BIS Working Papers
No 1273

Global portfolio investments and FX derivatives

by Tsvetelina Nenova, Andreas Schrimpf and Hyun Song Shin

Monetary and Economic Department

June 2025

JEL classification: F31, F32, F42, G15

Keywords: global portfolio investments, FX hedging, financial conditions

BIS Working Papers are written by members of the Monetary and Economic Department of the Bank for International Settlements, and from time to time by other economists, and are published by the Bank. The papers are on subjects of topical interest and are technical in character. The views expressed in them are those of their authors and not necessarily the views of the BIS.

This publication is available on the BIS website (www.bis.org).

ISSN 1020-0959 (print)
ISSN 1682-7678 (online)

Global portfolio investments and FX derivatives

Tsvetelina Nenova* Andreas Schrimpf† Hyun Song Shin‡

June 18, 2025

Abstract

We show that outstanding volumes in FX swaps serve as a good indicator for the hedging activity associated with portfolio positions of advanced economy bond investors. As such, FX swaps serve as a key barometer of risk-taking and global financial conditions. We develop a simple portfolio choice model for international bond investors and use it to estimate the relationship between global FX hedging activity, relative investment opportunities (captured by the yield curve slopes in respective economies), and the hedging costs associated with underlying investments. We find that higher FX hedging activity is closely associated with US portfolio debt inflows and outflows, indicating that FX hedging plays a crucial role in facilitating cross-border bond investments. This connection between FX hedging motives, portfolio bond flows, and the yield curve highlights a mechanism of international financial spillovers—not only from the US but also from advanced economies with significant accumulated wealth flowing into the US.

Keywords: Global portfolio investments, FX hedging, financial conditions
JEL Classification: F31, F32, F42, G15

*Bank for International Settlements, Switzerland. E-mail: Tsvetelina.Nenova@bis.org
†Bank for International Settlements, Switzerland and CEPR. E-mail: Andreas.Schrimpf@bis.org
‡Bank for International Settlements and CEPR, Switzerland. E-mail: Hyunsong.Shin@bis.org

We are grateful to Stefan Avdjiev, Gaston Gelos, Bryan Hardy, Marco Lombardi, Angelo Ranaldo, Cara Stromeyer, Damiano Sandri, Vladyslav Sushko and participants at the 2025 Goodhart lecture at the LSE and the inaugural conference of the International Finance Society for helpful discussions and comments. The views expressed are those of the authors and do not necessarily reflect those of the Bank for International Settlements.

Introduction

In this paper, we show that outstanding volumes in FX swaps (and related FX derivatives) proxy for the hedging activity of advanced economy investors in international bond markets. There is a symbiotic relationship between hedging through FX derivatives and bond portfolio flows which renders FX derivatives activity very well suited as an important barometer of *global* financial conditions.

The global nature of sovereign bond markets means that currency choice is an integral part of the investment decision. Investment funds, pension funds and life insurance companies from rich economies that have obligations to their beneficiaries or policyholders in domestic currency nevertheless hold a globally diversified asset portfolio in several currencies. Currency hedging is therefore a key theme, and the financial system has evolved to allow such hedging. FX swaps enable investors to mitigate FX risk, while achieving desired exposures to foreign assets, notably in the US. By tracking the volumes of FX swaps, researchers, practitioners and policymakers, can gain valuable insights into cross-border portfolio investment activity, to which they are closely linked, making them a useful indicator of the global financial cycle.

In this setting, our paper makes three main contributions to the literature. First, we provide new evidence on how FX derivatives activity facilitates cross-border bond investments, shedding light on a key mechanism for the transmission of global financial shocks. Second, we highlight the role of yield curve slopes and deviations from covered interest rate parity (CIP) as key determinants of hedging demand, linking FX derivatives markets to bond markets. Third, we contribute to the global financial cycle (GFC) literature by showing how FX hedging enables financial spillovers—not only from the US but also from other advanced economies with large accumulated wealth. These insights enhance our understanding of the interplay between FX derivatives, portfolio flows, and global financial conditions.

An initial look at the data underscores the rapid growth in global FX derivatives usage since the global financial crisis of 2008–09, reflecting their increasing importance in international financial markets. According to the BIS over-the-counter (OTC) derivatives statistics, the outstanding notional amounts of FX swaps and outright forwards – the most widely used instruments – have grown rapidly to USD 75 trillion at end-2024. This growth has been driven primarily by other financial institutions (OFIs), including non-bank financial intermediaries, such as investment funds, pension funds, and insurance companies. These institutions play a pivotal role in global financial linkages, yet important questions remain. What factors influence portfolio investment and hedging activities of these players? And, what do their actions entail for the international transmission of monetary and financial conditions?

Aggregate global FX derivatives statistics, such as those compiled by the BIS, provide a comprehensive overview but lack the granularity needed to identify specific positions or trading strategies. Conversely, granular datasets from commercial or regulatory sources[1] often cover only a subset of investors or transactions and typically span short time periods, rarely exceeding a single business cycle. To manage this tradeoff between aggregate and granular data, we adopt a pragmatic and eclectic approach, leveraging semi-annual BIS FX derivatives statistics from 1998 to 2024. We complement this long but low-frequency dataset with (i) bilateral portfolio exposure data by asset class vis-à-vis the US from the US Department of the Treasury's TIC dataset and (ii) an optimal FX-hedged portfolio allocation framework to identify the key determinants of international investors' hedging behaviour at the macro-level.

Our analysis begins by highlighting a few key stylized facts. First, financial institutions other than large dealer banks (e.g., non-bank financial institutions) dominate the dynamics of global FX derivatives markets. Second, the majority of activity is concentrated in major advanced economy currencies vis-à-vis the US dollar. This concentration reflects the geographic distribution of accumulated wealth, with large asset managers operating out of those economies. Third, these institutions predominantly use short-term FX derivatives to hedge long-term cross-border investments in debt securities. This maturity difference between assets being hedged and the hedging instrument itself introduces a role for the slope of the yield curve as a determinant of hedging. Other things being equal, a higher short-term interest rate in the destination currency of the investment raises the cost of hedging, while a higher long-term interest rate in the destination currency enhances the attractiveness of the investment. Therefore, a steeper, upward sloping yield curve of the destination economy is more conducive to greater hedged investments. Finally, such calculations will need to factor in the long-rates domestically. For these reasons, the yield curve slopes in advanced economies play a crucial role in influencing the incentives to invest in foreign bond markets on a hedged basis. Collectively, these findings suggest a deep interconnection between FX derivatives and bond markets, with growing cross-border bond investments by FX-hedging OFIs driving much of the observed dynamics.

To develop these insights more formally, we devise a partial equilibrium two-country mean-variance portfolio choice model. In this framework, US and foreign asset managers allocate their wealth between domestic and foreign bond markets, factoring in FX-hedging costs. The model predicts that yield curve slopes – both in USD and local currencies – are critical determinants of optimal hedged bond investments. Additionally, deviations from CIP, global risk appetite, and shifts in the relative wealth of US versus foreign investors influence aggregate FX hedging volumes. Notably, the hedging demand of US investors, who face dollar appreciation risks, often contrasts with that of foreign investors, who hedge against dollar depreciation risks. This interplay provides a useful lens to analyse the determinants of FX derivatives activity and their role in cross-border bond flows.

Empirically, we examine OFIs' FX derivatives activity across five major non-USD currencies (EUR, JPY, GBP, CHF, CAD) using a panel regression framework. Our findings reveal that

[1] See, for instance, Kloks et al. (2023), Kubitza et al. (2025), Hacioğlu-Hoke et al. (2024).

foreign investors' investment and hedging motives are crucial determinants of the relationship between yield curve slopes and FX derivatives activity. Specifically, a flatter yield curve in the euro area or Japan (possibly driven by quantitative easing policies in these two economies) is associated with higher FX derivatives growth for the respective currency. A flatter USD yield curve in turn reduces the attractiveness of cross-border investments for foreign bond investors, dampening their FX hedging demand. Global risk aversion, proxied by US financial conditions or implied volatilities across asset classes, also strongly co-moves with FX volumes, reflecting its role in shaping cross-border long-term bond investments along the global financial cycle. Importantly, these patterns are consistent only with OFIs' hedging behaviour and not with that of dealer banks or non-financial customers. The mandates and constraints of global asset managers thus seem key for these dynamics.

To strengthen identification, we instrument yield curve slopes and risk aversion using high-frequency "monetary policy shocks" (Gürkaynak et al., 2005, Kearns et al., 2023, Jarociński, 2024) and monetary policy-induced "risk shifts" (Kroencke et al., 2021, Bauer et al., 2023). These results suggest that advanced economy central bank announcements, which influence domestic yield curves or risk perceptions, can generate spillovers through FX-hedged bond flows by non-bank intermediaries. Crucially, these spillovers operate not only from the US to other economies but also in reverse, highlighting the bi-directional nature of global financial linkages.

Related literature. Our paper contributes to several strands of the literature on FX derivatives, international portfolio allocation, and the global financial cycle (GFC). A central theme in the literature is the use of FX derivatives by investors to hedge currency risk associated with cross-border investments. Foreign investors typically hedge their bond exposures to mitigate FX risk (Du and Huber, 2024, McGuire et al., 2021), while US-based investment funds also rely heavily on currency hedging strategies (Sialm and Zhu, 2024). However, US investors often avoid FX risk altogether by primarily investing in domestic or dollar-denominated international assets (Maggiori et al., 2020, 2024).

The purpose and usage of FX derivatives vary significantly across investor sectors and currencies. For instance, Hacioğlu-Hoke et al. (2024) document that the majority of non-bank financial institutions (NBFIs) – investment funds, pension funds, and insurance companies – use FX derivatives predominantly for hedging purposes. Pension funds and insurance companies especially tend to use derivatives for FX hedging most aggressively, followed by investment funds who transact in FX derivatives mostly for the purposes of currency hedging rather than speculation. The maturities of FX derivative contracts used by NBFIs are typically short, rarely exceeding six months. Consistent with this, Kubitza et al. (2025) show that euro area NBFIs frequently use short-term FX derivatives to hedge long-term bond exposures, resulting in a maturity mismatch. This behaviour indicates how crucial it is to zoom in on the role of asset managers in FX derivatives markets, where hedging motives dominate speculative ones. Despite the prevalence of hedging, there is evidence that these strategies are not always optimal. Bräuer and Hau (2024) find that investment funds often hedge each currency exposure separately, failing to account for FX covariances, which could improve efficiency. Moreover, the degree of hedging responds to the forward premium or hedging costs, suggesting that hedging is influenced by market conditions. In contrast to this evidence dominated by FX derivatives on advanced economy currencies, De Leo et al. (2024, 2025) focus on FX derivatives against emerging market currencies, where the trading activity is often dominated by speculative (carry trade or momentum) rather than hedging motives.

The interaction between FX derivatives and monetary policy has also received some attention in the literature. For instance, Ahmed et al. (2023) show that US monetary policy tightening, characterized by higher short-term interest rates, encourages foreign bond investors to take on more credit risk in USD-denominated assets. This response offsets some of the decline in hedged returns associated with a flatter USD yield curve. While much of the literature focuses on conventional monetary policy, our work also emphasizes the role of unconventional monetary policies – not only by the US, but also by other advanced economies – in jointly determining bond and FX derivatives demand by international investors.

Our paper also relates to the broader literature on the global financial cycle (GFC), which examines how global financial conditions are shaped by common factors such as US monetary policy, risk appetite, and capital flows. A key insight from that literature is that US monetary policy and financial markets play an outsized role in driving global capital flows and asset prices (Rey, 2013, Miranda-Agrippino and Rey, 2020). We extend this literature by showing how FX hedging serves as a transmission channel for financial spillovers, linking yield curve slopes and CIP deviations to cross-border bond investments. By highlighting the role of FX derivatives in facilitating these flows, our work sheds light on how NBFIs contribute to the propagation of the financial cycle through hedged portfolio flows. Importantly, we show that these spillovers are not uni-directional; they also operate in reverse, with advanced economies outside the US influencing US financial conditions through their own FX-hedged investments.

