably, the IMF's lending toolkit plays a vital role within the broader global financial safety net, offering tailored instruments to support countries facing FX liquidity pressures during adverse shocks.

Managing systemic risk arising from stress in FX markets may also require a policy action mix in line with the IMF's Integrated Policy Framework. This is particularly important when external shocks lead to undesirable macroeconomic fluctuations, particularly in the presence of significant FX mismatches on private sector balance sheets or shallow FX markets, as reflected in excess exchange rate return volatility, or wider bid-ask spreads and CIP premiums. The response may include FX intervention and macroprudential and capital flow management measures calibrated to country-specific conditions (IMF 2023).

Adequate Management of Operational and Settlement Risk

Strengthening the operational resilience of financial market infrastructures is critical to safeguarding FX market stability. In line with the Principles of Financial Market Infrastructures (BIS-CPSS-IOSCO 2012), financial market infrastructures should identify plausible sources of operational risk and implement robust systems, policies, and procedures to ensure high reliability. This implementation should include comprehensive business continuity planning, cyber resilience frameworks, and regular testing of contingency arrangements. Given the substantial netting efficiency provided by settlement and clearing systems, a prolonged failure could have serious effects, such as preventing participants from accessing additional liquidity they may require to fulfill payment obligations and capital needed to cover potential counterparty losses.[45] Financial institutions, likewise, should adopt comprehensive operational risk management practices that address vulnerabilities in technology, processes, and third-party dependencies (April 2024 *Global Financial Stability Report*). Given the interconnected nature of FX markets, disruptions in one jurisdiction can affect counterparties globally, underscoring the need for coordinated responses among central banks and agencies with oversight responsibility for financial market infrastructures.

Reducing FX settlement risks requires wider adoption of PvP arrangements. In the interim, dealer banks can strengthen risk controls through alternative arrangements, including "pre-settlement netting," which reduces settlement risk by bilaterally offsetting gross obligations, and "on-us" settlement, in which both legs of FX trades are settled within the same institution, thereby mitigating counterparty exposure (BIS 2025a). Strong anti-money laundering/combating the financing of terrorism measures should also be implemented to reduce uncertainty in settlement. Policy initiatives that leverage digital technologies, if properly designed, offer promising avenues for helping to address settlement risk and increase the safety and efficiency of cross-border payments. These include linking faster payment systems or developing cross-border central bank digital currency, as explored in recent Bank for International Settlements initiatives (IMF 2024a).[46]

[44]Effective oversight of NBFIs is essential to limit moral hazard and reduce central banks' exposure to collateral and credit risks. Liquidity support facilities should be temporary, collateralized with appropriate haircuts, and priced at a penalty rate, to safeguard financial stability. These measures should align with the Financial Stability Board's recommendations to address vulnerabilities in NBFIs, including liquidity mismatches and leverage (FSB 2025).

[45]For example, CLS's netting process typically reduces funding requirements by approximately 96 percent (CLS Group 2025).

[46]The cross-border use of FX-denominated central bank digital currency, if such currency is not properly designed and regulated, could displace domestic currencies, weaken monetary policy control, and heighten vulnerability to shocks (IMF 2023; October 2024 *Global Financial Stability Report*, Chapter 3).

Finally, FX markets could lower transaction costs and volatility by migrating toward well-designed financial platforms, which have the potential to reduce counterparty and settlement risks, as well as costs associated with information asymmetry and dealer constraints in over-the-counter markets (Adrian and Mancini-Griffoli 2023; IMF 2024b).[47]

[47]"Financial platforms" refers to infrastructures that facilitate the interoperability of financial assets.

