Global Investors in Local-Currency Bond Markets: Implications for Bond Yields and Exchange Rates*

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Abstract

We study how global investors in local-currency bond markets shape the joint dynamics of government bond yields and exchange rates. Using transaction-level data from Colombia's bond and foreign exchange markets, we show that global investors' bond trades are systematically accompanied by simultaneous transactions in the spot exchange market, whereas this is not the case for local investors. We incorporate these features into a model in which financial flows alter intermediaries' exposure to bond and currency risk, and thus the joint distribution of bond and currency risk premia. The model captures the effects of global investor inflows into local-currency bond markets, the observed patterns of investors' positions and returns, as well as the effects of central bank asset purchase policies in Colombia's bond and foreign exchange markets. The model also explains cross-country differences in the joint dynamics of bond yields and exchange rates.

Keywords: global investors, local-currency bond markets, exchange rates, financial intermediaries, capital flows

JEL Classification: E43, E52, F31, G12

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We study how key institutional features of international financial markets shape the joint dynamics of government bond yields and exchange rates. When risk premia compensate intermediaries for exposure to multiple risks, the joint distribution of financial flows across asset classes—which determines those exposures—becomes a central object. We show, both empirically and theoretically, that the composition of investors in a country's government bond market, whether local or global, shapes the joint distribution of flows into bond and currency markets and, in turn, explains cross-country differences in bond yield–exchange rate comovement, as well as the effects of quantitative easing and foreign exchange interventions.[1]

We emphasize a fundamental difference in the distribution of financial flows generated by global versus local investors. Because global investors fund themselves in US dollars, their purchases of local-currency government bonds generate contemporaneous flows across both bonds of different maturities and different currencies. Using transaction-level data from Colombia's government bond and foreign exchange markets, we show that flows initiated by global investors—those domiciled outside Colombia—tightly link bond-market transactions to spot currency trades: bond purchases are accompanied by purchases of domestic currency, while bond sales coincide with currency sales; and these bond-related flows account for most global investor (net) activity in the spot exchange market. By contrast, local investors' bond transactions generate little to no currency-market flow. These fundamental features exist regardless of the underlying drivers of bond investment and impose key restrictions on the joint distribution of financial flows in models of frictional financial intermediation.

We incorporate global and local investors' financial flows into a model of frictional financial intermediation with local long-term bond market and spot and forward currency markets. In the model, local financial intermediaries absorb financial flows in both bond and currency markets, and part of these flows reflects the correlated demand of global investors. Apart from these features, the structure of the model follows Greenwood et al. (2023).

The proposed extensions find wide empirical support from Colombian transaction-level data on cross-market positions and returns of different market participants. First, global investors' purchases of local-currency government bonds induce both quantity and price effects that are predicted by the model. We zoom in an episode of global financial flows into Colombia's local-currency government bond market—due to *J.P. Morgan* announced

[1] A growing literature emphasizes the role of financial flows in shaping bond yields and exchange rates, both empirically (Pandolfi and Williams, 2019; Ray et al., 2024; Hau et al., 2010; Beltran and He, 2024) and theoretically through models of frictional financial intermediation (Gabaix and Maggiori, 2015; Vayanos and Vila, 2021; Gourinchas et al., 2022; Greenwood et al., 2023). Virtually all these models assume independence between bond- and currency-market flows.

the inclusion of Colombian bonds in one of its flagship indexes in March 2014. These bond flows were matched almost one-for-one by global acquisitions of Colombian pesos in the spot currency market; in addition, local intermediaries largely absorbed the resulting imbalances in both bond and currency markets, and both Colombian bond prices and Colombian pesos appreciated. Second, changes in local intermediaries' positions in the bond and currency markets are positively correlated with subsequent bond and currency excess returns: when intermediaries accumulate a position in a given market, they earn significant positive returns in that market. In contrast, purchases by global investors and other domestic investors are followed by declines in excess returns. These patterns support the notion that risk premia compensate local intermediaries' changing exposure for absorbing imbalances created by financial flows. Third, changes in local intermediaries' bond and currency positions positively correlate with each other, consistent with the central role of correlated exposure.

In our framework, the joint dynamics of equilibrium bond and currency returns are driven by two sets of shocks: stochastic movements in short-term interest rates and fluctuations in global investors' bond flows, both treated as exogenous processes. First, short-term interest rate shocks affect bond and currency returns in opposing ways: an unanticipated increase in the local short-term interest rate lowers the price of long-term bonds while appreciating the domestic currency, thereby generating a negative correlation between excess bond and currency returns. Greenwood et al. (2023) and Gourinchas et al. (2022) emphasize this mechanism, which leads to a negative correlation between *expected* excess bond and currency returns. Second, correlated flows from global investors simultaneously alter local intermediaries' exposure to both yield-curve trade (borrow short–lend long domestically) and UIP trade (borrow short externally–lend short domestically). Correlated flows thus induce positively correlated revisions in bond and currency premia. For example, global investors' bond inflows lead local intermediaries to require lower excess bond and currency returns simultaneously—achieved through an equilibrium increase in long-term bond prices and currency appreciation. Correlated flows therefore generate joint movements in bond yields and exchange rates that differ qualitatively from those implied by models centered only on interest rate risk.

The relevance of correlated flows is governed by two forces. First, the relative volatility of global versus domestic investors' purchases of bonds: when global investors account for a larger fraction of fluctuations in bond purchases, intermediaries positions will largely be correlated across bond and currency markets. Second, the extent to which global investors hedge currency risk: we formally show that global investors generate correlated flows only when they

refrain from taking offsetting positions in the forward currency market, that is, only when their local-currency bond purchases remain at least partially unhedged. Using cross-country data on local-currency bond holdings (Arslanalp and Tsuda, 2012, 2014) and estimates of global investors' hedging ratios (Cheema-Fox and Greenwood, 2024; Chen and Zhou, 2025), we construct a model-based metric that captures the importance of correlated flows for each country. This metric reveals substantial heterogeneity across economies, reflecting differences both in the relevance of global investors and in their propensity to hedge.

We show that economies where global investors contribute more significantly to fluctuations in bond flows, or are less propense to hedge currency risk, display a more positive comovement in bond and currency returns. We extend the analysis of Lustig et al. (2019) to a broader panel of countries and document that the comovement between bond yields and exchange rates differs markedly across countries. That is, local-currency excess bond returns—defined as the return from borrowing short-term and lending long-term in domestic currency—and excess currency returns—defined as the return from borrowing short-term in foreign currency and lending short-term in domestic currency. These cross-country differences in comovment patterns are a robust feature of the data and do not appear to reflect differences in default risk (as proxied by credit-default-swap spreads).

Colombia exemplifies a country where correlated flows are relevant and bond and currency returns are positively correlated. In particular, not only global investors' bond flow volatility rivals that of local investors (Arslanalp and Tsuda, 2014), but also global investors' hedging behavior towards Colombian bonds is extremely limited. Estimates in Chen and Zhou (2025) based on international U.S. mutual funds imply a hedging ratio towards Colombian peso of roughly 5%. In line with this evidence, we show that global investors' bond transactions are *not* systematically associated with transactions in the forward currency market. To quantify the extent to which correlated flows matter for the comovement in bond and currency returns, we turn to a calibrated version of our model consistent with several moments of micro data from Colombia. A counterfactual exercise suggests that around 50% of the empirical bond–currency return correlation in Colombia can be attributed to correlated flows.

Understanding the correlation between bond and currency returns also matters because it shapes the transmission of asset-purchase policies, such as foreign-exchange interventions and quantitative easing. When the correlated flows risk dominates short-term interest-rate risk, bond and currency returns tend to comove positively. As a result, a central bank purchase of foreign currency increases intermediaries' exposure to the risk embedded in UIP trades, but also in yield-curve trade. This heightened exposure depreciates the currency and lowers bond

prices. Analogously, a central bank purchase of government bonds reduces intermediaries' exposure to this same positively correlated risk, raising bond prices and appreciating the domestic currency. These effects arise even though each intervention is confined to only one market.

We test these predictions on the asset price effects of asset-purchase policies using proprietary data from various auctions conducted by the Colombian central bank.

To examine the asset price effects of foreign exchange interventions, we draw from 641 auctions conducted by the Colombian central bank between 2008 and 2014 to acquire US dollars. Using a regression-discontinuity design around the auction cutoff price, we identify causal effects by comparing the secondary-market trading behavior of intermediaries that barely won and barely lost a given US-dollar auction. We find that winning an FXI auction—and thus selling dollars for pesos—leads intermediaries to trade in the secondary market at both a depreciated exchange rate *and* lower long-term bond prices.

Related literature There is growing recognition that financial flows shape movements in government bond yields and exchange rates. Identified financial-flow shocks across maturities or currencies affect these asset prices (Pandolfi and Williams, 2019; Ray et al., 2024; Hau et al., 2010; Beltran and He, 2024), and models with frictional financial intermediation have gained prominence in international finance (Gabaix and Maggiori, 2015; Vayanos and Vila, 2021; Gourinchas et al., 2022; Greenwood et al., 2023).[2,3] In these frameworks, financial flows that alter the exposures of intermediaries and prompt them to demand compensation in the form of risk premia across all trades affected by these exposures. As a result, the joint distribution of financial flows is a central object in these models. However, virtually all existing models assume independence between flows in bond and currency markets, or between exposures to yield-curve trades and UIP trades. We revisit this assumption. This paper introduces, empirically grounds, and quantitatively analyzes a novel mechanism that highlights the role of global investors' bond flows in shaping the joint dynamics in bond yields and exchange rates, and the asset price effects of asset purchase policies.[4]

Carstens and Shin (2019) proposes a "US dollar exchange rate risk-taking channel," by which US dollar appreciations alter the risk-taking capacity of constrained global investors that evaluate returns in US dollar terms (see also Bruno and Shin, 2015; Hofmann et al.,

[2]Koijen and Yogo (2020) estimates a demand system to study exchange rates jointly with short-term rates, long-term yields and equity prices.
[3]See also Zou (2024).
[4]For some empirical evidence on the comovement between bond yields and exchange rates, see, for example, Lustig et al. (2019); Lloyd and Marin (2024); Kekre and Lenel (2024).

2022; Bertaut et al., 2024).[5] Kekre and Lenel (2025) proposes a general equilibrium model in which fluctuations in the US dollar affect global risk premia by revaluing the wealth of currency-mismatched intermediaries. To the contrary, we emphasize the role of global investors' financial flows, rather than changes in interest rates or in the price of risk. Our analysis is thus related to Hau and Rey's (2006) and Camanho et al.'s (2022) equilibrium analyses of exchange rates, equity prices, and equity flows (see also, Rey and Stavrakeva, 2024). Consistent with the notion of correlated flows/exposures, Hau and Rey (2006) and Camanho et al. (2022) document that net equity flows into the foreign market are associated with a foreign currency appreciation.

This paper speaks to a broader literature on the role of global investors in economies' real and financial fluctuations (Calvo et al., 1993), the determinants of short-term market rates (De Leo et al., 2024a), deviations from covered interest parity (De Leo et al., 2024b), deviations from uncovered interest parity (Kalemli-Ozcan, 2019; di Giovanni et al., 2021; Cormun and De Leo, 2024), sovereign and firm borrowing costs (Fang et al., 2024; Zhou, 2024; Morelli et al., 2022; Moretti et al., 2024; Morais et al., 2019), the patterns of capital flows (Avdjiev et al., 2022), and the co-movement of a country's long-term yields with global bond markets (Xu, 2024).

1 Financial flows across bond and currency markets

Investors' financial flows change the risk exposures on intermediary balance sheets, affecting asset prices through portfolio balance. In this section we shed light on the properties of global and local investors financial flows across Colombia's government bond and currency markets. Colombia is a representative case of a small open economy, with global investors participation in its government bond market at levels comparable to those observed in other small open economies (Arslanalp and Tsuda, 2012, 2014).

1.1 Institutional details of Colombia's bond and currency markets

Government bonds market (*Títulos de Tesorería*, TES) Since the 2000s, most of Colombia's sovereign debt has been denominated in its domestic currency, the Colombian peso (COP). By 2020, total fiscal debt is USD 177 billion, representing around 65% of GDP. Of this total, two-thirds was denominated in COP, with 20% issued as inflation-linked bonds and 46% as standard peso-denominated instruments.