Finally, our paper relates to the literature on the structural characteristics of FX derivatives markets. Kloks et al. (2023) and Huang et al. (2025) explore the liquidity and other market characteristics that influence FX derivatives trading. Persistent deviations from covered interest rate parity (CIP) for advanced economy currencies are another well-documented phenomenon (Du et al., 2018a,b, Du and Schreger, 2022). These deviations not only affect hedging costs but also play a role in exchange rate determination, as discussed by Bacchetta et al. (2024) and Bräuer and Hau (2022). By building on these strands of literature, our paper provides new insights into the role of FX derivatives in facilitating cross-border bond investments and their implications for global financial conditions, while also offering a new perspective on the global financial cycle through the lens of FX hedging activity.

Roadmap. We proceed as follows. Section 1 summarizes motivating evidence that links FX derivatives activity with cross-border bond investments. Section 2 lays out the portfolio choice problem associated with hedged bond investment between the US and other major advanced economies. We test the predictions on key determinants of FX hedging demand by international asset managers using aggregate FX derivatives data in Section 3, revealing an important role for non-US investors in financial spillovers. Taking the analysis further in an IV setup drawing on central bank announcements, we show that relative yield curve slopes as well as investors' risk-taking emerge as one structural driver of such spillovers. Section 4 concludes.

1 Stylized facts and motivating evidence

In this section we provide some motivating evidence on FX derivatives volumes and their link with international portfolio investments. We start by characterizing the dynamics of FX derivatives activity using data gathered by the BIS over-the-counter (OTC) derivatives statistics.

The BIS data offer comprehensive coverage of the notionals outstanding of FX derivatives on a semi-annual basis since mid-1998, based on a survey of large reporting dealer banks. Here, we exploit several useful breakdowns – by the type of instrument, the counterparty sector with which the dealer enters a derivatives contract, the currency of the FX contract[2], and the maturity.

The BIS OTC data have several advantages for our purposes outweighing some of their downsides. The main benefits of these data are the global coverage and long time span. The latter is especially important to study the main determinants of global portfolio investments along the global financial cycle. This is especially important given that the amplitude of the global financial cycle tends to be very long, exceeding that of the typical business cycle (Borio, 2012). The main downside in turn is that the data are aggregated along many dimensions and refer to gross, not net, positions. For instance, all derivatives with the British pound as one leg of the underlying FX transaction, regardless whether the counterparty takes a short or long GBP position, are summed with their absolute value. Hence, these data are best used to study time series or panel dynamics, whereas research questions pertaining to the heterogeneity in positioning of different agents are better-directed at more disaggregate (albeit more partial) sources such as those explored in *inter alia* Hacioğlu-Hoke et al. (2024), Huang et al. (2025), Kloks et al. (2023), Kubitza et al. (2025).

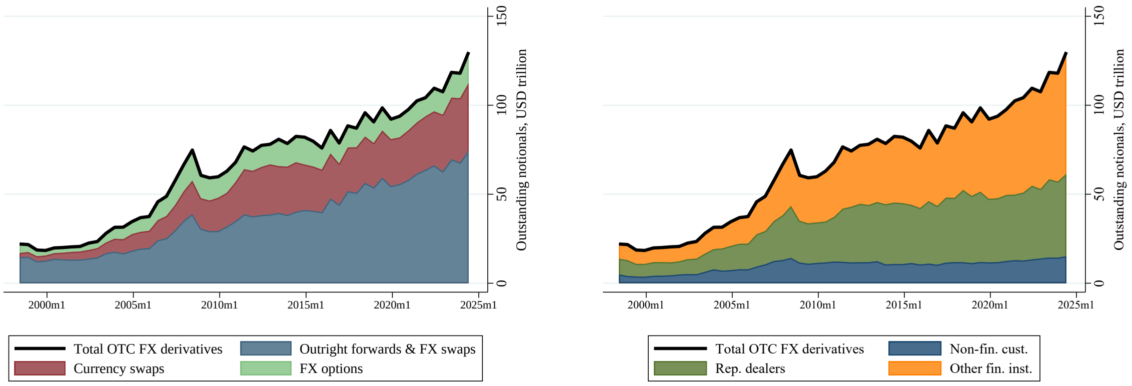
Here, we list four key features of the observed outstanding notionals of FX derivatives which help us understand the role played by FX derivatives in the international financial system and motivate the analysis in the subsequent sections.

1. **Growth in FX activity has been staggering** – especially in the aftermath of the

[2] A breakdown is only possible for one leg of the contract. This means that EUR/USD contracts will appear once in the statistics on EUR FX derivatives outstanding and once in the USD outstanding. Hence, the BIS total FX derivatives will equal half of the sum of the amounts outstanding by currency.

Figure 1: Global OTC derivatives activity by instrument and counterparty sector

(a) FX derivatives by instrument type **(b)** FX derivatives by counterparty sector



SOURCE: BIS over-the-counter (OTC) derivatives statistics.

global financial crisis (GFC) of 2008-09 – with the overall volume more than doubling between end-2009 and mid-2024. The strongest growth has been seen in **outright forwards and FX swaps** – the largest, most standardized and liquid types of FX derivative instruments (left panel of Figure 1).

2. In terms of counterparties, the sector accounting for most of overall FX derivatives growth is that of so-called **'other financial institutions', or OFIs** (right panel of Figure 1). As OFIs consist primarily of non-bank financial institutions (NBFIs), this aligns with the greater role of these players in the global financial system more broadly (see, e.g., Aramonte et al., 2021, Eren and Wooldridge, 2022).[3]

3. **The US dollar plays an outsized role in FX swap and forward contracts** given its dominance as major funding and investment currency in the financial system. It appears as one of the currency legs for 90% of FX swaps and outright forwards (Figure 2). Among the rest, the top five currencies appearing as a leg in outstanding global FX contracts are: EUR, JPY, GBP, CHF and CAD (jointly accounting for one currency leg of 60% of outstanding FX swaps and outright forwards). This crucially implies that to understand the key determinants of FX derivatives activity, we need to first and foremost understand the motives of investors intermediating capital **between the US and other major advanced economies**.

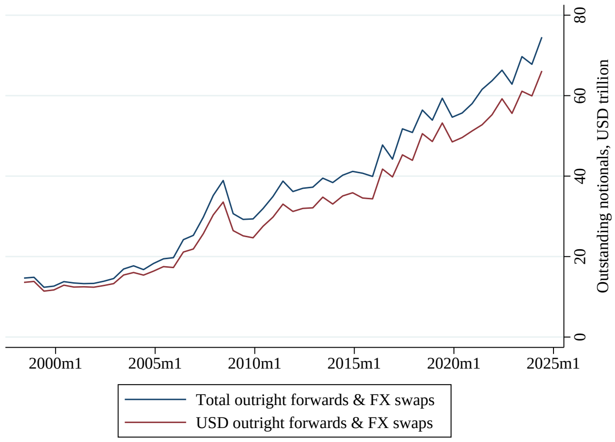
4. **While the portfolio investments themselves tend to be long-term, the hedging instruments have much shorter maturities.** Short-term FX contracts are most prevalent and most so for OFIs, with over 80% of those FX derivatives having a tenor of up to 1 year (Panel (a) in Figure 3).[4] However, these appear to be used to hedge long-

[3] The OFIs counterpary sector within BIS derivative statistics also includes some smaller non-reporting banks as detailed in `https://www.bis.org/statistics/triennialrep/2025survey_guidelinesoutstanding.pdf`.

[4] Kubitza et al. (2025) find for euro area non-bank investors an average time to maturity of FX hedging positions of 2.3 months. According to the 2022 Triennial Central Bank Survey of foreign exchange and over-the-counter (OTC) derivatives markets, 92% of the turnover in FX swap and forward markets also comes from

term cross-border investments, primarily in bonds. In particular, the overall volume of FX swaps & forwards comoves positively with long-term debt security investment in and out of the US (panel (b) in Figure 3). There is therefore a significant **maturity mismatch between the tenor of FX hedging and the maturity of the hedged asset**. As we show in the next section, this mismatch makes the slope of the yield curve (of the foreign investor as well as in the US) a key consideration for the hedging demand related to cross-border investment.

Figure 2: Total vs USD FX swaps and outright forwards



SOURCE: BIS over-the-counter (OTC) derivatives statistics.

These four initial observations indicate there might be important informational content of aggregate FX swaps and forwards activity as an indicator of the amount of cross-border risk-taking along the global financial cycle. The key underlying markets linked to this hedging activity are bond markets as hedge ratios will be notably higher for these instruments (compared to equity markets). In line with this, the scatter plots in Panel (b) of Figure 3 show that FX derivatives activity by OFIs tends to meaningfully increase whenever there are inflows portfolio investments into long-term US government bond markets (as recorded in the Treasury's TIC data). In a meaningful but somewhat weaker fashion, we also see increase in activity of the reverse - ie. when US investors venture more abroad with their outward investments.

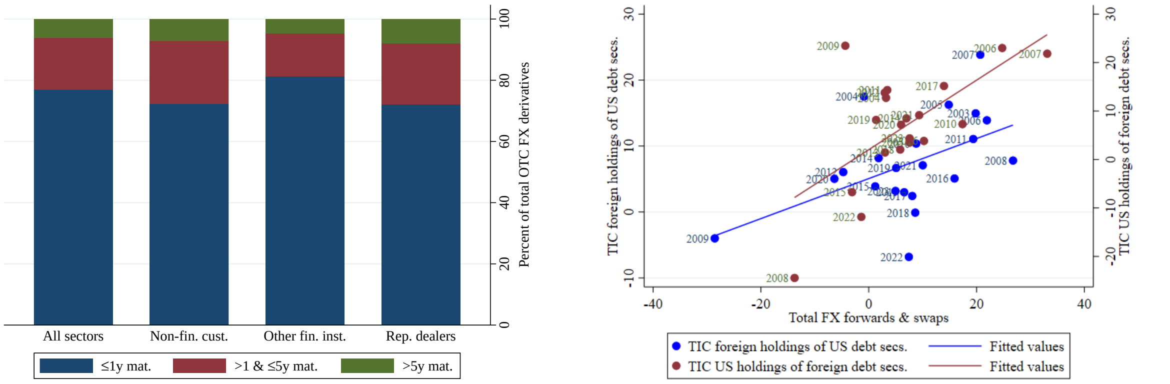
Through these hedged portfolio allocation shifts, financial conditions can be transmitted globally, with non-bank financial intermediaries as key players.[5] FX derivatives are central here as they allow asset managers to hedge against exchange rate volatility, facilitating international bond investment.

contracts with maturity of up to three months.

[5]Note that when it comes to aggregate FX activity statistics, any dynamics are dominated by contracts on advanced economy currencies. In this context, bond-related FX hedging activity appears to play a crucial role. In emerging markets, FX hedging of foreigners' investment is often costly and, thus, more limited so that FX derivatives dynamics may relate more to speculation than hedging activity (De Leo et al., 2024, 2025). However, FX derivatives volumes in emerging market currencies account for a very small share of the global aggregates and data on these are not as readily available (including in BIS statistics).