Box 2.1. Foreign Exchange Market Dynamics around the April US Tariff Announcement

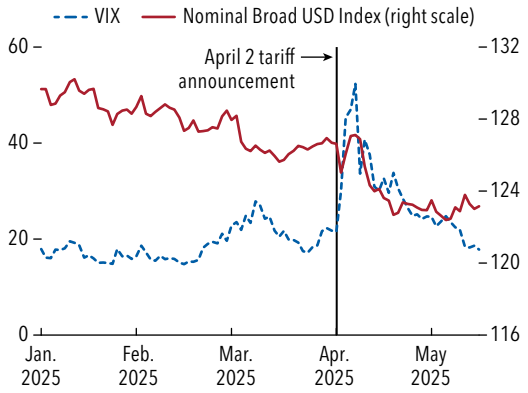
On April 2, 2025, the United States announced increased tariff rates on imports, marking a major policy shift with potential implications for global trade and investment. The announcement triggered a sharp reaction in financial markets: measures of financial uncertainty like the Chicago Board Options Exchange Volatility Index spiked, and the broad US dollar index depreciated by about 2 percent on impact (Figure 2.1.1). Although market volatility eased after the suspension of some tariffs on April 9, the dollar continued to weaken. Overall, despite the large magnitude of the shock, foreign exchange (FX) market conditions remained broadly orderly, with no major disruptions observed. Using data from the CLS FX settlement system, this box examines how FX market dynamics evolved around the announcement, focusing on changes in spot and swap dollar trading volumes across countries and sectors.

Spot dollar purchases by nonresident investors rose notably ahead of April 2, increasing by about $265 billion on a net basis between January 1 and April 1. Following the tariff announcement, purchases continued to rise through mid-April but have since declined (Figure 2.1.2, panel 1). As of the end of May, cumulative net spot purchases remained broadly stable.

Cross-country differences are evident in trading patterns. For example, Canada was a net buyer of spot dollars from November 2024 through mid-April 2025 but shifted to net selling thereafter. Similarly, spot dollar sales on a net basis by major euro area countries increased after April 2. Across sectors, most of non-US institutions' activity has been driven by nonbank financial institutions around the tariff episode, which contrasts with what took place in previous macrofinancial shocks, such as the COVID-19 market turmoil in March 2020, when banks dominated FX trading (Figure 2.1.2, panels 2 and 3).[1]

The FX swap activity of non-US nonbank investors against the US dollar increased notably after the April 2 tariff announcement (Figure 2.1.2, panel 4).[2] Compared with what took place after the COVID-19 shock, hedging demand from these investors—which involves selling US dollar forward contracts—has been stronger and more persistent.[3] Although the overall cumulative change in swap positions has been only slightly larger than that of the COVID-19 episode, combined with the muted net spot dollar purchases, this may have contributed to US dollar depreciation pressure during April and May.[4]

Figure 2.1.1. Broad US Dollar Index and VIX, January 2, 2025, to May 15, 2025
(Index)



Sources: Federal Reserve Bank of St. Louis, Federal Reserve Economic Data; and IMF staff calculations.

Note: USD = US dollar; VIX = Chicago Board Options Exchange Volatility Index.

[1]Net purchases of other safe haven currencies, such as the euro and Japanese yen, rose notably after April 2, exceeding levels observed during the COVID-19 turmoil (Online Annex Figure 2.7.2). Moreover, as Canada became net sellers of US dollars during this period, the country appeared to shift toward the euro, and major euro area countries moved toward the yen.

[2]Cumulative swap flows in panel 4 of Figure 2.1.2 should not be interpreted as net mark-to-market positions. This is because they do not account for maturity and refinancing activities. In addition, each flow is recorded using the forward rate fixed at the time of the contract, without incorporating after-the-fact valuation changes that are due to the shifts in market exchange rates.

[3]Swap dollar flows are positive for non-US banks, indicating that they sell dollar hedges, that is, they buy dollar forward contracts. A similar pattern holds for US banks, which are net hedge sellers, whereas US nonbank institutions are net buyers of FX hedges.

[4]Note that a shift in trading activity in other sectors, such as the official sector, or by other institutions not captured by the CLS settlement data may also have contributed to US dollar depreciation pressures following April 2 (see, for example, Jiang and others 2025).