[5] A related literature studies the determinants and dynamics of a country's sovereign debt currency composition (Ottonello and Perez, 2019; Du and Schreger, 2022; Engel and Park, 2022; Lee, 2024).

The *Ministry of Finance* designates financial institutions to participate in the "primary dealers" (PD) program for TES. Membership in this program is limited to a select group of institutions that meet the Ministry's eligibility criteria. On average, the primary market issues approximately COP 300 billion (less than USD 100 million) worth of TES bonds daily. In contrast, the secondary market for TES, described below, experiences a substantially higher daily turnover of around COP 2 trillion (USD 500 million).

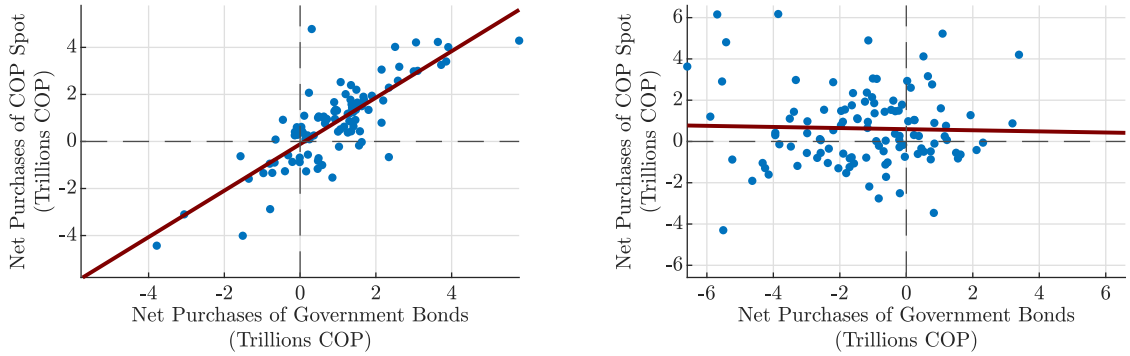
Foreign exchange markets The COP-USD spot and forward interdealer market in Colombia is highly centralized. A single electronic trading platform, *SET-ICAP FX*, accounts for approximately 95% of total market volume. Offshore trading is restricted by regulatory measures.

Transactions in foreign exchange markets are restricted to authorized dealers (*Intermediarios del Mercado Cambiario*, IMC). Consequently, all market participants must conduct transactions through one of these 50 authorized dealers. These intermediaries include banking institutions, financial corporations, financial cooperatives, and stock brokerage firms. The average daily turnover for the spot market is USD 1.5 billion, while the forward market sees a average daily turnover of USD 4 billion.

These institutions are subject to FX mismatch regulations overseen by the central bank, *Banco de la República*. The two most relevant regulations pertain to the *Posición Propia Contado* (PPC) and the *Posición Propia* (PP). Both indicators measure the difference between assets and liabilities denominated in foreign currency, relative to the institution's total equity. The key distinction is that the PP includes transactions involving derivatives, whereas the PPC does not. The regulatory framework permits banks to maintain a PP within a range of -5 to 20 percent, and a PPC between 0 and 50 percent of their equity. These thresholds allow financial intermediaries to hold a sizable degree of currency risk on their balance sheets.

Data sources Our analysis resorts to several datasets. Transactions involving purchases and sales of TES in the secondary market take place on two trading platforms: (i) the Colombian Electronic Market (*MEC*), operated by the *Colombian Stock Exchange*, and (ii) the Electronic Trading System (*SEN*), managed by the central bank. All trades executed on these platforms are registered in the Central Securities Depository (*DCV*), overseen by the central bank. To identify trades involving foreign investors, we use data from the "Declarations of Foreign Exchange Transactions" (*Declaraciones de Cambio*), which records all transactions involving foreign exchange and is compiled by the Technical and Economic

Figure 1
Investors' flows in bond and currency markets



(a) By global investors (b) By local investors

Note: The figure displays monthly net purchases of TES bonds (x-axis) and COP in the spot market (y-axis). Panel 1a displays the net purchases by global investors; Panel 1b displays the net purchases by local investors. The fitted OLS regression line is shown in each panel.

Information Department of the central bank. To analyze FX Spot, Next-Day, and Forward markets in the interdealer market using data from *SET-ICAP FX*.[6]

1.2 Global and local investors in bond and currency markets

We argue that global and local investor flows in the government bond market affect intermediaries' balance sheet risk exposures in fundamentally different ways. This distinction arises from their funding currencies: global investors use US dollars to purchase local-currency government bonds, whereas local investors fund themselves in COP.

Figure 1a plots global investors' monthly net purchases of TES in the secondary government bond market (x-axis) against their net purchases of COP in the spot foreign exchange market (y-axis).[7] The data lie tightly along the 45-degree line. A regression of COP purchases on TES purchases for global investors yields a slope statistically indistinguishable from 1, with an R^2 of around 65%. A large share of global investors' (net) spot FX transactions is thus directly tied to their government bond market activity. In other words, global investors' TES purchases dominate their acquisitions of other assets such as equities or local-currency corporate bonds.

By contrast, local investors' net TES purchases are not systematically correlated with their COP transactions in the spot FX market (Figure 1b). A regression of COP purchases

[6] While TES trades can be directly attributed to individual foreign investors, FX transactions may be conducted either directly by these investors or through foreign intermediaries, obscuring the identity of the ultimate buyer. Consequently, it is not possible to establish a precise link between FX transactions and TES trades at the individual transaction level.

[7] During this period, total outstanding TES debt was around COP 250 trillion, of which global investors held roughly one-quarter.

on TES purchases for local investors produces a slope indistinguishable from zero, with an R^2 near 0%.

The patterns in Figure 1 stem from differences in funding currency. A COP-funded investor buying X COP of a local-currency bond affects only the domestic bond market. The intermediary delivers X COP worth of bonds from inventory in exchange of COP cash, with no foreign exchange transaction.

A USD-funded investor, however, must first convert USD into COP at the spot rate Q to acquire the same bond. The intermediary then delivers the bond from inventory while receiving X/Q USD in exchange. This transaction generates both a COP bond outflow and a USD inflow. The new balance sheet of the intermediary involved in the transaction now features different exposures to both bond price risk and currency risk.

The first-order implication is that global and local investors' bond flows affect intermediary balance sheet risk in qualitatively different ways. Specifically, global investor activity induces a correlated change in exposures to both bond and currency risk for the (local) intermediaries that absorb the global investor flow.

We next formalize these insights in a model of bond and currency markets with frictional financial intermediation. The main purpose of the model is to derive the asset price implications resulting of these different features of investor composition. In the model, we also consider the role of currency hedging by global investors. Following Greenwood et al. (2023), we model global and local investors' bond demand as exogenous and inelastic. Although investor behavior is undoubtedly more complex in practice, the patterns documented in Figure 1 are driven by a fundamental difference in funding currency, and would arise even in environments with fully endogenous portfolio choice.[8]

2 Financial flows, bond yields and exchange rates

We present a model in which government bond and spot and forward foreign-exchange markets are integrated with one another but segmented from other financial markets. A group of local intermediaries trades in all of these markets, conducting both the "yield-curve trade"—the trade that borrows short-term and lends long-term in domestic currency—and the "UIP trade"—the trade that borrows short-term in foreign currency and lends short-term in domestic currency. These two distinct trades are exposed to two distinct sources of risk: bond price risk and currency risk.

[8]Studies incorporating endogenous portfolio choices of global investors include Morelli et al. (2022); Akinci et al. (2022); Kekre et al. (2024); Kekre and Lenel (2025); Bruno and Shin (2015); Hofmann et al. (2022).

In the model two sets of shocks determine the equilibrium risk profile of bonds and currencies. First, interest rate shocks, as in Greenwood et al. (2023) and Gourinchas et al. (2022), which alter the cash flow from holding bonds and currencies. Second, financial flows due to global and local investors which alter the balance sheet of intermediaries.

In this section, we derive the equilibrium of the model. Section 3 confronts key aspects of the model with Colombia's detailed data on investors' positions in bond and currency markets. Section 4 discusses the model implication for the comovement between bond and currency returns, as well as their cross-country differences. Section 5 presents the model's implication for the asset price effects of asset purchase policies and confronts them with the data.

2.1 Baseline Model

The discrete-time model includes domestic short- and long-term bonds, as well as foreign short-term bonds, denominated in their respective currency. There are two types of agents: local and global bond investors and local intermediaries. Global and local bond investors have a preference—resulting in inelastic demand—for assets of specific currencies and maturities. Local intermediaries, on the other hand, are specialized investors who absorb the net supply of domestic long-term bonds and foreign exchange resulting from exogenous demand shocks.

We follow Greenwood et al. (2023) and assume that asset prices (or yields) and expected returns are linear functions of a vector of state variables. To model fixed income assets, we (i) substitute log returns for simple returns throughout and (ii) use Campbell and Shiller (1988) linearizations of log returns.

Short-term bonds Short-term bonds in both currencies are supplied perfectly elastically, and short-term interest rates are determined exogenously according to AR(1) processes:

$$i_{t+1} = \bar{\imath} + \phi_i(i_t - \bar{\imath}) + \varepsilon_{i_{t+1}}; \tag{1}$$

$$i^\star_{t+1} = \bar{\imath} + \phi_i(i^\star_t - \bar{\imath}) + \varepsilon_{i^\star_{t+1}}, \tag{2}$$

where $\bar{\imath} > 0$, $\phi_i \in (0,1)$, $\text{var}_t[\varepsilon_{i_{t+1}}] = \text{var}_t[\varepsilon_{i^\star_{t+1}}] = \sigma_i^2 > 0$, and $\text{corr}[\varepsilon_{i_{t+1}}, \varepsilon_{i^\star_{t+1}}] = \rho \in [0,1]$. That is, we allow interest rate shocks to be correlated.

Long-term bonds Long-term bonds are default-free perpetuities whose payments decline geometrically. The domestic currency return on long-term domestic bonds from t to $t+1$ is

$$r^y_{t+1} = y_t - \frac{\delta}{1-\delta}(y_{t+1} - y_t) - g_t, \tag{3}$$

where y_t is the log yield-to-maturity on domestic long-term bonds, and parameter $\delta \in (0,1)$ is the bond's payment decline rate (see Appendix A.1). Equation (3) expresses the bond's return as consisting of three components: (i) a carry component, y_t; (ii) a capital gain component, $\frac{\delta}{1-\delta}(y_{t+1} - y_t)$; and (iii) a stochastic, time-varying wedge to bond returns, g_t. The last term introduces a time-varying wedge in the price of domestic long-term bonds without directly influencing the fundamental value of the exchange rate. It can be interpreted as a time-varying tax on local-currency bond returns, or a time-varying convenience yield. It follows an AR(1) process:

$$g_t = \phi_g g_{t-1} + \varepsilon_{g_t}, \tag{4}$$

where $\phi_g \in [0,1)$, and $\text{var}_t[\varepsilon_{g_t}] = \sigma_g^2 \geq 0$.

Let rx^y_{t+1} denote the excess return on domestic bonds, that is the return on the "yield-curve trade"—the trade that borrows short-term and lends long-term in domestic currency. Iterating equation (3) forward and taking expectations, one obtains:

$$y_t = (1-\delta) \sum_{j=0}^{\infty} \delta^j \, \text{E}_t[i_{t+j} + rx^y_{t+j+1} + g_{t+j}], \tag{5}$$

which indicates that the domestic long-term yield can be decomposed into the standard expectations hypothesis and term premium components, as well as a term that accounts for all current and future expected wedge ("taxes") on bond returns. The excess return on domestic bonds rx^y_{t+1} is determined in equilibrium.

The yield on foreign long-term bond is determined as

$$y^\star_t = (1-\delta) \sum_{j=0}^{\infty} \delta^j \, \text{E}_t[i^\star_{t+j} + rx^{y,\star}_{t+j+1}], \tag{6}$$

where $rx^{y,\star}_{t+j+1}$ is exogenous.