Figure 3: Maturity mismatch of FX hedging

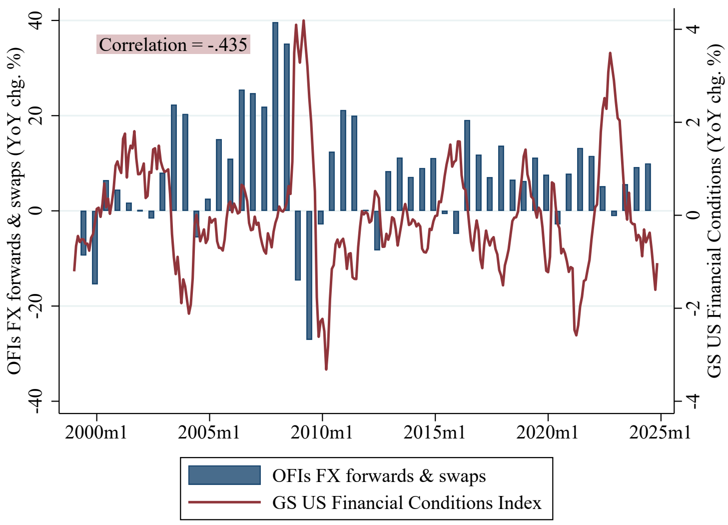
(a) FX derivatives by tenor **(b)** FX swaps vs US LT debt sec. in- & outflows



Source: BIS over-the-counter (OTC) derivatives statistics; US Treasury International Capital (TIC) reporting system. Maturity breakdown (panel a) for the amounts outstanding of all FX derivatives instruments – FX swaps, outright forwards, currency swaps and options.

Even if indirect, such information on the hedging-related bond investments of OFIs is invaluable due to the dearth of direct bilateral exposures data on these intermediaries. Data sources on the overall (FX-hedged and -unhedged) cross-border portfolio investment (e.g. the IMF's CPIS data or in the US Treasury's TIC dataset) cannot speak to the home currency of the investors. They often lack a long time span of bilateral exposures of NBFIs and cannot see through to the ultimate investor for flows re-routed via financial centres. OFIs' FX swaps by currency proxy for the home currency of the investor and thus provide complementary information on the underlying portfolio flows from the lens of the accompanying hedging activity. In addition, they capture the large gross off-balance sheet positions from FX swaps that are not recorded in such cross-border investment due to their accounting treatment (Borio et al., 2022).

Figure 4: FX swaps activity by OFIs picks up when global financial conditions are loose



Source: BIS over-the-counter (OTC) derivatives statistics; Goldman Sachs.

Motivational evidence on the link with financial conditions. Consistent with this interpretation, OFIs' FX swaps activity tends to pick up when financial conditions are loose– as captured by the Goldman Sachs US financial conditions index (Figure 4). FX swaps enable cross-border bond investment–where FX-hedging is more prevalent–and, therefore, serve as a barometer of risk-taking and financial spillovers across advanced economy bond markets. Bond and FX derivatives markets are, thus, two sides of the same coin. And the US dollar plays a prominent role both as the main reference currency for the related hedging activity and as the currency with the deepest bond market.

These observations motivate us to explore the dynamics of FX derivatives activity more formally in the remainder of the paper, focusing on the determinants of bond hedging demands and the associated costs vis-á-vis the US dollar. In the following section, we present a simple international bond portfolio choice model that guides us in selecting the key variables influencing asset managers' hedging decisions. In the subsequent empirical analysis, we investigate the determinants of FX derivatives activity and elaborate on the mechanism through which this hedging activity – and the bond investments it supports – can propagate spillovers across the bond markets of major advanced economies.

2 Model

The discussion in the previous section highlights the need for a framework that provides predictions on three key aspects: (i) the total hedging volume in each of the five major currencies against the US dollar; (ii) the incentives of asset managers in both foreign advanced economies and the US; and (iii) determinants of international long-term bond investments, as this type of cross-border investment is most closely linked to FX derivatives.

We focus on a simple two-period mean-variance bond portfolio problem for foreign investors into US bonds and a mirror problem for US residents' investment in foreign bonds. We build on the framework in Du and Huber (2024), extending it first to allow each investor access to both foreign and domestic risky assets, referred to here as long-term bonds (following Ahmed et al., 2023). Second, we deviate from the existing frameworks which focus solely on foreigners' incentives to hedge their US positions and consider jointly cross-border investments into and out of the US. Finally, to tailor predictions to the BIS FX derivatives data on overall volumes, we assume all cross-border bond investments are FX-hedged, even though, in practice, hedging may be partial and potentially time-varying (Du and Huber, 2024, Sialm and Zhu, 2024).[6] Our simple set-up is geared to emphasize the symbiotic relationship between FX hedging and cross-border portfolio bond investment to make clear the usefulness of FX derivatives dynamics in a macro context.

[6]Since we do not observe precise volumes of hedged versus unhedged investments, a model predicting the optimal hedging ratio, such as Du and Huber (2024), would be less suited to our data.

The foreign investor allocates a portfolio of size $A_{i=l,t}$ between two risky and one risk-free assets:

1. an FX-hedged USD long-term bond with dollar log return equal to the sum of the home risk-free rate plus a term premium $r^{\$}_{t+1} = rf^{\$}_t + T^{\$}_{t+1}$, with volatility of $\sigma^2_{T^{\$}}$;

2. a domestic (to the investor country l) long-term bond with local currency return comprising $r^l_{t+1} = rf^l_t + T^l_{t+1}$ and volatility of $\sigma^2_{T^l}$;

3. and the local risk-free rate rf^l_t.

Throughout the analysis, we use a consistent FX quoting convention, with the nominal exchange rate S_{t+1} (or s_{t+1} in log terms) defined as units of the foreign currency per 1 US dollar. The same convention applies to the forward exchange rate F_{t+1} (or f_{t+1} in log terms). The foreign investor hedges the return on the USD bond using an FX swap (the cost of which has two components – the short-term interest rate differential $rf^{\$}_t - rf^l_t$ and the cross-currency basis, or CCB, x^l_t[7]) and in period $t+1$ receives the hedged return in his domestic currency l of $r^{\$,H}_{t+1}$. *Ex post*, the excess return over his domestic risk-free rate thus consists of the USD bond's term premium plus the cross-currency basis:

$$
\begin{aligned}
rx^{\$,H}_{t+1} &\approx r^{\$}_{t+1} + (f^l_t - s^l_t) - rf^l_t \\
&= T^{\$}_{t+1} + rf^{\$}_t + (f^l_t - s^l_t) - rf^l_t \\
&= T^{\$}_{t+1} + x^l_t,
\end{aligned}
$$

where $rx^{\$,H}_{t+1}$ stands for the excess return on the hedged USD long-term bond from the perspective of the foreign investor (i.e. subtracting his local risk-free rate rf^l_t); and the approximation in the first line reflect investors' inability to perfectly forecast the price of the dollar asset at $t+1$ (Du and Huber, 2024). The notation here assumes that $x^l_t \equiv rf^{\$}_t + (f^l_t - s^l_t) - rf^l_t$ is negative when it is more costly to hedge against a dollar depreciation, such that the hedged return falls below the USD term premium $T^{\$}_{t+1}$. Empirically, x^l_t has indeed been negative across the majority if advanced economy currencies for much of the period since the global financial crisis (Du et al., 2018a, Du and Schreger, 2022).

The *ex post* excess return on the foreign investor's local bond is by definition the local term spread:

$$
rx^l_{t+1} = r^l_{t+1} - rf^l_t \equiv T^l_{t+1}.
$$

[7]Specifically, the foreign investor buys USD in the spot market at the rate s^l_t (local currency per 1 USD) and sells dollars at the forward rate f^l_t. The cost of this FX swap or the difference between the forward and spot exchange rate is given by $f^l_t - s^l_t = -(rf^{\$}_t - rf^l_t) + x^l_t$, or the interest rate differential between the short-term rate gained by lending the foreign currency rf^l_t minus that paid to borrow dollars $rf^{\$}_t$ plus any additional cost of hedging against a dollar appreciation, captured by the cross-currency basis x^l_t (Du et al., 2018a).

Hence, the main excess returns sources are the home and dollar term spreads ($T^{\$}_{t+1}$ and T^{l}_{t+1}) as well as the cost of hedging against a dollar appreciation beyond the interest rate differential, or the cross-currency basis (x^l_t).

The foreign investor chooses his portfolio allocation to the two risky investments by maximizing a linear combination of mean and variance of portfolio returns in excess of his local risk-free rate. The two portfolio weights which the investor chooses are: $w^{\$}, w^l$, leaving $1 - w^{\$} - w^l$ in the local risk-free asset. The maximization problem becomes:

$$\max_{w^{\$}, w^l} \mathbb{E}[rx^p_{t+1}] - \frac{\gamma_t}{2}\mathbb{V}\mathrm{ar}[rx^p_{t+1}],$$

where γ_t denotes the investor's potentially time-varying risk aversion[8]; $w^{\$}$ is the portfolio weight allocated to the USD bond and hedged using FX derivatives, w^l the weight allocated to the local bond; and the log portfolio excess return in local currency is given by:

$$rx^p_{t+1} = w^{\$}(T^{\$}_{t+1} + x^l_t) + w^l T^l_{t+1}.$$

As we show in Appendix B, the optimal portfolio weights for this problem are:

$$w^{\$}_{i=l} = \frac{\sigma^2_{T^l}\ (\overline{T^{\$}_{t+1}} + x^l_t) - \sigma_{T^{\$},T^l}\ \overline{T^l_{t+1}}}{\gamma_t(\sigma^2_{T^{\$}}\sigma^2_{T^l} - (\sigma_{T^{\$},T^l})^2)}, \tag{1}$$

where $\overline{T^A_{t+1}}$ denotes the expectation (as of time t) of the excess return on bond A one period ahead; σ^2_A is the variance of A's return; and $\sigma_{A,B}$ denotes the covariance between return on asset A and B.

Whereas eq. (1) gives us the optimal weight of hedged dollar assets in the overall bond portfolio, what we observe in BIS statistics is the volume of FX derivatives in US dollar terms. To get an object more closely related to the data, we rescale eq. (1) by the wealth of the foreign bond investor (converted into dollars using the spot exchange rate S^l_t). This quantity can be interpreted as a model-based contribution of foreign investors to the *volume of FX hedging*:

$$\frac{A_{i=l,t}}{S^l_t} \times w^{\$}_{i=l} = \frac{A_{i=l,t}}{S^l_t} \times \frac{\sigma^2_{T^l}\ (\overline{T^{\$}_{t+1}} + x^l_t) - \sigma_{T^{\$},T^l}\ \overline{T^l_{t+1}}}{\gamma_t(\sigma^2_{T^{\$}}\sigma^2_{T^l} - (\sigma_{T^{\$},T^l})^2)}, \tag{2}$$

where we take fluctuations in both the local currency wealth $A_{i=l,t}$ and in the spot exchange rate S^l_t as exogenous.

As we summarize in Table 1, the model-implied contribution to hedging volume increases with the foreign investor's wealth as, all else equal, the investor buys more of all bonds

[8] Here, this is not indexed by investor location, so it is assumed to be the same for foreign and US bond investors alike.

including dollar-denominated ones. The contribution decreases with a local currency depreciation against the dollar (an increase in S_t^l) as his local-currency wealth is now mechanically worth less in USD terms.[9] Both the amount of FX derivatives taken up by foreign investors in eq. (2) and the optimal portfolio weight in eq. (1) increase with the expected excess return on the hedged USD asset – increasing with its dollar term premium $\overline{T_{t+1}^{\$}}$ and decreasing with the cost of hedging against a USD depreciation (which increases as the cross-currency basis x_t^l becomes more negative). At the same time, a higher local excess return $\overline{T_{t+1}^l}$ makes the foreign investor's local bond market more attractive and decreases his USD investment along with the related FX hedging demand. The role of these expected returns is scaled by the risks they pose – captured by the variance of the local and USD bonds term premia $\sigma_{T^l}^2$ and $\sigma_{T^{\$}}^2$, as well as the covariance between the two term premia $\sigma_{T^{\$},T^l}$, which we will assume to be constant in our baseline specification (and as a result incorporated in the estimated coefficients on time-varying bond returns). Finally, when investors' time-varying risk aversion increases, it can decrease overall allocation to risky bonds – including to those denominated in dollars for the foreign investor.

The BIS FX derivatives data records neither the location of the counterparty to each contract, nor the direction of each contract (whether hedging a dollar depreciation or appreciation). Thus, to fully capture the sources of hedging demand across advanced economy bilateral exchange rates vis-á-vis the US dollar, we consider an identical portfolio choice problem from the perspective of a US investor and combine the predictions for both investors' demand for FX hedging into the empirical investigation in the subsequent section.