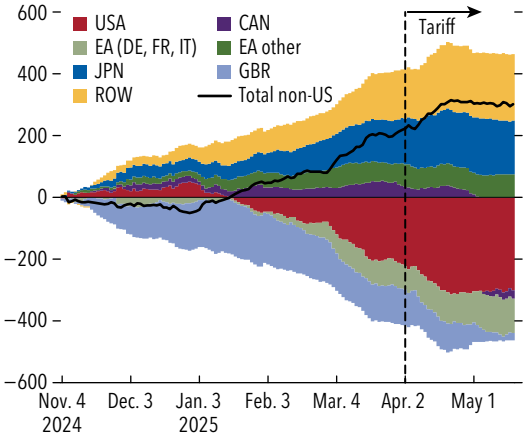
Box 2.1 *(continued)*

Figure 2.1.2. Net Spot US Dollar Flows before and after the US Tariff Announcement on April 2, 2025

(Billions of dollars)

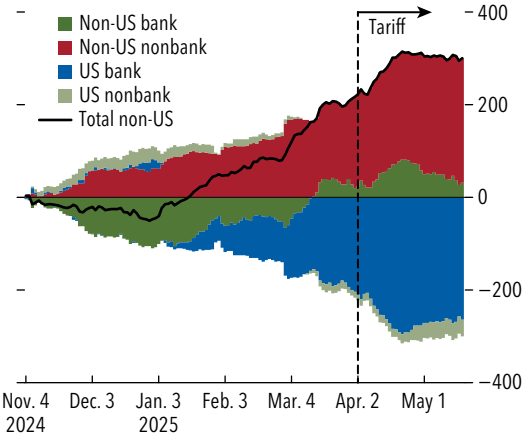
Net purchases of US dollars increased in the first quarter of 2025 but have stabilized since then.

1. Cumulative Net US Dollar Spot Flows, by Purchaser Nationality, 2024:M11–2025:M5



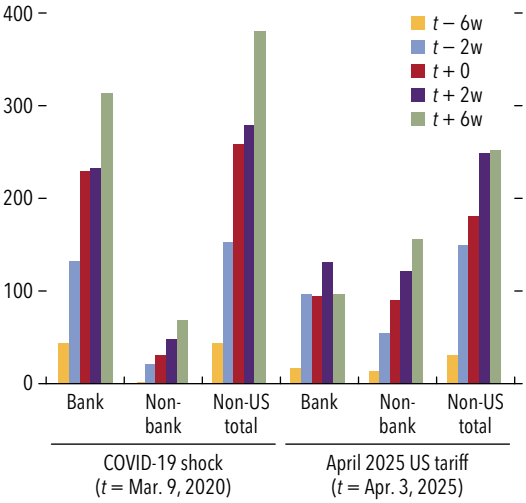
Non-US nonbank institutions have been active buyers of US dollars in the spot market.

2. Cumulative Net US Dollar Spot Flows, by Sector, 2024:M11–2025:M5



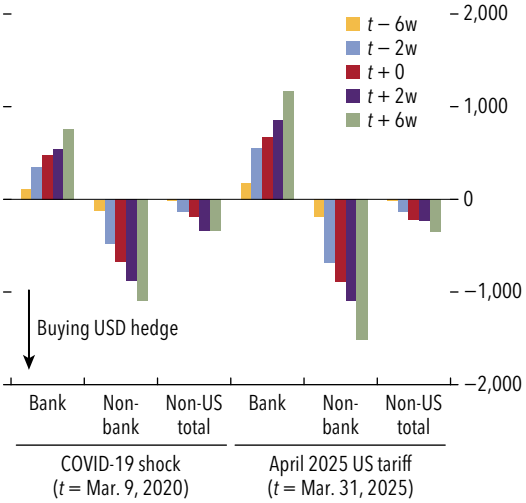
Spot US dollar purchases by non-US investors decreased more after the April US tariff announcement than they did during the COVID-19 episode ...

3. Cumulative Net US Dollar Spot Flows of Non-US Institutions



... although hedging demand has been higher.

4. Cumulative Net US Dollar Swap Flows of Non-US Institutions



Sources: CLS Group; and IMF staff calculations.

Note: In panel 1, residency is based on the institutions participating in CLS Settlement System. Panels 3 and 4 present net US dollar spot and swap flows around two major shocks—COVID-19 and the April US tariff announcement—denoted as time t, with $t - h$ and $t + h$ representing h weeks before and after the event, respectively ($h = 2$ and 6). For COVID-19, t is set as March 9, the date of a sharp stock market decline amid broader financial turmoil triggered by pandemic fears. In panel 3, for the US tariff announcement shock, t is defined as April 3, reflecting the timing of the US tariff announcement after market close in several major economies. In panel 4, t is set as March 31 to align with the weekly frequency of FX swap flow data; a positive bar indicates that the institutional sector is a net buyer of US dollars in the forward leg of swap contracts and a net seller of US dollars in the near leg of swap contracts; US dollar swap flows with tenors of less than 35 days are excluded from panel 4. Country names are represented by International Organization for Standardization (ISO) three-digit country codes except EA (DE, FR, IT) = euro area (Germany, France, and Italy); EA other = euro area except Germany, France, and Italy; ROW = rest of the world.