Foreign exchange Let q_t denote the log nominal exchange rate, expressed as units of home currency per unit of foreign currency, in the spot market. The log excess return on home currency, *i.e.* on the "UIP trade"—the trade that borrows short-term in foreign currency and lends short-term in domestic currency, is:

$$rx^q_{t+1} = (i_t - i^\star_t) - (q_{t+1} - q_t). \tag{7}$$

Iterating this expression forward and taking expectations yields:

$$q_t = \sum_{j=0}^{\infty} \text{E}_t[(i^\star_{t+j} - i_{t+j}) + rx^q_{t+j+1}] + \text{E}_t \, q_{t+\infty}. \tag{8}$$

Equation (8) expresses the spot exchange rate as the sum of three components: (i) the expected future sum of interest rate differentials, *i.e.* the UIP component; (ii) a foreign exchange risk premium; and (iii) the expected long-run nominal exchange rate. We assume that the long-term nominal exchange rate follows a random walk. That is:

$$q_{t+\infty} = \varepsilon_{q_t}, \tag{9}$$

where $\text{var}_t[\varepsilon_{q_t}] = \sigma_q^2 \geq 0$. Time variation in the long-term value of the nominal exchange rate introduces an additional, yet independent, source of risk for the UIP trade. While it is unmodeled here, time variation in the value of the long-term nominal spot exchange rate arises naturally in open-economy macroeconomic models with cross-country differences in inflation rates, while maintaining real exchange rate stationarity.

Local intermediaries A subset of agents can trade all assets and enforce no arbitrage. Anticipating our empirical findings in Section 3, we refer to these agents as "local intermediaries." These agents maximize their next-period wealth through mean-variance preferences with a risk tolerance parameter τ. Let d_t^y denote the market value of the intermediary' holdings of long-term domestic bonds and d_t^q denote the value of the net intermediary's position in the borrow-foreign and lend-domestic FX trade, all denominated in domestic currency. Defining $\mathbf{d}_t \equiv [d_t^y, d_t^q]'$ and $\mathbf{rx}_{t+1} \equiv [rx_{t+1}^y, rx_{t+1}^q]'$, intermediaries solve:

$$\max_{\mathbf{d}_t} \left\{ \mathbf{d}_t' \, \text{E}_t[\mathbf{rx}_{t+1}] - \frac{1}{2\tau} \mathbf{d}_t' \, \text{var}_t[\mathbf{rx}_{t+1}] \mathbf{d}_t \right\}, \tag{10}$$

Taking first-order condition yields the optimality condition faced by local intermediaries:

$$\text{E}_t[\mathbf{rx}_{t+1}] = \tau^{-1} \, \text{var}_t[\mathbf{rx}_{t+1}] \mathbf{d}_t. \tag{11}$$

Equation (11) links the intermediaries' expected excess returns on different assets to their asset holdings. The variance-covariance matrix of excess returns governs the equilibrium relationship of excess returns across the yield-curve trade and the UIP trade. In Appendix A.2, we show that d_t^q consists of the sum of long spot and long forward positions, and thus indeed represents the net exposure of the intermediaries to the UIP trade.

Net supplies and correlated flows In each period, domestic long-term bonds are available in a given net supply, denoted as s_t^y, which is equal to their gross issuance minus the demand from bond investors. The net supply of domestic long-term bonds follow AR(1) process:

$$s_{t+1}^y = \bar{s}^y + \phi_{s^y}(s_t^y - \bar{s}^y) + \varepsilon_{s_{t+1}^y}, \tag{12}$$

where $\bar{s}^y > 0$, $\phi_{s^y} \in [0,1)$, $\varepsilon_{s^y_{t+1}} = \eta_{t+1} + \eta^\star_{t+1}$, $\text{var}_t[\varepsilon_{s^y_{t+1}}] = \sigma^2_\eta + \sigma^2_{\eta^\star} \geq 0$. We distinguish here between demand shocks coming from local investors, η_{t+1}, and global investors, $\eta^\star_{t+1}$, and we allow them to have different stochastic properties.

Let the net supply of home currency in the spot market (that is, net of the demand from local and global investors), denominated in units of domestic currency, follow a stochastic process such that

$$s^x_{t+1} = \phi_{s^q} s^x_t + \varepsilon_{s^x_{t+1}}, \tag{13}$$

where $\phi_{s^q} \in [0,1)$, $\varepsilon_{s^x_{t+1}} = \gamma_{t+1} + \gamma^\star_{t+1}$, and $\text{var}_t[\varepsilon_{s^x_{t+1}}] = \sigma^2_\gamma + \sigma^2_{\gamma^\star} \geq 0$, distinguishing between demand shocks coming from local investors, γ_{t+1}, and global investors, $\gamma^\star_{t+1}$.

Without loss of generality, we assume throughout that:

$$\phi_{s^y} = \phi_{s^q} \in [0,1); \qquad \sigma^2_\eta = \sigma^2_\gamma \geq 0; \qquad \sigma^2_{\eta^\star} = \sigma^2_{\gamma^\star} \geq 0. \tag{14}$$

Departing from the framework of Greenwood et al. (2023), and in line with the evidence of Section 1, we assume that any purchase of domestic long-term bonds $\eta^\star_{t+1}$ by foreign bond investors is accompanied by a simultaneous purchase of home currency in the spot market $\gamma^\star_{t+1}$—of same local-currency amount, that is $\eta^\star_{t+1}$. That is:

$$\text{cov}_t(\eta^\star_{t+1}, \gamma^\star_{t+1}) = \sigma^2_{\eta^\star} = \sigma^2_{\gamma^\star} \geq 0; \qquad \text{corr}_t(\eta^\star_{t+1}, \gamma^\star_{t+1}) = 1. \tag{15}$$

This correlation arises naturally, as we argued in Section 1, as global investors intending to purchase domestic long-term bonds must inevitably acquire a corresponding amount of the home currency.

To the contrary, bond and currency demand of *domestic* investors are uncorrelated:

$$\text{cov}_t(\eta_{t+1}, \gamma_{t+1}) = 0; \qquad \text{corr}_t(\eta_{t+1}, \gamma_{t+1}) = 0. \tag{16}$$

Currency hedging We assume that a constant fraction $\alpha \in [0,1]$ of global investor bond purchases are hedged via forward contracts. Specifically, global investors always purchase the full amount of domestic currency in the spot market to acquire local-currency bonds, and hedge a share α of this exposure by selling domestic currency in the forward market.

Let the net supply of home currency in the forward market (net of the demand from global investors), denominated in units of domestic currency, follow

$$s^f_{t+1} = \phi_{s^q} s^f_t + \varepsilon_{s^f_{t+1}} \tag{17}$$

where $\varepsilon_{s^f_{t+1}} = -\alpha\gamma^\star_{t+1}$ and thus $\text{var}_t[\varepsilon_{s^f_{t+1}}] = \alpha^2\sigma^2_{\gamma^\star}$. Intermediaries absorb flows both in the

spot and forward FX markets. Taken together, the overall net supply of home currency (net of the demand from local and global investors), denominated in units of domestic currency, is

$$s^q_{t+1} = s^x_{t+1} + s^f_{t+1} = \phi_{s^q} s^q_t + \varepsilon^q_{t+1} \tag{18}$$

where $\varepsilon^q_{t+1} = \gamma_{t+1} + (1-\alpha)\gamma^\star_{t+1}$, and $\text{var}_t[\varepsilon_{s^q_{t+1}}] = \sigma^2_\gamma + (1-\alpha)^2\sigma^2_{\gamma^\star}$.

Market clearing The market clearing condition is:

$$\mathbf{s}_t = \mathbf{d}_t, \tag{19}$$

where $\mathbf{s}_t = [s^y_t, s^q_t]'$ denote a vector of net supplies.

Correlated exposure As a result, the correlation in intermediaries cross-market risk exposure is:

$$\Omega \equiv \text{corr}_t(d^y_t, d^q_t) = \frac{\text{cov}_t[s^y_t, s^q_t]}{\sqrt{\text{var}_t(s^y_t)}\sqrt{\text{var}_t(s^q_t)}} = \frac{(1-\alpha)\sigma^2_{\eta^\star}}{\sqrt{(\sigma^2_\eta + \sigma^2_{\eta^\star})}\sqrt{(\sigma^2_\eta + (1-\alpha)^2\sigma^2_{\eta^\star})}}, \tag{20}$$

which can be derived from equations (12)-(19).

The cross-market correlation in global investors' flows generates correlation of net supply across bond and foreign exchange markets in proportion to the relative importance of global flows in domestic bond and foreign exchange markets. Equation (20) highlights two key implications of our model. First, the relative importance of global investors in local-currency bond markets can be measured in terms of their relative volatility. When global investors play a relatively greater role in overall flow volatility, the cross-market correlation in flows is higher. Second, the amount of hedging done by global investors shapes the dynamics of this correlation. The comovement in net supplies is strongest when foreign investors do not hedge their FX positions ($\alpha = 0$). Conversely, when $\alpha = 1$, global investor bond purchases are fully hedged and impose no effective FX pressure, resulting in zero cross-market exposure.

Equilibrium Equilibrium expected excess returns must satisfy the intermediaries' optimality condition (11) as well as the market clearing condition (19), implying:

$$\text{E}_t[\mathbf{rx}_{t+1}] = \tau^{-1}\,\text{var}_t[\mathbf{rx}_{t+1}]\mathbf{s}_t. \tag{21}$$

To pin down equilibrium bond yields and exchange rates, y_t and q_t, we follow Greenwood et al. (2023) and conjecture that prices are linear functions of the state vector $\mathbf{z}_t$, which contains all stochastic processes, $\mathbf{z}_t = [i_t - \bar{\iota}, i^\star_t - \bar{\iota}, g_t, q_{t+\infty}, s^y_t - \bar{s}^y, s^q_t]'$. Appendix A.3 contains the full

mathematical solution, provides a characterization of equilibrium bond yield and exchange rate, as well as a discussion on equilibrium multiplicity and selection.

3 Global investors' flows and local intermediaries positions

The model implies tight predictions on the positions of different types of investors and asset returns. Section 3.1 studies position and price dynamics during a period of global investor inflows into the Colombian local-currency sovereign bond market. Among several findings, this episode supports the view that local intermediaries—at least in Colombia—absorb imbalances across both markets. To further substantiate this interpretation, Section 3.2 analyzes the positions and returns of local intermediaries and shows that they can indeed be regarded as the players responsible for enforcing no-arbitrage.

Some of the analytical results we present are derived under a simplified setting in which interest rate shocks are absent and global investors do not hedge currency risk ($\alpha = 0$). Specifically, we focus on the following special case of the model:

Assumption 1. *Short-term interest rates are deterministic ($\sigma_i = 0$), global investors do not hedge currency risk ($\alpha = 0$), asset-specific shocks are transitory ($\phi_g = 0$) and share the same volatility ($\sigma_g = \sigma_q$), and net-supply shocks are transitory ($\phi_{s_y} = \phi_{s_q} = 0$). In addition, long-term bonds are assumed to have near-infinite duration ($\delta \to 1$), and agents are sufficiently risk-tolerant (i.e., τ is large enough).*

3.1 The effects of global investors' bond purchases

We characterize the model-implied effects of a sudden increase in global investors' bond purchases.