The US investor allocates portfolio of size $A_{i=US,t}$ between:

1. a USD long-term bond with dollar log return $r_{t+1}^{\$} = rf_t^{\$} + T_{t+1}^{\$}$ and volatility of $\sigma_{T^{\$}}^2$;
2. an FX-hedged country-l long-term bond with local currency return $r_{t+1}^l = rf_t^l + T_{t+1}^l$ and volatility of $\sigma_{T^l}^2$[10];
3. and the USD risk-free rate $rf_t^{\$}$.

The *ex post* hedged excess return on the country-l investment in USD terms also consists of the foreign (to the US investor) term spread minus the cost of hedging against a USD

[9] A more general portfolio optimization problem with unhedged USD investment would have a more complex role for the exchange rate, as the valuation gains from a dollar appreciation would offset to some degree this effect. However, to the extent that less than the entire foreign investor's portfolio is allocated to the USD bond and left unhedged, the relationship between FX hedging volume and the spot exchange rate will remain negative.

[10] We set up the portfolio choice problem symmetrically and separately for each currency l bilateral against the dollar. It is straightforward to allow the US investor to choose between multiple foreign bonds by stacking their returns in a vector $\mathbf{r^l}_{t+1}$ with variance-covariance matrix Σ_{T^l}, mapping the model more closely to the FX derivatives data where the dollar appears as one leg of FX contracts against many other currencies. Matching firm-level derivatives data to asset portfolios, Bräuer and Hau (2024) show that hedging in each currency is done in isolation – in line with our simplifying modelling assumption.

appreciation (the cross-currency basis x_t^l):

$$rx_{t+1}^{l,H} \approx T_{t+1}^l + rf_t^l - (f_t^l - s_t^l) - rf_t^\$ \\ = T_{t+1}^l - x_t^l.$$

Note that given the aforementioned tendency of the cross-currency basis being negative in recent years there will be a positive contribution to returns by the U.S. investor stemming from hedging (since it is only costly to hedge against a USD depreciation, not an appreciation). The investor would compare this excess return on the hedged foreign bond to the USD bond excess return, or simply the dollar bond term premium $rx_{t+1}^\$ = T_{t+1}^\$$.

As before, the US investor chooses weights on the hedged foreign bond $w_{i=US}^l$ and his local USD bond $w_{i=US}^\$$ based on a mean-variance optimization problem:

$$\max_{w_{i=US}^\$, w_{i=US}^l} \mathbb{E}[rx_{US,t+1}^p] - \frac{\gamma_t}{2}\mathbb{V}\mathrm{ar}[rx_{US,t+1}^p],$$

where the log portfolio return in USD is:

$$rx_{US,t+1}^p = w_{i=US}^\$ T_{t+1}^\$ + w_{i=US}^l (T_{t+1}^l - x_t^l).$$

This implies the following expressions for the optimal portfolio weight on the country-l hedged asset and associated USD value of FX derivatives notional taken up by the US investor:

$$w_{i=US}^l = \frac{\sigma_{T^\$}^2 \ (\overline{T_{t+1}^l} - x_t^l) - \sigma_{T^\$,T^l} \ \overline{T_{t+1}^\$}}{\gamma_t(\sigma_{T^\$}^2 \sigma_{T^l}^2 - (\sigma_{T^\$,T^l})^2)} \tag{3}$$

$$A_{i=US,t} \times w_{i=US}^l = A_{i=US,t} \times \frac{\sigma_{T^\$}^2 \ (\overline{T_{t+1}^l} - x_t^l) - \sigma_{T^\$,T^l} \ \overline{T_{t+1}^\$}}{\gamma_t(\sigma_{T^\$}^2 \sigma_{T^l}^2 - (\sigma_{T^\$,T^l})^2)}. \tag{4}$$

As can be gleaned from eq. (4), FX hedging by the US investor depends on the same variables as for the foreign investor, with the exception of the spot exchange rate S_t^l which does not mechanically enter to convert US bond wealth into dollars. However, the signs on bond excess returns and the cross-currency basis are reversed, since a more attractive expected dollar bond return $\overline{T_{t+1}^\$}$ decreases foreign investment and the associated FX hedging demand. A higher expected foreign (country-l) bond excess return $\overline{T_{t+1}^l}$ or a lower cost of hedging against a depreciation in currency l (higher cross-currency basis x_t^l),in turn, encourage more cross-currency investment and the associated FX hedging.

Total FX hedging demand can be obtained from eqs. (2) and (4) as a weighted sum of the FX-hedged cross-currency bond allocations of the foreign and the US investors:

$$
\begin{aligned}
&\frac{A_{i=l,t}}{S_t^l} \times w_{i=l}^{\$} + A_{i=US,t} \times w_{i=US}^{l} = \\
&= \frac{A_{i=l,t}}{S_t^l} \times \frac{\sigma_{T^l}^2\,(\overline{T_{t+1}^{\$}} + x_t^l) - \sigma_{T^{\$},T^l}\,\overline{T_{t+1}^{l}}}{\gamma_t(\sigma_{T^{\$}}^2\sigma_{T^l}^2 - (\sigma_{T^{\$},T^l})^2)} + A_{i=US,t}\,\frac{\sigma_{T^{\$}}^2\,(\overline{T_{t+1}^{l}} - x_t^l) - \sigma_{T^{\$},T^l}\,\overline{T_{t+1}^{\$}}}{\gamma_t(\sigma_{T^{\$}}^2\sigma_{T^l}^2 - (\sigma_{T^{\$},T^l})^2)} \\
&= \left[\gamma_t(\sigma_{T^{\$}}^2\sigma_{T^l}^2 - (\sigma_{T^{\$},T^l})^2)\right]^{-1} \times \Big[\ \Big(\frac{A_{i=l,t}}{S_t^l}\,\sigma_{T^l}^2 - A_{i=US,t}\,\sigma_{T^{\$},T^l}\Big)\,\overline{T_{t+1}^{\$}} \\
&+ \Big(A_{i=US,t}\,\sigma_{T^{\$}}^2 - \frac{A_{i=l,t}}{S_t^l}\,\sigma_{T^{\$},T^l}\Big)\,\overline{T_{t+1}^{l}} + \Big(\frac{A_{i=l,t}}{S_t^l}\,\sigma_{T^l}^2 - A_{i=US,t}\,\sigma_{T^{\$}}^2\Big)\,x_t^l\ \Big],
\end{aligned} \tag{5}
$$

where we highlight (in red) the three asset-specific time-varying return variables – USD and local currency bond term spreads as well as the cross-currency basis – along with investor risk aversion. These are the four main time-varying FX hedging determinants that we take to the data in the subsequent empirical analysis. We also highlight (in blue) the relative wealth of US and foreign investor, which interact with bond risk (as captured by the variance and covariance terms) and can affect the coefficients on the three variables related to relative bond returns.

With eq. (5) in mind, we note that the aggregate nature of our data implies we cannot interpret the estimated coefficients on the hedging determinants (term spreads, cross-currency basis and risk aversion) as structural parameters. Instead, they offer a useful summary of which investors have on average accounted for dynamics in aggregate FX-hedging demand over the time period used in the estimation.

Table 1: Variables that affect FX hedging demand

Variable	**Foreign**	**US**	**Data**
US slope $\overline{T_{t+1}^{\$}}$	↑	↓	↑
Foreign slope $\overline{T_{t+1}^{l}}$	↓	↑	↓
CCB x_t^l	↑	↓	↓
Risk aversion γ_t	↓	↓	↓
Spot FX S_t^l	↓	0	↓
US wealth $A_{i=US,t}$	0	↑	N/A
Foreign wealth $A_{i=l,t}$	↑	0	N/A

Table 1 summarizes how the optimal portfolio results in eqs. (2) and (4) can be related to the data. The model predicts that the three relative bond return variables will affect foreign and US investors' FX hedging demand with opposite signs. The spot exchange rate and foreign wealth only affect foreigners' demand for FX hedging, while US investors' wealth is only relevant for US investors' demand for FX hedging.

The final column in Table 1 previews our empirical results and highlights that relative yield curve dynamics (first two rows) and associated bond demand by foreigners align more closely to aggregate FX swaps dynamics for the sample between mid-1998 and mid-2024. This suggests a strong role for private foreign demand for US bonds in understanding the recent growth in global FX swaps markets, highlighting the interplay between the bond and FX derivatives markets. Consistent with the uniform effect of risk aversion on long-term bond investment across both US and foreign investors, the data suggests a negative coefficient between FX swaps and risk aversion proxies. As the mechanical effect of the spot exchange rate on foreign wealth converted into US dollars suggests (see eq. (2)), a dollar appreciation lowers the aggregate amount outstanding of FX swaps in USD terms. Finally, we do not explicitly control for the US and foreign wealth invested in the bond market in the empirical part of this paper but note that the relative wealth of investors will likely make all relationships above state-contingent.

3 What drives FX swaps activity: an empirical investigation

This section draws on this theoretical framework to study the drivers of FX swaps activity empirically. We focus on the determinants of international bond investment and FX hedging, leveraging BIS data on FX derivatives and cross-border bond flows. The analysis is structured as follows: we first describe the empirical specification and data mapping assumptions and then present the baseline OLS regression results. Finally, we go a step further relying on monetary policy surprises as instruments in IV regressions before concluding with a study of the link between FX swap dynamics and financial conditions.

3.1 Empirical specification and data mapping

To empirically examine the relationship between FX swaps activity and cross-border bond investment, we rely on a panel regression model with currency fixed effects. The dependent variable is the semi-annual change in the outstanding notional values of FX swaps and outright forwards. The explanatory variables in turn capture key FX hedging determinants identified in the theoretical model, mapped to observable data.

In the BIS FX derivatives data, the counterparty sector most closely resembling the hedging motives of asset managers in the model is that of other financial institutions (OFIs). Consequently, our analysis focuses on the FX derivatives activity of OFIs, which disproportionately use FX swaps and forwards (even though we also show results for other sectors for comparison). FX swaps and forwards are the most prevalent types of derivative contract in the BIS statistics and are particularly well-suited to studying the maturity mismatch between FX hedging and bond investment. As for the tenor of FX hedging, we assume a three-month horizon, consistent with empirical evidence on euro area non-bank investors (Kubitza et al., 2025). The underlying bond investments are assumed to have a ten-year maturity, which aligns both with the empirical evidence and with available benchmark yield data.

To proxy for investors' ex-ante expectations of returns on USD and local currency bonds, we use ten-year government benchmark yields. Risk-free rates are represented by three-month T-bill rates, while the investors' ex-ante term premia (corresponding to $\overline{T^{\$}_{t+1}}$ and $\overline{T^{l}_{t+1}}$ in the model) are captured by yield curve slopes, defined as the difference between ten-year and three-month yields. The cost of hedging beyond short-term interest rate differentials is measured by deviations from covered interest parity (CIP), denoted x^l_t in the model, and calculated using spot and 3-month forward exchange rates along with the same-maturity interest rates.[11] Investor risk aversion (γ_t in the model) is proxied by the Goldman Sachs US Financial Conditions Index (GS US FCI), which summarizes conditions in US rates, credit, and equity markets[12], but we also use more refined measures recently proposed by Lombardi, Manea and Schrimpf (2025).[13]

The resulting panel regression model reads as follows:

$$\begin{aligned}\Delta_{t,t-6}\ln(FXswaps_{l,t}) = \alpha_l + \beta_1\ \Delta_{t,t-6}Slope^{10y-3m}_{\$,t} + \beta_2\ \Delta_{t,t-6}Slope^{10y-3m}_{l,t} \\ + \beta_3\ \Delta_{t,t-6}CIPdev_{l/\$,t} + \beta_4\ \Delta_{t,t-6}Risk_t + \beta_5\ \Delta_{t,t-6}\ln(S_{l,t}) + \zeta_{l,t},\end{aligned} \tag{6}$$

where $\Delta_{t,t-6}$ denotes the six-monthly difference in the respective variable and $l \in \{CAD, CHF, EUR, GBP, JPY\}$ captures the currency of the swap and the explanatory prices.