Box 2.2. The Relevance of Settlement Risk in Foreign Exchange Markets

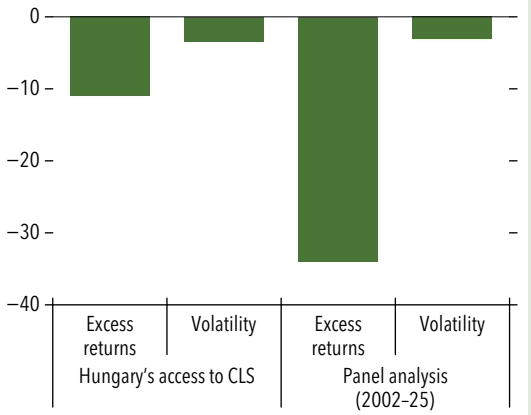
Foreign exchange (FX) settlement risk, often referred to as Herstatt risk, arises when one party in a currency trade delivers the currency it sold but fails to receive the currency it bought. Such risk is significant because such failures can trigger liquidity pressures, credit losses, and even systemic disruptions, especially during periods of market stress. Whereas payment infrastructure and risk mitigation tools have improved over the years, settlement risk remains a concern, particularly in emerging market and developing economies. These jurisdictions often lack access to robust simultaneous settlement mechanisms like payment-versus-payment (PvP) systems, rely more on correspondent banking relationships that introduce additional layers of counterparty exposure and operational complexity, and operate within payment and legal frameworks that may not align with global FX settlement arrangements. This box reviews key historical episodes, outlines the evolution of mitigation strategies, and assesses the relevance of settlement risk for countries without access to global PvP platforms like the CLS system.[1]

Key Episodes and Risk Mitigation Frameworks

The term "Herstatt risk" originates from the failure of Bankhaus Herstatt on June 26, 1974, when German regulators closed the bank after it had received Deutsche mark payments from US counterparties but before it delivered the corresponding US dollars later that day. The default triggered widespread disruption in the multilateral net settlement system and prompted the establishment of the Basel Committee on Banking Supervision later that year. Settlement risk has persisted well beyond this episode. In 2008, Kreditanstalt für Wiederaufbau, a German state-owned investment and development bank, transferred €300 million (equivalent to $426 million at the time) to Lehman Brothers on the morning of Lehman's bankruptcy filing but never received the corresponding payment, resulting in a unilateral loss. More recently, in March 2020, Barclays suffered a $129 million FX loss when its counterparty, UAE Exchange, failed to deliver the currency owed amid COVID-19-related market stress. These incidents underscore enduring vulnerabilities in FX settlement, particularly during periods of heightened market volatility or institutional fragility.

In response to these vulnerabilities, the global financial community has progressively developed strategies to mitigate FX settlement risk. A pivotal advancement was the establishment in 2002 of CLS, a multicurrency PvP system designed to ensure simultaneous settlement of both legs of an FX transaction. CLS significantly reduces counterparty risk by linking settlements across time zones and currencies and covers a substantial share of global FX turnover (see Online Annex 2.2 for further details). In parallel, international standard-setting bodies, such as the Basel Committee on Banking Supervision, the Committee on Payments and Market Infrastructures–International Organization of Securities Commissions, and the Global Foreign

Figure 2.2.1. Effect of CLS Entry on Excess Foreign Exchange Returns and Volatility
(Basis points)



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

Note: The figure shows the difference-in-difference impact of Hungary's entry into the CLS system on excess foreign exchange rate returns and the associated volatility, using daily data for a one-month window before and after the event. The analysis includes relevant control variables, including country and time fixed effects. Standard errors are clustered at the country level. The estimated effects are statistically significant at the 10 percent level or lower.