Proposition 1. *Under Assumption 1, a global investors' purchase of local-currency denominated long-term bonds causes*

(a) a simultaneous acquisition of domestic currency and domestic bonds by global investors;

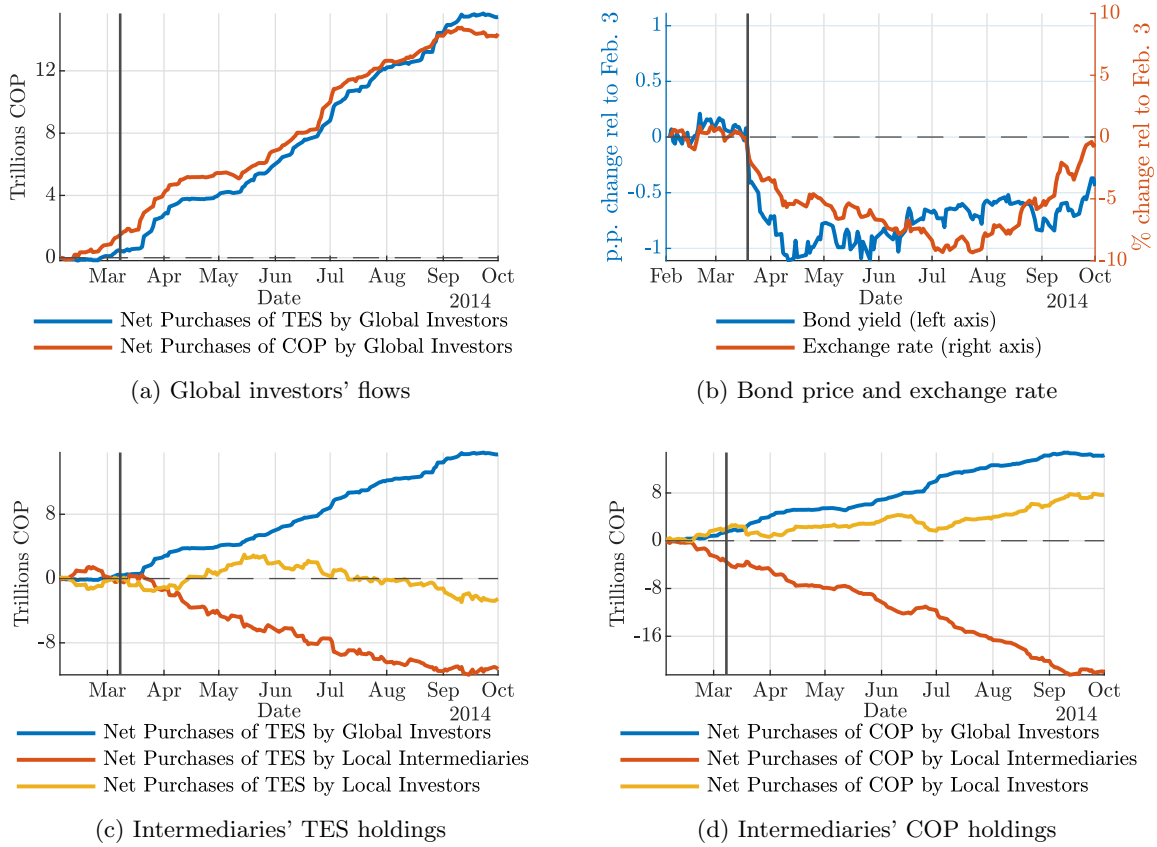
(b) a decline in local intermediaries' exposure to home bond and currency risk;

(c) a decline in long-term bond yields and home currency appreciation.

Proof. See Appendix A.4. □

This proposition captures a key mechanism in the paper. When global investors buy local-currency bonds, they exchange short-term dollars for long-term pesos: they obtain

Figure 2
Positions and prices during J.P. Morgan Index Rebalancing



(a) Global investors' flows

(b) Bond price and exchange rate

(c) Intermediaries' TES holdings

(d) Intermediaries' COP holdings

Note: Figure 2a displays the evolution of the daily accumulated foreign purchases of TES bonds as well as with the daily accumulated foreign purchases of COP in the spot market during 2014. Figure 2c and Figure 2d display the evolution of the daily accumulated purchases of TES bonds and COP in the spot market, respectively, during 2014 for different investor groups (described in Section 1 and Section 3). The black vertical line denotes March 19, 2014, the day the rebalancing was announced.

short-term pesos and immediately use them to purchase long-term peso bonds. As local intermediaries sell these bonds for dollars, their exposures to both bond risk (the yield-curve trade) and currency risk (the UIP trade) fall. Consequently, they require a lower premium on long-term bonds relative to short-term bonds, and on pesos relative to dollars. In equilibrium, long-term bond yields fall and the home currency appreciates.

We test these predictions against a major episode of global investor inflows into Colombia's local-currency government bond market (TES). In March 2014, *J.P. Morgan* announced the inclusion of five TES bonds in its flagship emerging-market local-currency index. The announcement triggered large index-driven purchases: by the time inclusion was completed in October 2014, foreign investors had acquired nearly 10% of outstanding TES bonds.[9] These purchases were mirrored almost one-for-one by foreign acquisitions of Colombian pesos

[9] Williams (2018) uses Colombia's inclusion in *J.P. Morgan*'s emerging markets debt index to study how increased foreign access to sovereign debt markets boosts private credit availability.

(COP) in the spot FX market (Figure 2a). Consistent with Proposition 1, although the shock originates in the bond market, it simultaneously generates flows in the FX market because it is funded in dollars.

During this episode, local intermediaries largely absorbed the resulting imbalances in both the bond and spot exchange markets (Figure 2c, Figure 2d); a similar pattern appears when considering net spot purchases minus forward sales (Appendix Figure C.1). Thus, the global investor purchase significantly altered local intermediaries' exposure to bond and currency risk.

Price dynamics also align with the model. Figure 2b reveals that, following the announcement, long-term yields fell and the peso appreciated. This patterns are consistent with the notion that intermediaries required lower returns on both yield-curve and UIP trades as their exposures to these strategies' underlying risk has declined.

3.2 Local intermediaries: positions and returns

We now present evidence that the portfolios of local intermediaries exhibit correlated exposures to bond and currency risk. We also show that the patterns of these intermediaries' positions and portfolio returns suggest that they demand compensation for bearing bond and currency risks.

Correlated exposure of local intermediaries In the model, global investors generate correlated exposures on the balance sheets of local intermediaries.

Lemma 1. *As long as global investors participate in local-currency bond markets and that they do not hedge perfectly, local intermediaries feature correlated bond and currency exposures.*

Proof. It follows from equation (20). If $\sigma^2_{\eta^\star} > 0$ and $\alpha < 1$, then $\Omega > 0$. □

We now examine whether Colombian intermediaries exhibit a positive correlation between their holdings of long-term TES bonds and Colombian pesos (COP). For the group of local intermediaries, we compute holdings of TES and COP (based on FX spot purchases), both measured in domestic currency. TES holdings are taken directly as a share of total TES outstanding. COP holdings are constructed by taking total liquid assets in the financial system as of January 2013 (the start of our sample), accumulating monthly FX spot purchases, and normalizing by M1 money supply in Colombia.

Consider the following regression:

$$\text{COP}_t = \alpha + \beta \text{TES}_t + \varepsilon_t \tag{22}$$

Table 1
Portfolio positions of local intermediaries

	COP holdings	
	Monthly	Quarterly
TES holdings	2.239***	1.990**
	(0.720)	(0.806)
Correlation	0.45	0.40
Observations	95	32
R-Squared	0.20	0.16

Note: The table presents OLS estimates of regression (22) of COP holdings on TES holdings by local intermediaries. Driscoll-Kraay robust standard errors are reported in parenthesis. *, **, and *** denote statistically significant at the 10%, 5%, and 1% level, respectively.

where COP_t and TES_t are spot and bond holdings by local intermediaries. We perform this regression at both monthly and quarterly frequencies and report the estimated coefficients in Table 1.

The estimates indicate a positive relationship, with a correlation around 0.4. Interestingly, this estimate closely matches our estimate of Ω for Colombia in Section 4.3, computed using local-currency bond holdings and global investors' hedge ratios (for a number of countries). Overall, the results support the view that correlated exposures are a salient feature of intermediary portfolios.

Positions and returns A key feature of intermediaries—the agents that enforce no-arbitrage—in models with frictional financial intermediation is that their exposures are systematically linked to the corresponding expected returns. The following proposition illustrates how this principle operates in our model.

Proposition 2. *Under Assumption 1, local intermediaries gain positive excess returns, on average, on both their bond and currency positions. That is,* $\mathbb{E}(d_t^y rx_{t+1}^y) \geq 0$ *and* $\mathbb{E}(d_t^q rx_{t+1}^q) \geq 0$*, where* $\mathbb{E}$ *is the unconditional expectation operator.*

Proof. See Appendix A.4. □

We test whether local intermediaries earn positive excess returns in both markets by constructing monthly-level trade returns for different investor groups. Specifically, the UIP trade returns are computed as:

$$\text{UIP Trade Returns}_{t,h}^j = X_t^{\text{Curr},j} \times rx_{t+h}^q, \qquad h = 1, 3, 6, 12, \tag{23}$$

Table 2
UIP and Yield-Curve Trade Returns

	UIP Trade Returns				Yield-Curve Trade Returns			
	1M	3M	6M	12M	1M	3M	6M	12M
Intermediaries	3.4	15.3**	38.8***	74.4***	4.5	13.2**	18.6***	24.9***
	(2.4)	(7.0)	(11.8)	(21.6)	(5.2)	(6.1)	(7.0)	(8.2)
Global Investors	0.9	−5.3	−19.9*	−46.4**	−0.4	−1.8	−3.8	−9.8***
	(2.3)	(5.0)	(10.2)	(17.7)	(1.8)	(2.0)	(2.7)	(3.6)
Local Investors	−4.3**	−10.0**	−19.0***	−28.0**	−4.1	−11.4**	−14.8**	−15.1*
	(2.0)	(4.7)	(6.9)	(13.5)	(4.4)	(5.5)	(6.1)	(7.7)
Observations	83	81	78	72	120	120	120	120

Note: This table reports results from mean t-Tests of UIP trade and yield-curve trade returns for different investor groups. UIP trade returns are computed following equation (23) and yield-curve trade returns are computed using equation (24). The 1M, 3M, 6M, and 12M columns denote test for average returns with holding periods of 1, 3, 6, and 12-month, respectively. The null hypothesis is that average returns are equal to zero. *, **, and *** denote statistically significant at the 10%, 5%, and 1% level, respectively.

where $X_t^{\text{Curr},j}$ is the flow of investor j associated with selling USD to buy COP (measured in USD), and rx_{t+h}^q denotes currency returns over a holding period of h months (Section 4).

Yield-curve trade returns are computed as:

$$\text{Yield-Curve Trade Returns}_{t,h}^j = X_t^{\text{Bond},j} \times rx_{t+h}^{(n)}, \qquad h = 1, 3, 6, 12, \tag{24}$$

where $X_t^{\text{Bond},j}$ is the flow of investor j into long-term domestic government bonds, and $rx_{t+h}^{(n)}$ denotes the corresponding bond returns. For simplicity, we use the 10-year local-currency bond and measure returns in domestic currency.

We consider three investor groups: local intermediaries, foreign investors, and local investors (that is local financial market participants other than local intermediaries). After calculating trade returns for each holding period, we perform mean t-tests to assess whether the returns are significantly different from zero.

Table 2 reveals that UIP and yield-curve trade returns are positive for local intermediaries and negative for both global and local investors. Returns are noisier for 1- and 3-month horizons, but all average returns are statistically significant for 6- and 12-month holding periods. These findings support the model's implication in Proposition 2 and suggests that local intermediaries—both primary dealers and FX market intermediaries—act as the agents enforcing no-arbitrage.[10]

[10]Other studies that highlight the role of local banks in financial intermediation and asset pricing include di Giovanni et al. (2021); Gutierrez et al. (2023); Keller (2024); De Leo et al. (2024b); Fendoglu et al. (2019); Gonzalez et al. (2021).

4 Implications for bond yields and exchange rates

We now draw the implications of the mechanism for the equilibrium relationship between bond yields and exchange rate. Our main object of interest is the correlation between excess bond returns and excess currency returns.

4.1 Equilibrium bond and currency returns

In the simplified version of the model, one can draw a tight connection between the presence of unhedged global investor flows and the correlation in bond and currency returns.

Proposition 3. *Under Assumption 1,* $\text{corr}_t(rx^y_{t+1}, rx^q_{t+1}) > 0$ *if and only if* $\Omega > 0$.