In our baseline specification, the left-hand variable corresponds to the outstanding notionals of FX swaps and outright forwards taken up by OFIs in each currency outstanding at the end of month t (and available on a semi-annual frequency as of June and DecemberThe empirical section also reports results for alternative counterparty sectors and separately by currency rather than in a panel setting. The currency-specific and time-varying FX hedging determinants $Slope^{10y-3m}_{\$,t}$, $Slope^{10y-3m}_{l,t}$and $CIPdev_{l/\$,t}$ are as explained above; $S_{l,t}$ is the spot exchange rate expressed as units of currency l per 1 US dollar. $Risk_t$ corresponds to our proxy for investor risk aversion, or the logarithm of the GS US FCI in the baseline case. We account for currency fixed effects α_l and denote the unexplained residual six-monthly variation in FX swaps by currency as $\zeta_{l,t}$.

3.2 Baseline results: drivers of FX swaps activity

We estimate the regression model in eq. (6) using OLS for a semi-annual panel of five currencies from June 1998 to June 2024. The results, summarized in Table 2, reveal several important

[11]For a currency-l investor, the CIP deviation relevant for hedging against a USD depreciation vis-á-vis the local currency is given by: $CIPdev_{l/\$,t} = y^{3m}_{\$,t} - y^{3m}_{l,t} + \frac{12}{3} \times \ln\left(\frac{F^l_t}{S^l_t}\right) \times 100$ (see Du and Schreger, 2022). The more negative the CIP deviation becomes, the more costly it is to hedge the dollar exposure.

[12]A global version of this index is only available with a much shorter time span (from 2007) and has a correlation of 80% with the US index – in line with he central role of the US in the global financial system.

[13]All asset pricing data are collected at daily frequency from Bloomberg and transformations of the raw series into CIP deviations or yield curve slopes are performed at daily frequency, too. We then convert the explanatory variables to monthly averages and calculate semi-annual changes between the respective monthly values. The same semi-annual transformation is performed on the daily FCI indices.

insights.

Table 2: Baseline panel regression OLS results

	(1)	(2)	(3)	(4)	(5)
Slope USD (10y-3m)	2.706**	2.702**	1.861	1.798	1.645
	(1.239)	(1.248)	(1.161)	(1.116)	(1.123)
Slope local (10y-3m)	-7.346***	-7.348***	-4.827***	-4.730***	-5.106***
	(1.656)	(1.661)	(1.582)	(1.521)	(1.524)
CIP dev. (3m)		0.062	-4.335**	-4.774**	
		(2.244)	(2.178)	(2.096)	
GS US FCI			-5.580***	-3.647***	-3.124***
			(0.845)	(0.914)	(0.892)
Spot ER				-0.502***	-0.490***
(local per 1 USD)				(0.108)	(0.109)
Currency FE	Yes	Yes	Yes	Yes	Yes
Obs	258	258	258	258	258
Adj. Rsq.	0.06	0.05	0.19	0.25	0.24

NOTES: Panel regression results with currency fixed effects. Sample: June 1998–June 2024. Dependent variable is the semi-annual change in the outstanding notional values of FX swaps and outright forwards taken up by other financial institutions (OFIs) in five major currencies on one side (EUR, JPY, GBP, CHF, CAD). Explanatory variables include contemporaneous semi-annual changes in: the 10-year minus 3-month slope of the sovereign yield curve for the US, as well as for the main issuer country for the respective currency (Germany, Japan, United Kingdom, Switzerland, Canada); covered interest parity (CIP) deviations in each currency vis-á-vis the USD at the 3-month tenor; the Goldman Sachs' US financial conditions index; the bilateral spot exchange rate of each currency vis-á-vis the USD. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

First, a steeper USD yield curve tends to come with greater FX swaps activity, consistent with foreign investors hedging their investments in higher-return USD bonds. Conversely, a steeper local currency yield curve reduces FX swaps usage, reflecting the reduced attractiveness of local bonds for domestic investors. A key reason for such flattening of the non-US curve may be quantitative easing conducted by the foreign central bank, depressing term premia and investment opportunities in the affected currency area. The signs of the two slope variables are consistent with a dominant role of investors outside of the US (or with liabilities in the respective non-USD currency) in overall FX hedging activity (see Table 1).

Second, lower hedging costs against a dollar depreciation, as measured by more positive CIP deviations, are associated with lower FX swaps outstanding. This result deviates from the prediction of the model for foreigners which posits that those investors reduce hedging when the cost rises. We find the opposite in our simple OLS regression, likely reflecting either reverse causality[14] or the influence of US investors' hedging costs instead.

Third, tighter financial conditions, indicative of greater investor risk aversion, tend to go hand in hand with a fall in FX swaps activity. This finding aligns with the theoretical prediction that risk appetite affects both bond investment and hedging behaviour. Finally, local currency appreciation against the USD reduces FX swaps outstanding, consistent with valuation effects on non-US investors' portfolio wealth.

[14]E.g. Borio et al. (2018) and Moskowitz et al. (2024) find investors' FX derivatives demand plays a role in determining CIP deviations.

These results are stable as we gradually introduce more hedging determinants from column (1) to (4) of Table 2. Also, results remain stable when we specifically drop the CIP deviation estimated to have the opposite effect of what the model implies for the FX hedging demand of foreign investors in column (5). We use column (4) as a baseline for alternative data cuts and specifications in the rest of our empirical tests.

The relationship between OFIs' FX swaps activity and cross-border bond flows is further illustrated in Figure 5. The figure demonstrates a strong comovement between FX swaps and bond flows[15], with fitted values from the regression model in column (4) of Table 2 providing an even tighter link than the raw data – especially for investments of foreigners into US bonds (panel b). These patterns suggest that FX hedging of cross-border bond investment by asset managers in advanced economies is a key driver of the link between cross-border bond flows and FX derivatives activity.

Zooming in on the role of different investor types. Next, we drill down into *who* the investors are that account for the FX hedging demand documented above. We first re-estimate the regression in column (4) of Table 2 separately for each of the five major currencies in order of their footprint in global FX swaps notionals by OFIs. The results are reported in Table 3. We note that the number of observations is quite limited when looking at semi-annual observation by currency and view this exercise as complementary, yet highly suggestive, evidence.

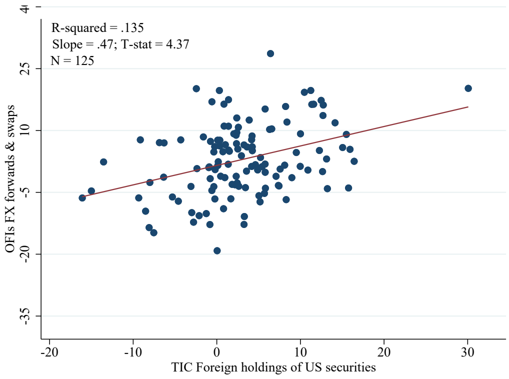
As can be gleaned from Table 3, the two currencies with the biggest volume also account for most of the relationship between local currency yield curve slopes and FX hedging demand. FX swaps with the euro and yen on one side are both estimated to be affected to a greater degree than average by the German and Japanese government yield curve slopes, respectively. The USD slope is estimated to have a significant (and larger than average) positive effect on the amounts outstanding of FX derivatives only in the case of the euro. The remaining three hedging-related variables (CIP deviations, financial conditions and the respective spot exchange rate against the US dollar) are estimated to affect FX swaps in most currencies in the same direction as in the panel regressions, albeit with different economic and statistical significance. Overall, the results by currency confirm our baseline results and highlight the role of investors with euro and yen liabilities as especially prominent in explaining the bond-related FX hedging behaviour we observe in aggregate.

Our baseline results focus on FX derivatives involving OFIs because they account for much of the recent growth in FX swaps (Figure 1), have an increasing role in cross-border bond expo-

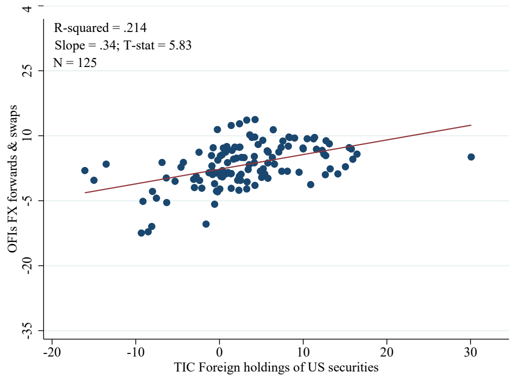
[15]The correlations between actual semi-annual FX swaps and US bond in- and outflows in Panels (a) and (c) of Figure 5 are the bilateral (by swap currency and investor country) counterpart of the annual unilateral relationship shown in Figure 3 (b). The bilateral link between bond flows and FX derivatives is examined more formally in Appendix Table A.1, where we estimate a panel regression of FX swaps and forwards on changes in bilateral portfolio investments between the respective currency's issuer country and the US across different asset classes. Long-term debt securities cross-border holdings–especially those associated with foreign inflows into the US bond market–correlate most significantly with FX swaps activity by currency.

Figure 5: Tighter link between portfolio flows and hedging-related changes in FX swaps

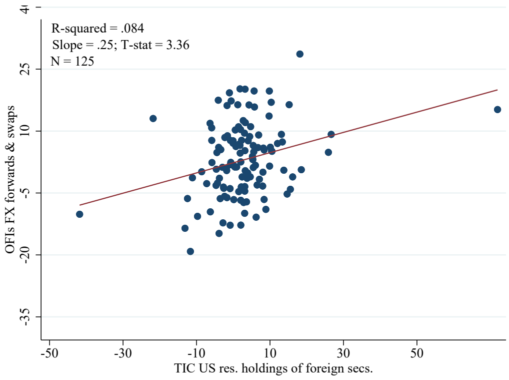
(a) Actual growth in FX derivatives & US portfolio inflows (LT debt securities)



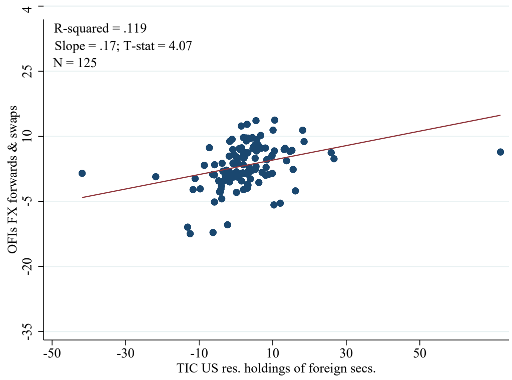
(b) Fitted growth in FX derivatives & US portfolio inflows (LT debt securities)



(c) Actual growth in FX derivatives & US portfolio outflows (LT debt securities)



(d) Fitted growth in FX derivatives & US portfolio outflows (LT debt securities)



NOTES: On the y-axes, we plot semi-annual growth in OFIs' FX derivatives notionals. In panels (a) and (c), these are raw changes calculated from BIS over-the-counter statistics. In panels (b) and (d), instead we show the fitted values of these changes from the regression in column (4) of Table 2, i.e. changes in FX derivatives conditional on hedging determinants. On the x-axes, we show semi-annual changes in cross-border holdings of long-term debt securities from the US Treasury International Capital (TIC) reporting system – panels (a) and (b) display foreigners' holdings of US securities; panels (a) and (b) show US investors' holdings of foreign securities. The sample period (June 2011–June 2024) is shorter due to the shorter time span of monthly TIC data. The slope coefficient, its t-statistic and associated R-squared from a bivariate regression of FX derivatives outstanding on security holdings are displayed in the upper-left corner of each panel.