[1]FX settlement risk can be mitigated through two key approaches: presettlement netting, which reduces the amount to be exchanged by offsetting obligations between counterparties, and simultaneous settlement mechanisms, such as PvP or on-us settlement. PvP ensures that each currency leg settles only if the other does, eliminating settlement risk. In on-us settlement, both legs are processed within the same institution. However, protection against loss is assured only if settlement occurs simultaneously or within preauthorized credit lines; this is known as "on-us with loss protection."

Box 2.2 *(continued)*

Exchange Committee, have issued guidelines to strengthen legal certainty, promote settlement finality, and encourage broader adoption of PvP mechanisms. Notably, the FX Global Code, published in 2017 under the auspices of the Bank for International Settlements, sets out principles for good market conduct, including robust risk management and settlement practices to enhance transparency and integrity in FX markets. Many jurisdictions have also implemented real-time gross settlement systems and improved their legal frameworks to support netting arrangements and cross-border enforceability. Despite these advancements, about 25 percent of the deliverable turnover of currencies is without risk mitigation mechanisms (Glowka and Nilsson 2022).

PvP Systems and Currency Risk Premiums

In typical FX transactions, mismatches in global time zones and payment system operating hours expose participants to settlement risk, including the possibility of counterparty default. PvP systems like CLS eliminate such risk. By reducing settlement uncertainty and counterparty exposure, PvP mechanisms could lower the settlement risk premiums investors may require for bearing settlement risk and reduce the volatility of such premiums. To examine these effects empirically, two complementary approaches are employed here: a natural experiment based on Hungary's accession to CLS in 2015 and a broader panel analysis covering 26 currencies over 2000–25, including 16 currencies settled through CLS and 4 currencies with other PvP arrangements (those of Brazil, India, Malaysia, and Thailand).

1. *Hungary's Accession to CLS*

Hungary's currency, the forint, joined the CLS system on November 16, 2015. To assess the impact of this change on the forint's excess FX rate returns and volatility, a difference-in-difference analysis is conducted. The Czech koruna and Polish zloty, similar regional currencies that did not join CLS at the time, are used as benchmarks for comparison.[2]

The analysis shows that CLS entry led to a significant decline in the average daily excess exchange rate returns and volatility of the forint—the former by about 11 basis points (bps) and the latter by 3 bps—when the one-month periods before and after CLS participation are compared (Figure 2.2.1). Notably, the average excess returns over the month before CLS accession were about 28 bps, suggesting that CLS participation eliminated this excess return, bringing the currency closer to the value expected for it in the forward market. These results suggest a meaningful reduction in market uncertainty and support the hypothesis that PvP systems help mitigate credit risk in FX markets, thereby lowering settlement risk premiums.

2. *Panel Analysis*

A number of currencies are settled through PvP systems, such as CLS, the B3 Foreign Exchange Clearinghouse in Brazil, the Clearing Corporation of India Limited's Forex Settlement, and the Hong Kong Special Administrative Region–based Clearing House Automated Transfer System. To estimate the impact of PvP adoption, a panel regression analysis is conducted over January 2000 to May 2025. The results support earlier findings, showing that CLS participation is associated with a significant decline of 34 bps in excess FX returns and 3 bps in volatility, on average (Figure 2.2.1). This reinforces the view that PvP systems can contribute to global FX market stability by lowering settlement risk and the associated risk premiums.

[2]The koruna and zloty are selected as control group currencies based on Czechia's and Poland's comparable macroeconomic characteristics to those in Hungary, with the validity of this selection supported by exchange rate correlation analysis and a parallel trends test conducted using one year of pre-CLS data. See Online Annex 2.8 for details on the empirical methodology.

Box 2.3. Implications of Operational Disruptions in Foreign Exchange Markets

The resilience of foreign exchange (FX) markets is critical to global financial stability, given their central role in facilitating cross-border trade, investment, and exchange rate determination. Although FX markets are typically deep and liquid, they also depend on a concentrated set of trading venues and dealer banks for execution and price formation.[1] This reliance creates potential vulnerabilities: operational disruptions, such as technological failures, natural disasters, and cyber incidents, affecting these core infrastructures and intermediaries can impair market functioning and liquidity, with spillovers to other financial markets, as discussed in the conceptual framework in this chapter's text. This box analyzes how operational disruptions can affect FX market conditions by estimating the effects of outages at two primary trading venues, Electronic Broking Services (EBS) and London Stock Exchange Group's FX Matching, as a case study.