Proof. See Appendix A.4. □

Proposition 3 demonstrates that, absent interest rate risk, the correlation between excess bond and foreign exchange returns is positive whenever global investors operate in the local-currency bond market, and thus risk exposures are positively correlated. Without interest rate shocks, the fundamental sources of risk are asset-specific *independent* shocks (fluctuations in the bond return wedge and long-run nominal exchange rate). If net supply fluctuations were independent, bond and FX premia would also be uncorrelated. However, when net supplies are correlated, as it is the case in the presence of global investors, their comovement is reflected in the joint distribution of premia.[11]

Correlated exposures thus beget correlated returns as they directly link the net supply in bond and currency markets that local intermediaries must absorb, and, as a result, the premia they require. This effect emerges even in models where intermediaries managing bonds and currency are distinct entities.

We now turn to examine the determinants of the bond-currency return comovement in a version of the baseline model that is calibrated to Colombia, and that accounts for short-term interest rate risk.

Calibration Our calibration approach does not target directly the empirical comovement in excess bond and currency returns. Instead, it relies on the time series properties of short-term interest rates as well as net supply volumes, the standard deviations of excess bond returns and excess currency returns. The model is calibrated on Colombian data at a quarterly

[11] Interestingly, Gabaix and Maggiori's (2015) model illustrates how capital flows into emerging market *short-term* local-currency bond markets can cause currency appreciations. We argue that these capital inflows occur primarily in the *long-term* local-currency bond markets, not only changing the net supply of different currencies, but also changing the net supply of local-currency bonds of different maturities.

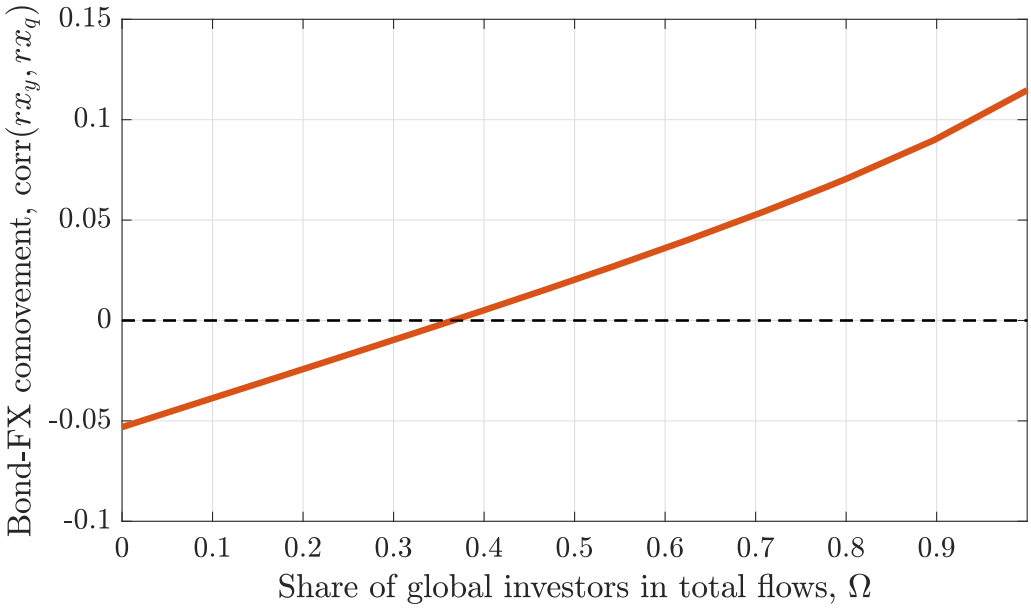
frequency. Table A.1 reports the values of the baseline parameters. To discipline the processes of short-term interest rates (ϕ_i, σ_i, ρ), we use 3-month interbank rates from Colombia and the United States. To discipline the persistence of the net supply shocks ($\phi_{s^y} = \phi_{s^q}$), we use Colombian transaction-level data in bond and FX markets. We compute the quarterly positions of local intermediaries in both markets, as well as their fluctuations stemming from local and global investors. The TES (COP) holdings are computed as a fraction of the total value of TES outstanding bonds (M1 money aggregate). Following simplifying assumption (14), we calibrate the parameters of the net supply processes as symmetric across markets, which represents a reasonable approximation of the properties of the data. We set the risk aversion of local intermediaries ($1/\tau$) to 0.03, in line with the range of values chosen by Gourinchas et al. (2022). We calibrate the unobservable asset-specific shocks (σ_g, σ_q) to match the standard deviation of excess 10-year Colombian bond returns and excess currency returns.

In this baseline calibration we set the (currency-risk) hedge ratio, α, to 0. We argue that this is a valid approximation of the data. Appendix Figure C.2 documents that there is no consistent relationship between global investors net purchases of COP in the spot market and their net sales of COP in the forward market. This indicates that global investors do not systematically hedge their Colombian bond positions.

Quantifying the role of correlated exposures [To be written up]

Global investors, bond yields, and exchange rates Using the calibrated model, Figure 3 depicts the correlation between excess bond and currency returns, for different composition of investors' flows (achieved through different relative volatility of foreign to domestic investors, for a given level of overall volatility of bond flows). Two key insights emerge. First, the correlation in excess bond and currency returns increases with the relevance of global investors, governed by Ω, echoing Proposition 3. A higher variance of global investors' flows (for a given total variance of flows) increases the correlation in bond and currency net supply movements and thus the correlation of bond and currency returns. Second, absent correlated flows ($\Omega = 0$), the correlation in excess returns is negative, as the only source of correlated risk are short-term interest rates shocks, echoing Greenwood et al. (2023) and Gourinchas et al. (2022). Interest rate risk, in fact, affects the yield-curve trade and the UIP trade in opposite directions. An increase in domestic short-term rates results in lower domestic long-term bond prices, which is detrimental to the yield-curve trade, but it simultaneously

Figure 3
Correlation in Bond and Currency Excess Returns



Note: The figure depicts the equilibrium correlation in bond and currency excess returns for different levels of correlation in net supplies, $\Omega \equiv \text{corr}_t(s^y_{t+1}, s^q_{t+1})$ (achieved by different relative importance of foreign to home standard deviations of supply shocks, see eq. (20)). Table A.1 reports the baseline calibration.

appreciates the domestic currency, benefiting the UIP trade.[12]

4.2 Bond and currency returns across countries

We now turn to the implications of this mechanism for the behavior of asset prices across countries. To this end, we construct a measure that captures the extent to which a country is exposed to unhedged global investor flows, and study whether cross-country differences in this measure are associated with differences in the joint behavior of bond yields and exchange rates.

We begin by extending the analysis of bond and currency returns in Lustig et al. (2019) to a larger panel of economies. We document that there is substantial amount of heterogeneity in correlation between excess bond returns and excess currency returns across countries.

Definitions We denote $P_t^{(n)}$ as the price of a zero-coupon bond of maturity n in local-currency terms at time t, with the continuously compounding yield on this bond given by $y_t^{(n)} = -\frac{1}{n} \log P_t^{(n)}$. The short-term risk-free rate r_t^f is the yield on a one-period bond.

The local-currency bond excess return on the domestic zero-coupon bond in local currency

[12]Short-rate risk only influences the correlation in returns if short-rate fluctuations are not perfectly correlated across countries. Correlated short-rate fluctuations limit the variation in the short-rate *differential*, thereby reducing the impact of interest rate risk on the UIP trade.

$rx_{t+1}^{(n)}$ is defined as:

$$rx_{t+1}^{(n)} = -(n-1)y_{t+1}^{(n-1)} + ny_t^{(n)} - r_t^f.$$

It represents the excess return on the "yield-curve trade"—the trade that borrows short-term and lends long-term in domestic currency. More precisely, the return from holding a long-term bond for one period, financed by borrowing at the short-term rate in domestic currency.

We use Q_t to denote the nominal spot exchange rate in terms of domestic currency per U.S. dollar, where $\Delta q_{t+1} = \log\left(Q_{t+1}/Q_t\right)$ represents the rate of domestic currency depreciation.

The excess return on home currency, rx_{t+1}^q, is

$$rx_{t+1}^q = r_t^f - r_t^{f,US} - \Delta q_{t+1}.$$

It represents the return on the "UIP trade"—the trade that borrows short-term in foreign currency and lends short-term in domestic currency.

Data We select all economies with bond benchmark indexes on *Datastream*. We use monthly data from January 2006 to December 2021.[13] The dataset includes spot exchange rates, 10-year government bond total return indexes, and 3-month deposit rates.[14] Our sample includes Australia, Canada, Colombia, the Eurozone, India, Indonesia, Japan, Mexico, New Zealand, Poland, South Africa, South Korea, Sweden, Switzerland, Thailand, and the United Kingdom.

Analysis Consider the following country-specific regressions:

$$rx_{j,t+3}^q = \alpha + \beta rx_{j,t+3}^{(10y)} + \epsilon_{j,t+1} \tag{25}$$

Table 3 (Columns (1)-(2)) reports the estimated slope coefficients for a the panel of countries described above. There is vast heterogeneity across countries in the comovment between bond and currency returns. Both regression and correlation coefficients are either significantly negative, significantly positive, or statistically insignificant. These conclusions apply also when using 1-month excess returns (see Appendix Table B.1).

We provide evidence that rules out time-varying default risk as an explanation for the positive association between bond and currency excess returns. We proxy for default risk using probabilities of default on 10-year sovereign bonds from *Refinitiv*. We residualize both bond and currency excess returns by controlling for contemporaneous and lagged default

[13] While some countries' sample starts in December 1999, the data is sparse before 2006, and thus we start our analysis in 2006. We exclude data beyond December 2021 to avoid incorporating recent inflation dynamics.
[14] Long maturity bond return data from *Datastream* may pertain to coupon government bonds.

Table 3
Bond and currency excess returns (3-month excess returns)

			Residualized excess returns	
Country	Regression coefficient	Correlation	Regression coefficient	Correlation
Australia	-0.88^{***}	-0.47	-0.68^{***}	-0.41
	(0.17)	$[-0.57, -0.35]$	(0.18)	$[-0.54, -0.26]$
Canada	-0.69^{***}	-0.44	-0.74^{***}	-0.51
	(0.11)	$[-0.55, -0.32]$	(0.13)	$[-0.62, -0.38]$
Colombia	0.13^{**}	0.14	0.18^{***}	0.12
	(0.06)	$[0.00, 0.28]$	(0.07)	$[-0.04, 0.28]$
India	0.02	0.02	0.07	-0.01
	(0.13)	$[-0.13, 0.17]$	(0.12)	$[-0.18, 0.16]$
Indonesia	0.56^{***}	0.62	0.57^{***}	0.21
	(0.08)	$[0.49, 0.72]$	(0.10)	$[0.02, 0.39]$
Japan	1.37^{***}	0.35	1.12^{***}	0.29
	(0.30)	$[0.21, 0.47]$	(0.38)	$[0.13, 0.43]$
Korea	-0.06	-0.04	-0.15	-0.02
	(0.16)	$[-0.22, 0.14]$	(0.18)	$[-0.21, 0.18]$
Mexico	0.29^{**}	0.20	0.36^{***}	0.17
	(0.11)	$[0.03, 0.35]$	(0.12)	$[-0.02, 0.34]$
New Zealand	-0.61^{***}	-0.34	-0.45^{**}	-0.27
	(0.16)	$[-0.46, -0.21]$	(0.18)	$[-0.42, -0.11]$
Poland	0.09	0.04	-0.01	0.11
	(0.14)	$[-0.10, 0.18]$	(0.13)	$[-0.06, 0.27]$
South Africa	0.61^{***}	0.30	0.74^{***}	0.24
	(0.16)	$[0.16, 0.42]$	(0.20)	$[0.07, 0.39]$
Sweden	-1.01^{***}	-0.53	-0.98^{***}	-0.55
	(0.14)	$[-0.63, -0.42]$	(0.14)	$[-0.66, -0.43]$
Switzerland	-0.31^{*}	-0.16	-0.23	-0.12
	(0.17)	$[-0.30, -0.02]$	(0.18)	$[-0.28, 0.04]$
Thailand	0.51^{**}	0.31	0.51^{**}	0.20
	(0.21)	$[0.00, 0.56]$	(0.21)	$[-0.11, 0.47]$
United Kingdom	-0.69^{***}	-0.45	-0.74^{***}	-0.51
	(0.12)	$[-0.56, -0.33]$	(0.15)	$[-0.63, -0.38]$

Note: Column (1) reports the estimated slope coefficient of regression equation (25). Column (2) reports the correlation between $rx^{q}_{j,t+3}$ and $rx^{(10y)}_{j,t+3}$. Columns (3)-(4) repeat the analysis using the excess returns residualized by current and lag probability of default in the 10-year sovereign bonds (as retrieved from *Refinitiv*), that is: $rx^{m}_{j,t+3} = \sum_{k=0}^{1} \phi_k (\text{Prob. default})_{j,t-k} + \epsilon^{rx^m}_{j,t+3}$, where $m = \{10y, q\}$. Stars denote significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Values in parenthesis are standard errors, and values in square brackets are 95 percent confidence interval.

probabilities, and then regress residualized excess currency returns ($\epsilon^{rx^q}_{j,t+1}$) on residualized excess bond returns ($\epsilon^{rx^y}_{j,t+1}$). Table 3 (Columns (3)–(4)) shows that the residualized returns exhibit comovement patterns very similar to those observed in the raw data (Columns (1)–(2)).