sures, and align with the international portfolio allocation behaviour in the model (Section 2). We next check if our intuition is correct by trying to explain the dynamics of FX swaps and forwards by other sectors in the BIS OTC derivatives statistics using the same bond-related hedging determinants (Table 4). Total FX swaps in column (1) respond to the same determinants, albeit to a slightly more muted degree, as OFIs' FX swaps (second column) – in line with the the glowing footprint of OFIs in FX derivatives markets. However, for FX swaps with dealer banks on both sides (column 3) or vis-á-vis non-financial customers (column 4), the currency-specific bond-hedging determinants (USD and local slopes, CIP deviations) do not play a significant role. Like OFIs, these sectors' FX swaps notionals can respond to shifts in global risk aversion (as captured by US financial conditions) and decrease in USD terms as the USD appreciates against their local currency (consistent with some of these investors being outside of the US). The comparison by counterparty sector reinforces our conjecture that OFIs are key for understanding FX swaps dynamics, and – through those – the underlying

Table 3: Baseline OLS regression by currency

	(1) EUR	(2) JPY	(3) GBP	(4) CHF	(5) CAD
Slope USD (10y-3m)	4.511*	-0.174	1.047	2.894	-2.675
	(2.283)	(1.811)	(2.759)	(2.770)	(3.979)
Slope local (10y-3m)	-9.081***	-10.048*	-0.390	-6.163	-1.195
	(2.898)	(5.878)	(3.633)	(4.360)	(4.102)
CIP dev. (3m)	-1.839	-5.866	-5.137	-8.980**	0.418
	(4.705)	(4.057)	(5.436)	(4.239)	(5.688)
GS US FCI	-0.461	-3.924**	-6.794**	-3.651	0.728
	(1.942)	(1.636)	(2.548)	(2.360)	(2.136)
Spot ER (local per 1 USD)	-0.631**	-0.123	-0.412	-0.380	-1.631***
	(0.237)	(0.173)	(0.329)	(0.278)	(0.311)
Obs	50	52	52	52	52
Adj. Rsq.	0.29	0.15	0.30	0.15	0.48

NOTES: Time series regression results by currency of FX derivatives. Sample and variables as defined in Table 2 notes. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

international bond market linkages between advanced economies.

Table 4: Baseline OLS regression by counterparty sector

	(1) All	(2) Other fin. inst.	(3) Rep. dealers	(4) Non-fin. customers
Slope USD (10y-3m)	0.258	1.798	-0.370	-1.748
	(0.975)	(1.116)	(1.308)	(1.256)
Slope local (10y-3m)	-2.800**	-4.730***	-2.298	0.080
	(1.329)	(1.521)	(1.783)	(1.712)
CIP dev. (3m)	-3.685**	-4.774**	-3.640	-1.776
	(1.832)	(2.096)	(2.457)	(2.360)
GS US FCI	-2.771***	-3.647***	-1.568	-2.893***
	(0.798)	(0.914)	(1.071)	(1.028)
Spot ER (local per 1 USD)	-0.509***	-0.502***	-0.636***	-0.290**
	(0.095)	(0.108)	(0.127)	(0.122)
Currency FE	Yes	Yes	Yes	Yes
Obs	258	258	258	258
Adj. Rsq.	0.25	0.25	0.15	0.08

NOTES: Panel regression results with currency fixed effects. As in Table 2, the dependent variable is the semi-annual change in the outstanding notional values of FX swaps and outright forwards in five major currencies but now varies across columns with the counterparty sector – (1) total across all three sectors; (2) other financial institutions (OFIs); (3) reporting dealers; (4) non-financial customers. Sample and explanatory variables as defined in Table 2 notes. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Alternative measures of risk aversion and the link to financial conditions. Finally, we examine what is behind the role of investor risk aversion captured by the negative coefficient on US financial conditions. We do so by comparing our baseline results to estimates using alternative proxies for γ in Table 5. The baseline measure by Goldman Sachs is constructed as a weighted average of changes in a range of asset prices, including short- and long-term interest rates, corporate bond spreads, equity prices and exchange rates (Hatzius and Stehn, 2018). In a recent paper, Lombardi, Manea and Schrimpf (2025) show that the price dynamics for such a broad array of asset classes can be meaningfully summarized by two factors – one that is closely related to the level of the yield curve (level factor) and one more closely tracking how investors perceive and price financial risk in credit and equities (risk factor). Column (2) of Table 5 replaces the GS US FCI with these two factors extracted from US asset prices. Only the risk aspect of US financial conditions affects FX swaps activity in a significant way and in the same direction[16]. Indeed, our specification already captures the level of the yield curve in the other controls, so separating the risk component of financial conditions actually increases the explanatory power of our estimates (to 27%). Conceptually, this also confirms that our optimal portfolio framework in Section 2 aligns well with the data – investor risk appetite or perceptions are a separate driver of FX swaps and underlying cross-border investment, not completely spanned by the benchmark short- and long-term rates.[17]

Table 5: Baseline OLS regression: alternative risk proxies

	(1)	(2)	(3)	(4)	(5)
Slope USD (10y-3m)	1.798	1.994	2.000*	2.515**	2.038*
	(1.116)	(1.581)	(1.137)	(1.154)	(1.116)
Slope local (10y-3m)	-4.730***	-3.691**	-5.581***	-5.912***	-5.358***
	(1.521)	(1.744)	(1.528)	(1.526)	(1.503)
CIP dev. (3m)	-4.774**	-6.464***	-5.148**	-4.352*	-7.162***
	(2.096)	(2.356)	(2.326)	(2.305)	(2.365)
Spot ER (local per 1 USD)	-0.502***	-0.661***	-0.636***	-0.669***	-0.613***
	(0.108)	(0.113)	(0.102)	(0.100)	(0.099)
GS US FCI	-3.647***				
	(0.914)				
BIS US FCI (level)		0.052			
		(0.440)			
BIS US FCI (risk)		-1.280***			
		(0.388)			
VIX			-0.225**		
			(0.096)		
MOVE				-4.947*	
				(2.921)	
JP Morgan FX vol.					-1.118***
					(0.300)
Currency FE	Yes	Yes	Yes	Yes	Yes
Obs	258	220	258	258	258
Adj. Rsq.	0.25	0.27	0.22	0.21	0.25

NOTES: Panel regression results with currency fixed effects. Sample and variables as defined in Table 2 notes. Columns (2)–(5) control for alternative proxies for risk: the BIS two-factor US FCI of Lombardi et al. (2025), stock market implied volatility index (VIX), US Treasuries implied volatility index (MOVE), and FX implied volatility across major currencies (JP Morgan FX vol.). Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[16]Note that different measures of financial conditions in Table 5 do not have comparable units, such that the magnitude of coefficient is not informative.

[17]This aligns well with findings by Kroencke et al. (2021) and Boehm and Kroner (2025).

Robustness. We conduct a host of checks to examine the robustness of our results. In particular, we check that our results are also robust to risk measures based on the option-implied volatilities of different asset classes – US equities (VIX), US long-term Treasuries (MOVE) and exchange rates (JP Morgan FX volatility index). All these measures of global risk aversion are correlated with each other (and with financial conditions), such that our estimates remain intact. Reassuringly, the effects of local and USD slopes for OFIs' FX swaps dynamics are estimated with somewhat greater precision when using alternative risk proxies. And intuitively, the FX implied volatility measure, which is most closely related to the FX dimension of risk against which OFIs are assumed to be seeking protection through FX derivatives, generates the best fit among the specifications in the last three columns of Table 5.

We also confirm (but omit for brevity from the baseline results) that our conclusions are robust to the specific measure of CIP deviations used. In particular, neither using Libor-based 3-month rates when constructing the cross-currency basis, nor a 2-year interest rate differential instead of 3-months from the dataset of Du and Schreger (2016), Du et al. (2018a), changes our results meaningfully. In addition, we note that FX derivatives activity displays a seasonal pattern, whereby growth in outstanding notionals is systematically lower in the second half of the year – likely due to window-dressing practices by financial institutions ahead of end-of-year regulatory reporting of derivatives positions. We confirm that all relationships of FX derivatives activity (with bond holdings and hedging determinants, alike) also hold if we control for an end-of-year dummy, as well as if we express all changes in year-on-year instead of semi-annual terms.

3.3 Role of monetary policy surprises and estimation in IV setup

To address potential endogeneity concerns and isolate the role of monetary policy, we re-estimate the regression using an instrumental variables (IV) setting. High-frequency interest rate surprises around central bank announcements are used to instrument yield curve slopes, while FOMC 'risk shift' shocks serve as instruments for financial conditions and exchange rates. This helps us address endogeneity concerns regarding the comovement of the macro variables in the specification. It also sharpens the conclusions we can draw from the analysis – especially for the transmission of monetary policy shocks across international bond markets.

We use two types of high-frequency surprises in asset prices over intraday windows around monetary policy announcements.[18] Interest rate surprises at 3-month and 10-year maturities for the US are sourced via Jarociński (2024)'s updated version of FOMC announcements following Gürkaynak et al. (2005). For the other five countries, high-frequency interest rate surprises are from the updated dataset of Kearns et al. (2023). We use these interest surprises to obtain an instrument for the slope by taking the difference of the intraday movement in

[18]We obtain monetary policy surprises for all of the six central banks in our estimation sample (Federal Reserve, ECB, Bank of Japan, Bank of England, Swiss National Bank and Bank of Canada). We sum all surprises that occur in a given half-year to instrument the semi-annual change in the respective explanatory variable.

the 10-year rate and the 3-month rate for each of the six currencies. In addition, we follow the work of Kroencke et al. (2021) to obtain a separate FOMC instrument for US risky asset prices. This 'risk shift' shock around FOMC communications is not spanned by the interest rate surprises and captures a separate channel of transmission via investor risk-taking as described in Bauer et al. (2023). We use the FOMC risk shift shocks to instrument our risk proxy – the Goldman Sachs US FCI – as well as the spot dollar bilateral exchange rates of the five currencies in the sample.

The IV results, reported in Table 6, reveal stronger effects of yield curve slopes and financial conditions on FX swaps activity. Once high-frequency interest rate surprises around central bank announcements are used to instrument the USD and local yield curve slopes in column (2), both coefficients increase in absolute value and become statistically significant. On the one hand, FOMC news that steepens the USD yield curve make the USD bond market more attractive for foreign investors, and an increase in FX hedging enables them to access it without taking (all of) the associated FX risk. On the other hand, a flattening of the local yield curve induced by the respective central bank's announcements makes local bonds a less attractive investment for local investors who instead invest in the USD bond market, which shows up as an increase in OFIs' FX swaps notionals outstanding. The FOMC 'risk shift' shocks as measured by the surprise in the S&P 500 equity index and the dollar bilateral exchange rate against the five currencies in our sample, are then used to instrument the US FCI and spot exchange rate variables in our specification, as reported in column (3) of Table 6. The IV coefficient on financial conditions suggests even stronger effects of a tightening in US financial conditions for the degree of risk-taking in international bond markets and the associated hedging with FX swaps by OFIs. The spot exchange rate – which should have a more mechanical rather than causal effect on the volume of FX swaps (see Section 2) – retains its negative correlation when instrumented with FOMC 'risk shifts' but becomes insignificant. We combine the interest rate monetary policy surprises and FOMC 'risk shift' shocks in the last column of Table 6. The more pronounced roles of local and USD yield curves as well as of US financial conditions persist in this combined IV specification, suggesting that these variables capture the main channels through which advanced economies' central banks influence the FX hedging demand of OFIs and their associated cross-currency bond investment.