The core of the global FX network overlaps with the interdealer market (Figure 2.5, panels 2 and 3), in which transactions between dealer banks are facilitated by primary market venues, most notably EBS and FX Matching. These platforms play a central role in price formation and liquidity provision. In 2023, EBS experienced an outage; in 2015, trading on the FX Matching platform was disrupted. Both outages occurred when the London and New York trading sessions in the FX market overlapped, a period of high market liquidity (King, Osler, and Rime 2012). There are no detailed accounts of the exact nature of the disruptions, but publicly available information indicates that both outages lasted for some time and likely had a meaningful impact on trading in the interdealer market.

To examine the effect of these outages on FX market conditions, key market liquidity indicators, such as spot and forward bid-ask spreads, are analyzed across two dimensions—currencies that are primarily traded on the affected platform versus those that are not, and over time for all currencies—to assess the aggregate effects. Because the outages at EBS and FX Matching directly affected the interdealer segment of the FX market, they provide a natural setting for isolating the effects of operational disruptions, reducing the risk of confounding from broader financial market impairments (see Online Annex 2.9 for methodological details).

The analysis focusing on the currencies directly affected by the outages suggests a deterioration in market liquidity across multiple dimensions. During the outages,[2] the cost of FX transactions, as measured by bid-ask spreads, increased in the spot and swap markets (Figure 2.3.1, panel 1).[3] An examination of the volumes traded in the spot market on the days of the outages reveals a decline of $2.8 billion, on average, across the affected currencies.[4] Further analysis suggests that a $1 billion decrease in trading volume is associated with a 0.3 basis point widening of bid-ask spreads in the spot market, which could be considered an estimate of the causal effect of volumes on bid-ask spreads.[5] Larger drops in trading volumes because of more severe incidents, such as prolonged outages or simultaneous disruptions across multiple trading venues, could lead to more pronounced widenings of bid-ask spreads.

The market for the affected currencies also becomes less liquid, as measured by the price impact of trading volume (Figure 2.3.1, panel 2; Ranaldo and Santucci de Magistris 2022). Economically, however, the effect is moderate: the trading volume required to move daily FX returns by one standard deviation (about 3.4 percent) declines from $19.2 billion to $18.6 billion. The deterioration of market liquidity is also reflected in an increase of about 0.2 standard deviations (about 11 percent) in

[1]Over the past two decades, the number and types of FX trading venues (for example, multidealer platforms, single-dealer platforms, electronic communication networks, and retail platforms) have increased notably. However, core liquidity and price discovery in the interdealer segment, which underpins the broader FX market, remains concentrated in a few venues, notably Electronic Broking Services and London Stock Exchange Group's FX Matching.

[2]The effects of the outages on bid-ask spreads are quantified over their assumed durations, deduced from publicly available information (Mackenzie Smith 2015; Lambert 2023).

[3]The increase in bid-ask spreads for currencies directly affected by the outages suggests that disruptions to the interdealer market can raise inventory holding costs for dealer banks, thereby contributing to wider bid-ask spreads (Amihud and Mendelson 1980).

[4]All dollar volumes in this box are adjusted for inflation using the US Bureau of Labor Statistics Consumer Price Index and expressed in December 2024 US dollars.

[5]The relation between bid-ask spreads and trading volume is estimated using the outages as an instrumental variable for trading volume. The estimates are comparable with those in Bessembinder (1994), which translate to an increase of 0.2–1.1 basis points for a decrease of $1 billion, in December 2024 US dollars, in forecastable futures trading volume for the German mark, Japanese yen, British pound, and Swiss franc between January 1979 and December 1992.

Box 2.3 *(continued)*

the dispersion of transaction prices across counterparties, suggesting that some must accept less favorable terms of trade.