4.3 The importance of correlated flows across countries

We construct an empirical measure of correlated exposure, Ω in equation (20), for each economy in our sample.

We compute $\sigma_{\eta^\star}$ and σ_η as the standard deviations of the shares of foreign and non-bank domestic investors, respectively, in local-currency government debt securities. These measures are based on data on investor holding shares of sovereign debt for our sample economies from Arslanalp and Tsuda (2014) and Arslanalp and Tsuda (2012). In doing so, we assume that the total outstanding amount of local-currency bonds is constant. This assumption allows us to use investor holding shares, rather than levels, to construct estimates of $\sigma_{\eta^\star}$ and σ_η.[15] We identify domestic banks as the relevant "local intermediaries," a choice that finds empirical support in the analysis of Colombia's long-term bond and currency markets in Section 3.

To measure hedging shares, α, we rely on estimates from the existing literature. For advanced economies, we use hedge ratios for global fixed-income investors from Cheema-Fox and Greenwood (2024). For emerging economies, we use the estimates of hedge ratios for US mutual funds from Chen and Zhou (2025). Although these data for emerging economies are based solely on US mutual funds, we assume that they are representative of the hedging behavior of the broader population of global investors.[16]

Table 4 reports the estimated values of Ω, together with $\sigma_{\eta^\star}$, σ_η, and α, for each country in the sample. We observe substantial cross-country heterogeneity: Ω ranges from close to zero in the United Kingdom to roughly 80 percent in Indonesia. These differences reflect variation across countries in the relative importance of global versus local investor flows, as well as differences in global investors' currency-hedging behavior.

4.4 Correlated flow risk, bond and currency returns

Do countries with more correlated exposure exhibit a higher (i.e., more positive) correlation between bond and currency returns? Figure 4 shows that countries with higher Ω also display, on average, stronger comovement between bond and currency returns. Although our empirical measure of Ω is admittedly simple, we view this evidence as indicative of a meaningful relationship between the relative importance of unhedged foreign flows in total flow volatility and the comovement of bond and currency returns. In Appendix Figure B.3,

[15] Non-bank domestic investors exclude domestic bank and central bank holdings. For emerging economies, we construct these shares using the share of non-bank domestic investors in total sovereign debt, as data disaggregated by currency denomination are not available.

[16] Appendix B.1 shows that international mutual funds are the main global investor type in Colombia's local currency government bond market.

Table 4
Measure of correlated exposure across countries

Country	Corr. Exp. Ω	Global Inv. (s.d., %)	Local Inv. (s.d., %)	Hedge Ratio α
Australia	0.09	6.24	9.45	0.75
Canada	0.08	3.39	5.32	0.76
Colombia	0.46	8.29	8.72	0.05
India	0.09	1.16	4.00	−0.20
Indonesia	0.81	9.27	4.63	−0.09
Japan	0.03	2.70	9.87	0.56
Korea	0.14	4.07	11.56	−0.33
Mexico	0.70	12.21	8.88	−0.24
New Zealand	0.20	8.59	8.03	0.74
Poland	0.59	8.44	8.14	−0.38
South Africa	0.70	10.62	6.70	0.09
Sweden	0.04	7.94	9.99	0.91
Switzerland	0.12	7.54	9.47	0.75
Thailand	0.63	4.52	3.97	−0.36
UK	0.001	2.10	20.41	0.93

Note: Column 1 computes our estimated measure of overall correlation in net supplies, given in eq. (20). The table also contains the standard deviation in the share of local-currency sovereign debt securities by foreigners (column 2) and domestic non-bank investors (column 3) using data from Arslanalp and Tsuda (2012, 2014). Column 4 computes the hedging ratio for each country, following Cheema-Fox and Greenwood (2024) for advanced economies, and Chen and Zhou (2025) for emerging economies.

we reproduce Figure 4 while alternatively holding hedge ratios and relative volatilities fixed at their median values across countries, and show that both factors independently contribute to cross-country variation in bond–currency return comovement.[17]

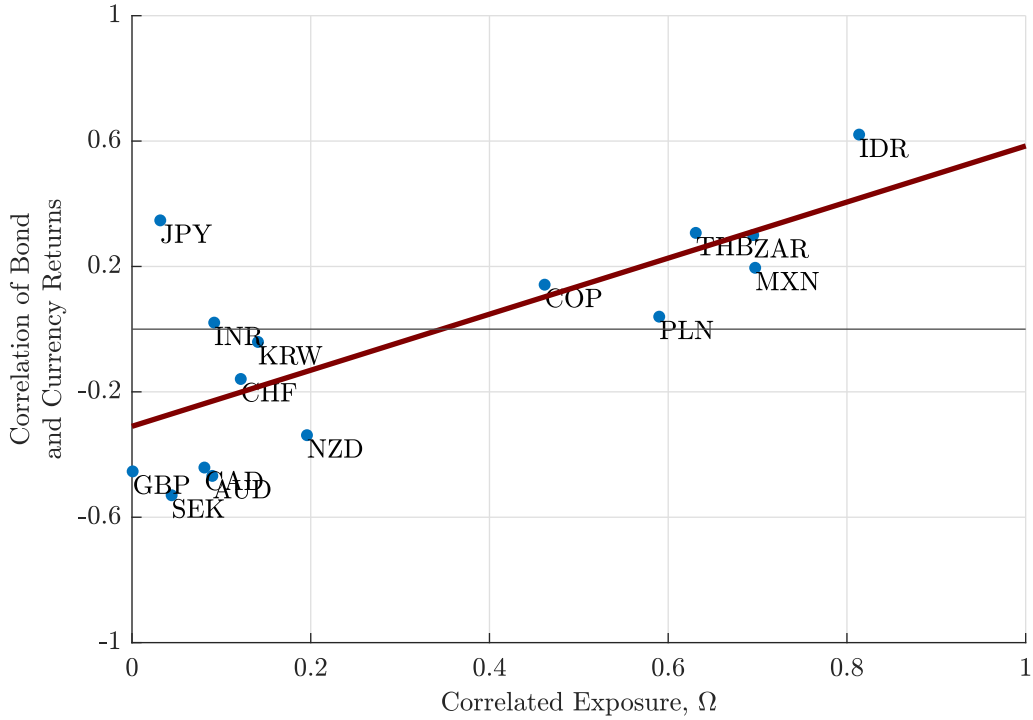
Advanced vs. emerging economies Figure 4 reveals a clear distinction between advanced and emerging economies. With a few notable exceptions, emerging economies exhibit both high correlated exposure and positive comovement between bond and currency returns. As shown in Table 4, the large correlated exposure of emerging economies can be attributed to the prominent role of global investors and their limited use of currency hedging.

Systematic differences in hedge ratios between emerging and advanced economies are not surprising. Foreign investors are typically attracted to emerging markets by substantially higher interest rate differentials relative to advanced economies. Hedging currency risk in such environments is costly, as it effectively requires giving up the interest rate differential when covered interest parity approximately holds.[18] In addition, many emerging economies—both

[17] As Chen and Zhou (2025) emphasize, hedge ratios of US mutual funds investing in emerging economies are often negative. In Appendix Figure B.2, we recompute Ω by truncating the distribution of hedge ratios so that $\alpha \geq 0$. The conclusions remain unchanged.

[18] This consideration has led many investment advisors, such as Meketa Investment Group (2022), to recommend avoiding currency hedging for emerging market investments, while viewing hedging as more appropriate for advanced economies.

Figure 4
Correlated Exposure and Bond-Yield Comovement



Note: This figure displays the correlation of bond and currency excess returns (y-axis) and the Ω from eq. (20) (x-axis).

sovereigns and corporates—issue debt in US dollars, providing an alternative to investing in local-currency assets that require costly currency hedging. This feature may further contribute to the observed differences in hedging behavior across the two groups of countries.[19]

5 Effects of asset purchases on bond yields and exchange rates

The portfolio–balance model described above yields clear predictions regarding the effects of asset purchases, such as quantitative easing (QE) and foreign exchange interventions (FXI). The following proposition formalizes these predictions.

Proposition 4.

(a) A domestic central bank's purchase of foreign currency, modeled as an increase in γ_t in equation (18), causes a home currency depreciation and a decrease in the price of long-term bonds if and only if $\text{cov}_t(rx^y_{t+1}, rx^q_{t+1}) > 0$.

(b) A domestic central bank's purchase of local-currency long-term bonds, modeled as a reduction in η_t in equation (12), causes an increase in the price of long-term bonds and

[19] De Leo et al. (2024b) argue that foreign investors oriented toward emerging economies primarily use the forward market for currency speculation rather than for hedging purposes.

home currency appreciation if and only if $\text{cov}_t(rx^y_{t+1}, rx^q_{t+1}) > 0$.

Proof. See Appendix A.4. □

Proposition 4 characterizes the effects of asset purchase policies that are confined to a single market on both bond yields and exchange rates. It shows that FXI—interventions in the FX market—can influence the price of long-term bonds, while QE—purchases of long-term bonds—can affect the exchange rate. These cross-market effects arise from two central features of our small open economy framework.

First, local intermediaries simultaneously intermediate positions in both the bond and currency markets, which display correlated risks. As a result, a shift in the net supply of one asset alters their exposure to both risks, and thus induces changes in required bond and currency premia. Second, the magnitude and direction of these effects depend on the stochastic properties of bond yields and exchange rates, embodied in the covariance of excess returns. As discussed in Section 4.1, this covariance reflects the relative strength of unhedged global investor flow shocks versus short-term interest rate shocks.

In economies where unhedged global investor flows are dominant, the risks associated with the UIP trade and the yield-curve trade are positively correlated. In such settings, a central bank purchase of foreign currency (FXI) increases intermediaries' exposure to domestic yield curve risk, thus lowering the equilibrium price of long-term domestic bonds. Analogously, a central bank purchase of domestic bonds (QE) reduces intermediaries' exposure to currency risk, leading to an appreciation of the domestic currency.

Taken together, when foreign investors play a significant role in local-currency bond markets, FXI tends to raise the price of long-term bonds, while QE tends to appreciate the exchange rate. Crucially, these cross-asset spillovers arise even though each policy targets only one market at a time.[20,21]

We now turn to examine how these predictions hold up in the data.

Central bank U.S. dollar auctions (FXI) We present empirical evidence that sterilized foreign exchange interventions have significant effects on both the exchange rate and long-

[20] Formally, QE in our model should be interpreted as a central bank bond purchase carried out under the full variance-covariance structure implied by all exogenous processes, rather than as the effect of a bond purchase in a counterfactual setting where asset purchases are the sole source of variation (and analogously for FXI).

[21] Using high-frequency identification, Rebucci et al. (2022) show that QE—central bank purchases of long-term government bonds—appreciated currencies in emerging market economies during COVID-19 (see also Arslan et al., 2020 and Toraman, 2025), in contrast to advanced economies where QE typically leads to depreciation (Bauer and Neely, 2014; Neely, 2015; Swanson, 2021; Bhattarai and Neely, 2022). Differences in the covariance structure of bond yields and exchange rates can explain this different responses (see Proposition 4(b)).