Table 6: IV regression using monetary policy and risk-shift instruments

	(1)	(2)	(3)	(4)
Slope USD (10y-3m)	1.798	7.317***	1.496*	7.786***
	(0.963)	(2.040)	(0.869)	(1.897)
Slope local (10y-3m)	-4.730**	-14.015**	-3.772**	-13.762***
	(1.537)	(5.535)	(1.570)	(4.835)
CIP dev. (3m)	-4.774*	-3.003	-6.291***	-3.938
	(1.976)	(2.221)	(1.469)	(2.771)
GS US FCI	-3.647**	-2.345**	-7.003***	-4.703***
	(1.035)	(1.138)	(1.502)	(1.724)
Spot ER (local per 1 USD)	-0.502*	-0.471***	-0.213	-0.159
	(0.185)	(0.172)	(0.251)	(0.457)
Obs	258	218	258	218
Adj. Rsq.	0.26	0.17	0.20	0.15
Curr FE	Yes	Yes	Yes	Yes
Endog.	OLS	Slopes (MP)	FCI & FX (shift)	All (MP+shift)
F: US slope		85.18		199.97
Pval		0.00		0.00
F: LC slope		1.54		5.85
Pval		0.32		0.06
F: US FCI			72.44	3269.29
Pval			0.00	0.00
F: FX spot			52.43	7578.97
Pval			0.00	0.00

NOTES: Panel regression results with currency fixed effects. Sample and variables as defined in Table 2 notes. Column (1) replicates the OLS results of Table 2, column (4). Columns (2)–(4) instrument key explanatory variables with high-frequency monetary policy shocks: US and local yield curve slopes with the interest rate surprises around respective central banks' announcements as measured by Jarociński (2024) and Kearns et al. (2023) in column (2); US FCI and the bilateral spot exchange rates with the 'risk shift' shocks of Kroencke et al. (2021) around Fed policy announcements in column (3); column (4) uses both the interest rate surprises and 'risk shift' shocks to instrument all explanatory variables except CIP deviations. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Summary. Our IV estimates indicate that monetary policy shocks' effects on asset prices can propagate internationally through the FX-hedged bond investments of asset managers. For instance, a flattening of the yield curve in the euro area or Japan would make the local bond market less attractive for domestic mutual funds, pension funds and insurers. This induces these investors to put more money into USD bonds, all else equal. Such behaviour can transmit the monetary policy stance (especially unconventional policy which acts at the longer end of the yield curve) from non-US advanced economies, where the bulk of non-bank private investors in USD bonds are located, to the US market. In addition, global shifts in investor risk appetite triggered by FOMC communications ('risk shift' shocks) affect how much duration risk international investors are willing to bear and can, thus, amplify the flows between advanced economy bond markets. FX swaps volumes are uniquely suited to capture these shifts in risk-taking in international bond markets due to the hedging of FX risk by international bond investors.

Taken together, the empirical evidence establishes a clear link between FX swaps activity and cross-border bond investment, driven by hedging motives and influenced by monetary policy and risk aversion. This dynamic highlights the dual role of FX swaps as both a reflection of and a conduit for international financial flows. The findings have significant implications for understanding monetary policy spillovers and the transmission of global financial shocks. By providing a mechanism for hedging FX risk, FX swaps enable investors to respond to changes in relative bond market returns and shifts in global risk appetite. This, in turn, underscores the importance of monitoring FX derivatives markets as a key component of the global financial system.

4 Conclusion

This paper highlights the central role of FX derivatives, particularly FX swaps and forwards, in facilitating cross-border bond investments. By linking FX hedging activity to yield curve dynamics, deviations from covered interest rate parity (CIP), and global risk appetite, we emphasize the key enabling role of FX hedging in channelling capital and thereby transmitting financial spillovers across advanced economies. Our findings indicate that FX derivatives markets are deeply interconnected with bond markets, with non-bank financial institutions (NBFIs) acting as pivotal players. The insights from this paper contribute to the understanding of the mechanisms driving the global financial cycle and highlight the importance of a key observed quantity – shifts in the outstanding volumes of FX swaps and related FX derivatives – as both a barometer and conduit of international financial flows.

Looking forward, the increasing reliance on FX derivatives for hedging long-term investments raises important implications for the resilience of the financial system. The maturity mismatch between short-term hedging instruments and long-term bond exposures could amplify vulnerabilities during periods of market stress, especially if liquidity in FX swaps and forward markets dries up. Furthermore, the bi-directional nature of monetary policy spillovers suggests that central bank actions in one jurisdiction can have far-reaching consequences for global financial stability. While the role of the Federal Reserve has been highlighted in this context for a long time, our results point to one channel through which meaningful spillovers could also arise from policies abroad impacting financial conditions in the US.

All in all, our results highlight how FX derivatives markets play a crucial role for intermediating capital across international financial markets. Further research on their structure and vulnerabilities, including through more granular and comprehensive data, is essential for understanding both financial channels of cross-border spillovers and identifying potential sources of systemic risk.

References

Ahmed, Ahmed, Boris Hofmann, and Martin Schmitz, "Foreign institutional investors, monetary policy, and reaching for yield," Technical Report, Bank for International Settlements 2023.

Aramonte, Sirio, Andreas Schrimpf, and Hyun Song Shin, "Non-bank financial intermediaries and financial stability," Technical Report, Bank for International Settlements, Working paper, No. 972 2021.

Bacchetta, Philippe, J Scott Davis, and Eric Van Wincoop, "Exchange Rate Determination under Limits to CIP Arbitrage," Technical Report, National Bureau of Economic Research 2024.

Bauer, Michael D, Ben S Bernanke, and Eric Milstein, "Risk appetite and the risk-taking channel of monetary policy," *Journal of Economic Perspectives*, 2023, *37* (1), 77–100.

Boehm, Christoph E. and T. Niklas Kroner, "Monetary Policy without Moving Interest Rates: The Fed Non-Yield Shock," 2025. NBER Working Paper 32636.

Borio, Claudio, "The financial cycle and macroeconomics: What have we learnt?," BIS Working Papers 395, Bank for International Settlements 2012.

Borio, Claudio EV, Mobeen Iqbal, Robert N McCauley, Patrick McGuire, and Vladyslav Sushko, "The failure of covered interest parity: FX hedging demand and costly balance sheets," 2018.

Borio, Claudio, Robert McCauley, and Patrick McGuire, "Dollar debt in FX swaps and forwards: huge, missing and growing," *BIS Quarterly Review*, 2022, *5*, 67–73.

Bräuer, Leonie and Harald Hau, "Can Time-Varying Currency Risk Hedging Explain Exchange Rates?," Technical Report, CESifo Working Paper 2022.

_ and _ , "Fund-Level FX Hedging Redux," *Swiss Finance Institute Research Paper*, 2024, (24-103).

De Leo, Pierre, Lorena Keller, and Dongchen Zou, "Speculation, forward exchange demand, and cip deviations in emerging economies," *Available at SSRN*, 2024.

_ , _ , Giuliano Simoncelli, Mauricio Villamizar-Villegas, and Tomás Williams, "Global Investors in Local-Currency Bond Markets: Implications for Bond Yields and Exchange Rates," *Available at SSRN*, 2025.

Du, Wenxin, Alexander Tepper, and Adrien Verdelhan, "Deviations from Covered Interest Rate Parity," *The Journal of Finance*, 2018, *73* (3), 915–957.

_ and Amy Huber, "Dollar Asset Holdings and Hedging Around the Globe," Technical Report, National Bureau of Economic Research 2024.

_ and Jesse Schreger, "Local currency sovereign risk," *The Journal of Finance*, 2016, *71* (3), 1027–1070.

_ and _ , "CIP deviations, the dollar, and frictions in international capital markets," in "Handbook of International Economics," Vol. 6, Elsevier, 2022, pp. 147–197.

_ , Joanne Im, and Jesse Schreger, "The us treasury premium," *Journal of International Economics*, 2018, *112*, 167–181.

Eren, Egemen and Philip Wooldridge, "The role of non-bank financial institutions in cross-border spillovers," *BIS Papers*, 2022.

Gürkaynak, RS, B Sack, and ET Swanson, "Do actions speak louder than words? The response of asset prices to monetary policy actions and statements," *International Journal of Central Banking*, 2005, *1* (1), 55–93.

Hacioğlu-Hoke, Sinem, Daniel Ostry, Hélène Rey, Adrien Rousset Planat, Vania Stavrakeva, and Jenny Tang, "Topography of the FX derivatives market: a view from London," Technical Report, Bank of England 2024.

Hatzius, Jan and Sven Jari Stehn, "The case for a financial conditions index," 2018.

Huang, Wenqian, Angelo Ranaldo, Andreas Schrimpf, and Fabricius Somogyi, "Constrained liquidity provision in currency markets," *Journal of Financial Economics*, 2025, *167*, 104028.

Jarociński, Marek, "Estimating the Fed's unconventional policy shocks," *Journal of Monetary Economics*, 2024, *144*, 103548.

Kearns, Jonathan, Andreas Schrimpf, and Fan Dora Xia, "Explaining monetary spillovers: The matrix reloaded," *Journal of Money, Credit and Banking*, 2023, *55* (6), 1535–1568.

Kloks, Peteris, Edouard Mattille, and Angelo Ranaldo, "Foreign exchange swap liquidity," *Swiss Finance Institute Research Paper*, 2023, (23-22).

Kroencke, Tim A, Maik Schmeling, and Andreas Schrimpf, "The FOMC risk shift," *Journal of Monetary Economics*, 2021, *120*, 21–39.

Kubitza, Christian, Jean-David Sigaux, and Quentin Vandeweyer, "The implications of CIP deviations for international capital flows," 2025.

Lombardi, Marco J., Cristina Manea, and Andreas Schrimpf, "Financial conditions and the macroeconomy: a two-factor view," *BIS Working Papers*, 2025, *1272.*

Maggiori, Matteo, Brent Neiman, and Jesse Schreger, "International currencies and capital allocation," *Journal of Political Economy*, 2020, *128* (6), 2019–2066.

_ , _ , and _ , "Corporate debt structure with home and international currency bias," *IMF Economic Review*, 2024, pp. 1–24.

McGuire, Patrick, Ilhyock Shim, Hyun Song Shin, and Vladyslav Sushko, "Outward portfolio investment and dollar funding in emerging Asia," *BIS Quarterly Review, December*, 2021.

Miranda-Agrippino, Silvia and Hélene Rey, "US monetary policy and the global financial cycle," *The Review of Economic Studies*, 2020, *87* (6), 2754–2776.

Moskowitz, Tobias J, Chase P Ross, Sharon Y Ross, and Kaushik Vasudevan, "Quantities and covered-interest parity," Technical Report, National Bureau of Economic Research 2024.

Rey, Hélène, "Dilemma not trilemma: the global financial cycle and monetary policy independence," 2013.

Sialm, Clemens and Qifei Zhu, "Currency Management by International Fixed-Income Mutual Funds," *The Journal of Finance*, 2024, *79* (6), 4037–4081.

A Additional results

Table A.1: Panel regression: BIS FX swaps and outright forwards by OFIs & TIC holdings by asset class

	(1) Total LT securities	(2) LT debt	(3) Equity	(4) ST debt
Foreign into US	0.362***	0.442***	0.189*	-0.051
	(0.120)	(0.117)	(0.098)	(0.054)
US abroad	0.179*	0.171**	0.189**	0.094**
	(0.105)	(0.075)	(0.093)	(0.047)
Obs	125	125	125	210
Adj. Rsq.	0.15	0.14	0.12	-0.01

NOTES: Panel regression results with currency fixed effects. Sample period: June 2011 – June 2024. We regress semi-annual growth in OFIs' FX derivatives notionals in five major currencies (EUR, JPY, GBP, CHF, CAD) on semi-annual changes in cross-border portfolio holdings of different securities from the US Treasury International Capital (TIC) reporting system – both on foreigners' holdings of US securities ("Foreign into US" and "US abroad") and US investors' holdings of foreign securities. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

B Bond portfolio problem in detail

The foreign investor allocates a portfolio of size $A_{i=l,t}$ between two risky and one risk-free assets:

1. an FX-hedged USD long-term bond with dollar log return equal to sum of the home risk-free rate plus a term premium $r^{\$}_{t+1} = rf^{\$}_t + T^{\$}_{t+1}$, with volatility of $\sigma^2_{T^{\$}}$;

2. a domestic (to the investor country l) long-term bond with local currency return comprising $r^l_{t+1} = rf^l_t + T^l_{t+1}$ and volatility of $\sigma^2_{T^l}$;

3. and the local risk-free rate rf^l_t.