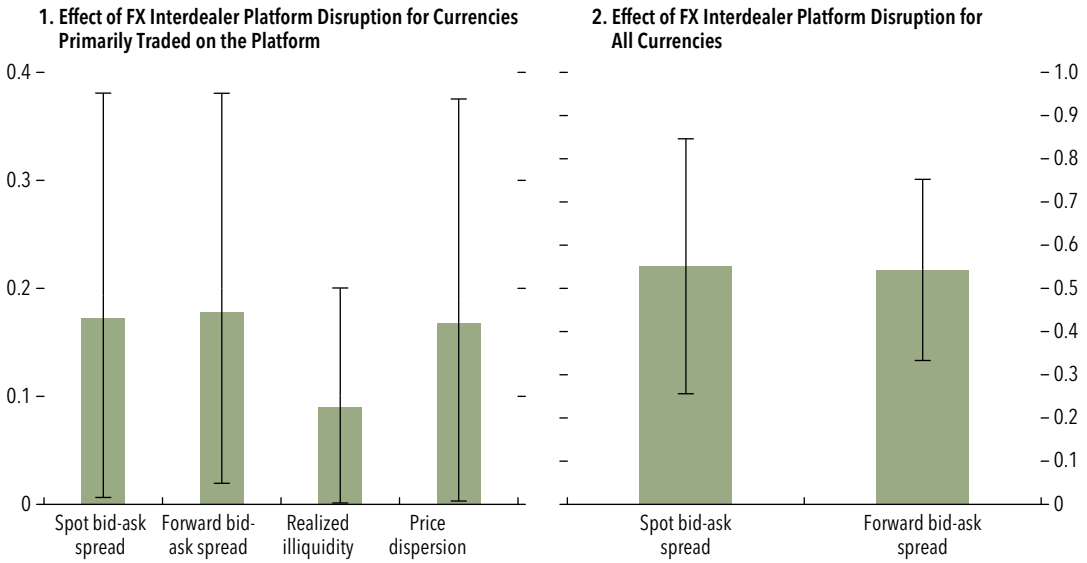
Further analysis of the aggregate effects of the outages indicates that transaction costs in the spot and swap markets rose significantly across all currencies, including those mainly traded on venues that remained operational (Figure 2.3.1, panel 2). This suggests the presence of liquidity spillovers across market venues, which is possibly due to the migration of trading from the affected platforms to other venues, leading to congestion and strained liquidity conditions. Nonetheless, the increase in transaction costs is economically moderate, with bid-ask spreads across all major currency pairs against the US dollar widening, on average, from 3 to 4 basis points in the spot market and from 4 to 5 basis points in the swap market during the outages.

Together, the results suggest that even relatively short-lived outages of trading platforms can materially affect FX market liquidity. This underscores the importance of resilient infrastructures and intermediaries in safeguarding against more severe operational disruptions that could pose risks to financial stability.

Figure 2.3.1. Effect of Interdealer Platform Disruption on Market Liquidity
(Standard deviations)

Outages on interdealer platforms reduce liquidity for affected currencies ...

... and raise transaction costs for those traded on other platforms.



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

Note: The bars in the figure represent estimated coefficients from panel regressions of the outcome variables on an indicator variable for platform outage. In panel 1, the indicator variable is equal to 1 during a platform outage only for the currencies traded primarily on the platform and 0 otherwise. In panel 2, the indicator variable is equal to 1 during a platform outage for all currencies. "Realized illiquidity," defined as in Ranaldo and Santucci de Magistris (2022), refers to the ratio of the realized absolute variation of intraday returns to the volume of transactions in billions of US dollars and measures the price impact of trading volume. Price dispersion is the coefficient of variation of transaction prices for each pair of currencies traded across different counterparty sectors. Bid-ask spreads are sampled at 30-minute intervals, whereas the other measures are constructed at a daily frequency. The sample period covers the day of each outage as well as 90 days before and after. All the measures are standardized separately in each of the two 181-day windows and for each currency traded on the platform. The currencies in the sample are the euro, the Japanese yen, the British pound, the Swiss franc, the Canadian dollar, the Australian dollar, the New Zealand dollar, the Swedish krona, and the Norwegian krone, trading against the US dollar. The specifications in panel 1 include time and currency-year effects, and those in panel 2 include currency-year effects. The specifications for the bid-ask spreads also include currency–time of day–year effects. The error bars represent 90 percent confidence intervals, obtained using Driscoll-Kraay standard errors, with the number of lags equal to $\sqrt[4]{T}$, in which T denotes the number of time periods in the sample. FX = foreign exchange.

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