Table 5
U.S. Dollar Auctions: Summary Statistics

	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Cutoff price[(a)]	1,885	93.9	1,756	1,804	1,882	1,932	2,372
Ask price std. dev.	0.59	0.49	0.07	0.30	0.46	0.66	4.14
Ask price range	1.71	1.40	0.10	0.90	1.30	2.00	9.18
Announced demand[(b)]	23.2	10.1	10.0	15.0	20.1	31.9	50.0
Total offered	47.5	21.9	5.0	29.5	46.0	61.0	135.5
Total purchased	23.1	10.0	5.0	15.0	20.1	30.5	50.0
Number of bidders	8.14	2.58	2	6	8	10	15
Number of winners	4.91	2.10	1	3	5	6	11
Number of losers	3.23	2.20	0	2	3	5	10

Note: This table presents summary statistics for all 641 auctions in our sample. Ask price range is the difference between the highest and the lowest ask price submitted by bidders in each auction. Announced demand is the maximum amount of USD that the CBC announces it will purchase at each auction. [(a)]Prices are measured in COP/USD. [(b)]Amounts are measured in million USD.

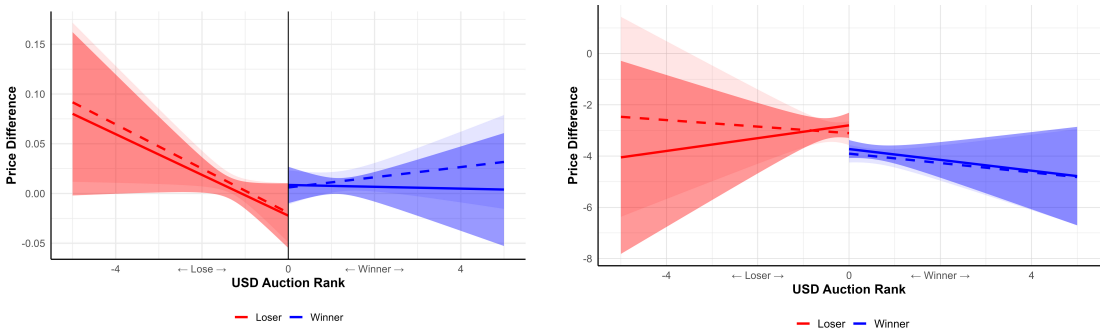
term bond prices.[22] We test Proposition 4(a) using proprietary data from 651 multiunit uniform price auctions conducted daily in Colombia between June 2008 and December 2014. The auction mechanics were as follows: prior to each auction, the central bank announced the maximum amount of U.S. dollars to be purchased. Each auction lasted three minutes, during which participants could submit and revise their bids, specifying both an ask price in COP/USD and the total dollar amount offered. At the close of the auction, bids were ranked in ascending order by price. The central bank then accepted offers starting with the lowest ask price, purchasing sequentially until its pre-announced demand was fulfilled. The cutoff price (applied uniformly to all winning bids) was thus determined by the highest ask price among those from whom the central bank acquired a positive amount.

Descriptive statistics for the auctions are presented in Table 5. On average, each auction involved 8 participating financial institutions, primarily private banks (the list of authorized bidders is publicly available). The central bank purchased an average of USD 23 million per day, with amounts occasionally reaching up to USD 50 million. For context, during the same period, the total daily turnover in the Colombian COP/USD spot market was approximately USD 950 million, with an average individual transaction size of USD 0.785 million.

For identification, we exploit the inherent discontinuity generated by the auction's cutoff price to compare the behavior of marginal winners and marginal losers in their subsequent trading activity in both the bond and foreign exchange secondary markets. We argue that,

[22]Sterilized FXI are aimed at (i) accumulating international reserves, (ii) correcting short-term exchange rate misalignments, and (iii) reducing excessive exchange rate volatility.

Figure 5
Effects of FXI (U.S. Dollar Purchases) on Secondary Market Prices



(a) Exchange Rate (b) Long-term Bond Price

Note: This figure presents the results from estimating equation (26), with robust standard errors. The dotted line shows a linear fit weighted by the trading volume in the secondary market, corresponding to either spot FX transactions (left panel) or sovereign bond trades (right panel) conducted by each bank with foreign investors. Dependent variables are measured as a % deviation (log-difference) from the median spot price of the corresponding day. The bandwidth is selected optimally according to the procedure proposed by Calonico et al. (2014), and statistical significance is evaluated at the 5% level.

within a narrow window around the cutoff, the exchange rate becomes locally decoupled from broader macroeconomic and financial variables, thereby creating a localized quasi-experimental setting. This identification strategy relies on the assumption that bidders near the threshold (barely winners and barely losers) are ex-ante similar.

Formally, we estimate the following regression discontinuity design (RDD) centered around the auction cutoff price:

$$\arg\min_{\boldsymbol{\gamma}} \sum_{i=1}^{I} \left[y_i - \gamma_0 + \gamma_1 D_i + \gamma_2 (bid_i - c) + \gamma_3 (bid_i - c) \times D_i \right]^2 K\left(\frac{bid_i - c}{h} \right) \tag{26}$$

where y_i denotes either bond prices or USD prices in the secondary market, measured during the trading day immediately following the auction, but still within the same calendar day;[23] $(bid_i - c)$ is the standardized distance of bid i from the auction cutoff price c (positive for winners, negative for losers); $D_i = \mathbb{1}\{bid_i \geq c\}$ is a treatment indicator equal to one if bid i was accepted; and $K(\cdot)$ is a triangular kernel function with bandwidth h. The parameter of interest, γ_1, captures the local average treatment effect of winning the auction on subsequent market outcomes.

To illustrate, Appendix Figure C.3 displays a histogram of FX trades in the secondary spot market following the auction, distinguishing between auction winners and losers. As can be visually observed, the distribution of spot FX prices for winners is slightly shifted to the right, suggesting that they negotiated higher prices on average.

[23] The term secondary market refers to both the secondary market for government bonds and the spot foreign exchange market. To avoid issues related to unit scaling over time, we express each secondary market trade as a % deviation (log-difference) from the median spot price of the corresponding day.

More formally, the results from estimating equation (26) are presented numerically in Table C.1 and graphically in Figure 5, where panel (a) illustrates the effects on the spot exchange rate and panel (b) depicts the effects on bond prices, in line with the prediction in Proposition 4(a). As shown, central bank purchases of U.S. dollars lead to both a depreciation of the exchange rate and a decline in bond prices. Specifically, auction winners—dealers that sell USD to the central bank—subsequently trade FX at prices that are 0.031 % higher than those of auction losers (dummy coefficient in column 3 of Table C.1). This effect is economically meaningful, representing approximately 60% of the standard deviation of that variable (0.053%). Similarly, auction winners trade sovereign bonds at prices that are 1.15% lower than those of auction losers (dummy coefficient in column 1 of Table C.1), corresponding to about 40% of the standard deviation in bond prices (2.87%).

Quantitative easing [To be written up]

6 Conclusion

Local-currency government bond markets worldwide are populated by investors with different funding currencies. We show that investor composition shapes the distribution of flows that financial intermediaries must absorb—and, consequently, the premia they require—across both bond and currency markets. This simple mechanism helps explain the effects of global capital inflows into local-currency bond markets, the patterns of positions and returns across different investors, the transmission of central bank asset purchase policies, and cross-country differences in the joint dynamics of bond yields and exchange rates.[24]

[24] A natural extension would allow for heterogeneity in investor characteristics such as risk tolerance, portfolio elasticity, and investment horizons. Sovereign bonds are held by a diverse set of investors across countries (Fang et al., 2022; Zhou, 2024), and preferences over currency denomination may further segment investor demand (Faia et al., 2024).

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Appendix

A Model Appendix

A.1 Return of a Perpetuity: Campbell-Shiller Approximation

We use the Campbell and Shiller (1988) log-linear approximation to model the before-tax return on default-free long-term bonds. We assume that agents take as given the exogenous tax described in the model section. These bonds are self-amortizing perpetuities whose payments decline geometrically, are free of default risk, and have a face value of 1 at time t. Let P_t^y be the price and Y_t the yield-to-maturity of these long-term bonds at time t. At $t+1$, this instrument will offer a coupon payment of C, a principal repayment of $1-\kappa$ for some $\kappa \in [0,1]$, and κ units of the asset. Here, κ is the amortization rate. The gross before-tax return on long-term bonds from t to $t+1$ is thus

$$1 + R_{t+1}^y = \frac{C + 1 - \kappa + \kappa P_{t+1}^y}{P_t^y}, \tag{A.1}$$

where

$$P_t^y = \sum_{j=1}^{\infty} \frac{\kappa^{j-1}(1-\kappa+C)}{(1+Y_t)^j} = \frac{1+C-\kappa}{1+Y_t-\kappa}. \tag{A.2}$$

Taking a log-linear approximation of the long-term bond's return around the point where it is trading at par at $t+1$ obtains

$$r_{t+1}^y \approx \theta + \delta p_{t+1}^y - p_t^y, \tag{A.3}$$

where $\theta \equiv \ln(1+C)$ and $\delta \equiv \kappa/(1+C)$ are parameters. We can iterate this equation forward and apply this approximation to Y_t to get

$$p_t^y \approx \frac{1}{1-\delta}\theta - \frac{1}{1-\delta} y_t. \tag{A.4}$$

We plug equation (A.4) into (A.3) to get the approximate one-period log return on the long-term bond

$$r_{t+1}^y \approx \frac{1}{1-\delta} y_t - \frac{\delta}{1-\delta} y_{t+1}, \tag{A.5}$$

where $D = (1-\delta)^{-1}$ is the Macaulay duration when the instrument is trading at par.

Lastly, one can subtract the tax g_t from this return to get expression (3).

A.2 Spot and forward exchange markets and Covered Interest Parity

Let d_t^x denote the intermediary's net positions in the borrow-foreign and lend-domestic FX trade in the spot market. Let d_t^f denote a long-domestic forward position of the intermediary. Both d_t^x and d_t^f are expressed in domestic currency units. The realized returns from these positions are given by:

$$d_t^x[i_t - i_t^\star - (q_{t+1} - q_t)] + d_t^f[f_t - q_{t+1}] \tag{A.6}$$

where f_t is the time-t forward log nominal exchange rate, measured in units of domestic currency per unit of foreign currency. Defining the total FX market position as $d_t^q = d_t^x + d_t^f$, we rewrite the expression above as:

$$d_t^q[i_t - i_t^\star - (q_{t+1} - q_t)] + d_t^f[i_t - i_t^\star - (f_t - q_t)] \tag{A.7}$$

The first term is the realized return of the intermediary's net exposure to the UIP trade, combining long spot and forward FX positions. The second term is the return from a *covered* FX trade, which earns any covered interest parity (CIP) deviations CIP devs$_t \equiv i_t - i_t^\star - (f_t - q_t)$.

Defining $\mathbf{d}_t \equiv [d_t^y, d_t^x, d_t^f]'$ and $\mathbf{rx}_{t+1} \equiv [rx_{t+1}^y, rx_{t+1}^q, \text{CIP devs}_t]'$, intermediaries solve:

$$\max_{\mathbf{d}_t} \left\{ \mathbf{d}_t' \, \mathrm{E}_t[\mathbf{rx}_{t+1}] - \frac{1}{2\tau} \mathbf{d}_t' \, \mathrm{var}_t[\mathbf{rx}_{t+1}] \mathbf{d}_t \right\}, \tag{A.8}$$

Taking first-order condition yields the optimality condition faced by local intermediaries:

$$\mathrm{E}_t[\mathbf{rx}_{t+1}] = \tau^{-1} \, \mathrm{var}_t[\mathbf{rx}_{t+1}] \mathbf{d}_t. \tag{A.9}$$

or:

$$\begin{bmatrix} \mathrm{E}_t[rx_{t+1}^y] \\ \mathrm{E}_t[rx_{t+1}^q] \\ \mathrm{E}_t[\text{CIP devs}_t] \end{bmatrix} = \tau^{-1} \begin{bmatrix} \mathrm{var}_t(rx_{t+1}^y) & \mathrm{cov}_t(rx_{t+1}^y, rx_{t+1}^q) & 0 \\ \mathrm{cov}_t(rx_{t+1}^q, rx_{t+1}^y) & \mathrm{var}_t(rx_{t+1}^q) & 0 \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} d_t^y \\ d_t^q \\ d_t^f \end{bmatrix}$$

and thus:

$$\text{CIP devs}_t = 0$$

Covered interest parity (CIP) holds in this model, because any CIP deviations would create *riskless* arbitrage opportunities. Regardless of their risk tolerance, intermediaries would thus eliminate away any CIP deviations.