The foreign investor hedges the return on the USD bond using an FX swap (the cost of which has two components – the short-term interest rate differential and cross-currency basis x^l_t) and receives the hedged return in his domestic currency l:

$$\begin{aligned}
r^{\$,H}_{t+1} &\approx r^{\$}_{t+1} + (f_t - s_t) \\
&= (T^{\$}_{t+1} + rf^{\$}_t) + (f_t - s_t) \\
rx^{\$,H}_{t+1} &\approx (T^{\$}_{t+1} + rf^{\$}_t) + (f_t - s_t) - rf^l_t \\
&= T^{\$}_{t+1} + [rf^{\$}_t + (f_t - s_t) - rf^l_t] \\
&= T^{\$}_{t+1} + x^l_t
\end{aligned}$$

where the approximation in the first line reflect investors' inability to perfectly forecast the price of the dollar asset at $t+1$ (Du and Huber, 2024). $x^l_t \equiv rf^{\$}_t + (f_t - s_t) - rf^l_t$ denotes the cross-currency basis for the currency of the foreign investor vis-á-vis the US dollar.

The domestic excess return that the investor compares to the hedged USD return is:

$$rx^l_{t+1} = r^l_{t+1} - rf^l_t = T^l_{t+1}$$

With these three excess return definitions, we see that the main excess returns sources are home and dollar term spreads ($T^{\$}_{t+1}$ and T^{l}_{t+1}) as well as the cost of hedging or cross-currency basis (x^l_t).

The local investor chooses his portfolio allocation to the two risky investments by maximizing a linear combination of mean and variance of portfolio returns in excess of the local risk-free rate. For now, assume risk aversion is a time-invariant parameter γ. The three portfolio weights are: $w^{\$}, w^l$, and leaves $1 - w^{\$} - w^l$ in the local risk-free asset. The maximization problem becomes:

$$\max_{w^{\$}, w^l} \mathbb{E}[rx^p_{t+1}] - \frac{\gamma}{2}\mathbb{V}\mathrm{ar}[rx^p_{t+1}]$$

where the log portfolio return in local currency is:

$$rx^p_{t+1} = w^{\$}(T^{\$}_{t+1} + x^l_t) + w^l T^l_{t+1}$$

The expected excess return and the variance of the portfolio are:

$$\begin{aligned}
\mathbb{E}[rx^p_{t+1}] &= w^{\$}\mathbb{E}[T^{\$}_{t+1}] + w^{\$}x^l_t + w^l\mathbb{E}[T^l_{t+1}] \\
&\equiv w^{\$}\ \overline{T^{\$}_{t+1}} + w^{\$}\ x^l_t + w^l\ \overline{T^l_{t+1}} \\
\mathbb{V}\mathrm{ar}[rx^p_{t+1}] &= (w^{\$})^2\ \sigma^2_{T^{\$}} + (w^l)^2\ \sigma^2_{T^l} + 2\ w^{\$}w^l\ \sigma_{T^{\$},T^l}
\end{aligned}$$

where $\sigma_{A,B}$ denotes the covariance between return on asset A and B; and σ^2_A is the variance of asset A's return.

Implying the optimal portfolio weights:

$$w^{\$}_{i=l} = \frac{\sigma^2_{T^l}\ (\overline{T^{\$}_{t+1}} + x^l_t) - \sigma_{T^{\$},T^l}\ \overline{T^l_{t+1}}}{\gamma(\sigma^2_{T^{\$}}\sigma^2_{T^l} - (\sigma_{T^{\$},T^l})^2)}$$

What we observe in BIS statistics is the volume of hedging in US dollars, such that the model-equivalent contribution of foreign investors is given by:

$$\frac{A_{i=l,t}}{S_t} \times w^{\$}_{i=l} = \frac{A_{i=l,t}}{S_t} \times \frac{\sigma^2_{T^l}\ (\overline{T^{\$}_{t+1}} + x^l_t) - \sigma_{T^{\$},T^l}\ \overline{T^l_{t+1}}}{\gamma(\sigma^2_{T^{\$}}\sigma^2_{T^l} - (\sigma_{T^{\$},T^l})^2)}$$

US investor allocates portfolio of size $A_{i=US,t}$ between:

1. a USD long-term (risky) asset with dollar log return $r^{\$}_{t+1} = rf^{\$}_t + T^{\$}_{t+1}$ and volatility of $\sigma^2_{T^{\$}}$;

2. a hedged country-l long-term (risky) security with local currency return $r^l_{t+1} = rf^l_t + T^l_{t+1}$ and volatility of $\sigma^2_{T^l}$;

3. and the USD risk-free rate $rf^{\$}_t$.

The hedged excess return in USD terms is:

$$\begin{aligned} r_{t+1}^{l,H} &\approx r_{t+1}^{l} - (f_t - s_t) \\ &= (T_{t+1}^{l} + rf_t^{l}) - (f_t - s_t) \\ rx_{t+1}^{l,H} &\approx (T_{t+1}^{l} + rf_t^{l}) - (f_t - s_t) - rf_t^{\$} \\ &= T_{t+1}^{l} - [rf_t^{\$} + (f_t - s_t) - rf_t^{l}] \\ &= T_{t+1}^{l} - x_t^{l} \end{aligned}$$

The US excess return that the investor compares to the hedged country-l return is:

$$rx_{t+1}^{\$} = r_{t+1}^{\$} - rf_t^{\$} = T_{t+1}^{\$}$$

The US investor's maximization problem is:

$$\max_{w_{i=US}^{\$}, w_{i=US}^{l}} \quad \mathbb{E}[rx_{US,t+1}^{p}] - \frac{\gamma}{2}\mathbb{V}\mathrm{ar}[rx_{US,t+1}^{p}]$$

where the log portfolio return in USD is:

$$rx_{US,t+1}^{p} = w_{i=US}^{\$} T_{t+1}^{\$} + w_{i=US}^{l}(T_{t+1}^{l} - x_t^{l})$$

The expected return and the variance of the portfolio are:

$$\begin{aligned} \mathbb{E}[rx_{US,t+1}^{p}] &= w_{i=US}^{\$}\mathbb{E}[T_{t+1}^{\$}] + w_{i=US}^{l}\mathbb{E}[T_{t+1}^{l}] - w_{i=US}^{l} x_t^{l} \\ &\equiv w_{i=US}^{\$}\ \overline{T_{t+1}^{\$}} + w_{i=US}^{l}\ \overline{T_{t+1}^{l}} - w_{i=US}^{l}\ x_t^{l} \\ \mathbb{V}\mathrm{ar}[rx_{US,t+1}^{p}] &= (w_{i=US}^{\$})^2\ \sigma_{T^{\$}}^2 + (w_{i=US}^{l})^2\ \sigma_{T^{l}}^2 + 2\ w_{i=US}^{\$} w_{i=US}^{l}\ \sigma_{T^{\$},T^{l}} \end{aligned}$$

Implying the optimal portfolio weight on the country-l hedged asset:

$$w_{i=US}^{l} = \frac{\sigma_{T^{\$}}^2\ (\overline{T_{t+1}^{l}} - x_t^{l}) - \sigma_{T^{\$},T^{l}}\ \overline{T_{t+1}^{\$}}}{\gamma(\sigma_{T^{\$}}^2 \sigma_{T^{l}}^2 - (\sigma_{T^{\$},T^{l}})^2)}$$

What we observe in BIS statistics is the volume of hedging in US dollars, such that the model-equivalent contribution of US investors is given by:

$$A_{i=US,t} \times w_{i=US}^{l} = A_{i=US,t} \times \frac{\sigma_{T^{\$}}^2\ (\overline{T_{t+1}^{l}} - x_t^{l}) - \sigma_{T^{\$},T^{l}}\ \overline{T_{t+1}^{\$}}}{\gamma(\sigma_{T^{\$}}^2 \sigma_{T^{l}}^2 - (\sigma_{T^{\$},T^{l}})^2)}$$

Total FX hedging demand is a weighted sum of the foreign investor allocation to USD assets and the US investor's allocation to foreign assets.

$$
\begin{aligned}
\frac{A_{i=l,t}}{S_t} \times w^{\$}_{i=l} + A_{i=US,t} \times w^{l}_{i=US} &= \frac{A_{i=l,t}}{S_t} \times \frac{\sigma^2_{T^l}\ (\overline{T^{\$}_{t+1}} + x^l_t) - \sigma_{T^{\$},T^l}\ \overline{T^l_{t+1}}}{\gamma(\sigma^2_{T^{\$}}\sigma^2_{T^l} - (\sigma_{T^{\$},T^l})^2)} \\
&+ A_{i=US,t}\ \frac{\sigma^2_{T^{\$}}\ (\overline{T^l_{t+1}} - x^l_t) - \sigma_{T^{\$},T^l}\ \overline{T^{\$}_{t+1}}}{\gamma(\sigma^2_{T^{\$}}\sigma^2_{T^l} - (\sigma_{T^{\$},T^l})^2)} \\
&= \left[\gamma(\sigma^2_{T^{\$}}\sigma^2_{T^l} - (\sigma_{T^{\$},T^l})^2)\right]^{-1} \times \\
&\times \Big[\quad (\frac{A_{i=l,t}}{S_t}\ \sigma^2_{T^l} - A_{i=US,t}\ \sigma_{T^{\$},T^l})\ \overline{T^{\$}_{t+1}} \\
&+ (A_{i=US,t}\ \sigma^2_{T^{\$}} - \frac{A_{i=l,t}}{S_t}\ \sigma_{T^{\$},T^l})\ \overline{T^l_{t+1}} \\
&+ (\frac{A_{i=l,t}}{S_t}\ \sigma^2_{T^l} - A_{i=US,t}\ \sigma^2_{T^{\$}})\ x^l_t \quad \Big]
\end{aligned}
$$

Previous volumes in this series

1272 June 2025	Financial conditions and the macroeconomy: a two-factor view	Marco Jacopo Lombardi, Cristina Manea and Andreas Schrimpf
1271 June 2025	Monetary policy and earnings inequality: inflation dependencies	Jaanika Meriküll and Matthias Rottner
1270 May 2025	Stablecoins and safe asset prices	Rashad Ahmed and Iñaki Aldasoro
1269 May 2025	Expecting job replacement by GenAI: Effects on workers' economic outlook and behavior	Yusuke Aoki, Joon Suk Park, Yuya Takada and Koji Takahashi
1268 May 2025	Towards verifiability of total value locked (TVL) in decentralized finance	Pietro Saggese, Michael Fröwis, Stefan Kitzler, Bernhard Haslhofer and Raphael Auer
1267 May 2025	Collateralized lending in private credit	Iñaki Aldasoro and Sebastian Doerr
1266 May 2025	Exchange Rate Effects on Firm Performance: A NICER Approach	Nuwat Nookhwun, Jettawat Pattararangrong and Phurichai Rungcharoenkitkul
1265 May 2025	DeFiying gravity? An empirical analysis of cross-border Bitcoin, Ether and stablecoin flows	Raphael Auer, Ulf Lewrick and Jan Paulick
1264 April 2025	Inflation cycles: evidence from international data	Alberto Americo, Douglas K G Araujo, Johannes Damp, Sjur Nilsen, Daniel Rees, Rafael Schmidt and Christian Schmieder
1263 April 2025	Fragile wholesale deposits, liquidity risk, and banks' maturity transformation	Carola Müller, Matias Ossandon Busch, Miguel Sarmiento and Freddy Pinzon-Puerto
1262 April 2025	The risk sensitivity of global liquidity flows: heterogeneity, evolution and drivers	Stefan Avdjiev, Leonardo Gambacorta, Linda S Goldberg and Stefano Schiaffi
1261 April 2025	ETFs as a disciplinary device	Yuet Chau, Karamfil Todorov and Eyub Yegen
1260 April 2025	Supply chain transmission of climate-related physical risks	Douglas K G Araujo, Fernando Linardi and Luis Vissotto

All volumes are available on our website www.bis.org.