As a result, we can simplify the intermediary's optimization problem by recasting it in terms of their positions in the long-term domestic bond market (d_t^y) and in the combined FX

market ($d_t^q \equiv d_t^x + d_t^f$), which consolidates spot and forward FX exposures.

A.3 Solution of baseline model

In this subsection, we derive the system of equations necessary to solve the baseline model presented in Section 2.1. We follow Greenwood et al. (2023) by conjecturing that equilibrium prices are a linear function of a state vector of shocks and arrive at a system of three equations with three unknowns. The resulting equations can be studied to derive qualitative implications about the model. We close out Appendix A by proving the main propositions of the paper.

A.3.1 Equilibrium Conjecture and Properties

Equilibrium Conjecture We conjecture that the two prices that we need to pin down in equilibrium, y_t and q_t, are a linear function of a state vector of z_t

$$y_t = \alpha_0^y + \alpha_1^{y'} z_t;$$
$$q_t = \alpha_0^q + \alpha_1^{q'} z_t,$$

where the 6×1 state vector $\mathbf{z}_t = [i_t - \bar{\iota}, i_t^* - \bar{\iota}, g_t, q_{t+\infty}, s_t^y - \bar{s}^y, s_t^q]'$ follows a VAR(1) process $\mathbf{z}_{t+1} = \Phi \mathbf{z}_t + \varepsilon_{t+1}$, with $\text{var}_t[\varepsilon_{t+1}] = \Sigma$ and $\Phi = \text{diag}(\phi_i, \phi_i, \phi_g, 0, \phi_{s^y}, \phi_{s^q})$. In vector form the two prices yield $\mathbf{y}_t + \mathbf{a} + \mathbf{A}\mathbf{z}_t$, where $\mathbf{y}_t = [y_t, q_t]'$, $\mathbf{a} = [\alpha_0^y, \alpha_0^q]'$, and $\mathbf{A} = [\alpha_1^y, \alpha_1^q]'$.

Rational Expectations Equilibrium Let $f(\alpha_0)$ be an operator that gives the price-impact coefficients that clear the markets for long-term bonds and FX when agents conjecture that $\alpha = \alpha_0$, where $\alpha = vec(\text{A})$. We say that a rational expectations equilibrium in this model is a fixed point

$$\alpha^* = f(\alpha^*). \tag{A.11}$$

Within this context, local intermediaries must form beliefs—specifically, price-impact coefficients—about how the net supplies of long-term bonds and foreign exchange, s_t^y and s_t^q, influence equilibrium asset prices, y_t and q_t. A rational expectations equilibrium is therefore a fixed point of a specific operator involving these price-impact coefficients.

Equilibrium Properties The presence of supply risk in this model makes the risk tolerance of investors τ a key variable. If agents are not risk-tolerant enough, then an equilibrium does not exist. However, for high levels of risk tolerance, stochastic supply shocks generate multiple equilibria. The different equilibria correspond to different self-fulfilling beliefs (price-impact coefficients) that investors might have about the risk of holding the different assets. For

example, if investors believe that supply shocks barely affect prices, they will perceive these assets as less risky. Consequently, investors will absorb large supply shocks and will not require large compensations through a fall in asset prices. However, if investors believe supply shocks will have greater impact on prices, they demand a large decline in prices as compensation for absorbing these shocks.

Despite multiple equilibria, there is always a unique stable equilibrium. Denoting by $\{\lambda_i\}$ the eigenvalues of the Jacobian $D_\alpha f(\alpha^*)$, we see that α^* is stable if $|\lambda_i| < 1$. The importance of a unique stable equilibrium lies in the fact that we can infer qualitative implications from our model. It also implies that comparative statics on our equilibrium price-impact coefficients α^* offer an easy and informative interpretation.

A.3.2 Equilibrium Solution

The first-order condition of the local intermediaries that we derived is written again for completeness

$$\mathrm{E}_t[\mathbf{rx}_{t+1}] = \tau^{-1}\,\mathrm{var}_t[\mathbf{rx}_{t+1}]\mathbf{d}_t. \tag{A.12}$$

This, coupled with the usual market clearing condition that supply equals demand ($\mathbf{d}_t = \mathbf{s}_t$), and letting $\mathbf{V} = \mathrm{var}_t[\mathbf{rx}_{t+1}]$, we get

$$\mathrm{E}_t[\mathbf{rx}_{t+1}] = \tau^{-1}\mathbf{V}\mathbf{s}_t, \tag{A.13}$$

with

$$\mathbf{V} = \mathrm{var}_t[\mathbf{rx}_{t+1}] = \begin{bmatrix} V_y & C_{y,q} \\ C_{y,q} & V_q \end{bmatrix}.$$

We can write out equation (A.12), yielding individual excess return equations:

$$\mathrm{E}_t\left[rx^y_{t+1}\right] = \frac{1}{\tau}\left[V_y \cdot s^y_t + C_{y,q} \cdot s^q_t\right]; \tag{A.14a}$$

$$\mathrm{E}_t\left[rx^q_{t+1}\right] = \frac{1}{\tau}\left[C_{y,q} \cdot s^y_t + V_q \cdot s^q_t\right], \tag{A.14b}$$

where $V_y \equiv \mathrm{var}_t[rx^y_{t+1}]$, $V_q \equiv \mathrm{var}_t[rx^q_{t+1}]$, and $C_{y,q} \equiv \mathrm{cov}_t[rx^y_{t+1}, rx^q_{t+1}]$. Note that $\mathbf{V}$ is constant in equilibrium and we hereafter drop the time subscripts.
Using these equilibrium excess return equations, along with asset prices equations (5) and (8), as well as the exogenous processes, we can characterize equilibrium bond yields and foreign exchange prices:

$$y_t = \left\{\bar{\iota} + \frac{1-\delta}{1-\delta\phi_i}\cdot(i_t - \bar{\iota})\right\} + \frac{1-\delta}{1-\delta\phi_g}g_t + \left\{\tau^{-1}V_y \cdot \bar{s}^y\right\} + \tau^{-1}\left\{\frac{1-\delta}{1-\delta\phi_{s^y}}V_y \cdot (s^y_t - \bar{s}^y) + \frac{1-\delta}{1-\delta\phi_{s^q}}C_{y,q} \cdot s^q_t\right\}; \tag{A.15}$$

$$q_t = \left\{ \frac{1}{1-\phi_i} \cdot (i_t^\star - i_t) \right\} + \mathrm{E}_t\, q_{t+\infty} + \tau^{-1} \left\{ C_{y,q} \bar{s}^y + \frac{1}{1-\phi_{s^y}} C_{y,q} \cdot (s_t^y - \bar{s}^y) + \frac{1}{1-\phi_{s^q}} V_q \cdot s_t^q \right\}. \tag{A.16}$$

We now focus on the fixed-point problem. The vector of excess returns is

$$\mathbf{rx}_{t+1} \equiv \begin{bmatrix} rx_{t+1}^y \\ rx_{t+1}^q \end{bmatrix} = \begin{bmatrix} \frac{1}{1-\delta} y_t - \frac{\delta}{1-\delta} y_{t+1} - i_t - g_t \\ i_t - i_t^\star - (q_{t+1} - q_t) \end{bmatrix} = \mathbf{B}_0 \mathbf{y}_t + \mathbf{B}_1 \mathbf{y}_{t+1} + \mathbf{R}_1 \mathbf{z}_t + \mathbf{r}_0.$$

where we have used equations (1), (2), (3), (7), and the fact that $rx_{t+1}^y \equiv r_{t+1}^y - i_t$. Additionally,

$$\mathbf{B}_0 = \begin{bmatrix} \frac{1}{1-\delta} & 0 \\ 0 & 1 \end{bmatrix}, \ \mathbf{B}_1 = \begin{bmatrix} -\frac{\delta}{1-\delta} & 0 \\ 0 & -1 \end{bmatrix}, \ \mathbf{R}_1 = \begin{bmatrix} -1 & 0 & -1 & 0 & 0 & 0 \\ 1 & -1 & 0 & 0 & 0 & 0 \end{bmatrix}, \mathbf{r}_0 = \begin{bmatrix} -\bar{\iota} \\ 0 \end{bmatrix}.$$

Note that when conjecturing the equilibrium, we defined $\mathbf{y}_t = \mathbf{a} + \mathbf{A}\mathbf{z}_t$. Iterating this expression one period forward and using that $\mathbf{z}_{t+1} = \Phi \mathbf{z}_t + \varepsilon_{t+1}$, one can obtain that

$$\mathbf{y}_{t+1} = \mathbf{a} + \mathbf{A}\mathbf{z}_{t+1} = \mathbf{a} + \mathbf{A}\Phi \mathbf{z}_t + \mathbf{A}\varepsilon_{t+1}. \tag{A.17}$$

Recall that Φ is a diagonal matrix with the AR(1) coefficients of the 6 different exogenous processes. Going back to the equation for $\mathbf{rx}_{t+1}$ we just derived yields

$$\mathbf{rx}_{t+1} = [\mathbf{B}_0\mathbf{a} + \mathbf{B}_1\mathbf{a} + \mathbf{r}_0] + [\mathbf{B}_0\mathbf{A} + \mathbf{B}_1\mathbf{A}\Phi + \mathbf{R}_1]\mathbf{z}_t + [\mathbf{B}_1\mathbf{A}]\varepsilon_{t+1}, \tag{A.18}$$

which implies that

$$E_t[\mathbf{rx}_{t+1}] = [\mathbf{B}_0\mathbf{a} + \mathbf{B}_1\mathbf{a} + \mathbf{r}_0] + [\mathbf{B}_0\mathbf{A} + \mathbf{B}_1\mathbf{A}\Phi + \mathbf{R}_1]\mathbf{z}_t; \tag{A.19}$$

$$\mathbf{V} \equiv \mathrm{var}_t[\mathbf{rx}_{t+1}] = \mathbf{B}_1\mathbf{A}\Sigma\mathbf{A}'\mathbf{B}_1'. \tag{A.20}$$

Going back to the market-clearing condition in equation (A.13), $\mathbf{s}_t = [s_t^y, s_t^q]'$ can be written as $\mathbf{s}_t = \mathbf{s}_0 + \mathbf{S}_1\mathbf{z}_t$, where

$$\mathbf{S}_1 \equiv \begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}, \text{ and } \mathbf{s}_0 = \begin{bmatrix} \bar{s}^y \\ 0 \end{bmatrix},$$

which allows us to write equation (A.13) as

$$[\mathbf{B}_0\mathbf{a} + \mathbf{B}_1\mathbf{a} + \mathbf{r}_0] + [\mathbf{B}_0\mathbf{A} + \mathbf{B}_1\mathbf{A}\Phi + \mathbf{R}_1]\mathbf{z}_t = \tau^{-1}(\mathbf{B}_1\mathbf{A}\Sigma\mathbf{A}'\mathbf{B}_1')(\mathbf{s}_0 + \mathbf{S}_1\mathbf{z}_t). \tag{A.21}$$

Equation (A.21) is the main equation which will be used to solve the fixed-point problem. We first separate the terms that contain $\mathbf{z}_t$ from the terms that do not. For the constant

terms we find that

$$(\mathbf{B}_0 + \mathbf{B}_1)\mathbf{a} = \left[\tau^{-1}\mathbf{B}_1\mathbf{A}\Sigma\mathbf{A}'\mathbf{B}_1'\mathbf{s}_0 - \mathbf{r}_0\right]. \tag{A.22}$$

Recall how $\mathbf{B}_0$ and $\mathbf{B}_1$ look like. The last row of the sum only contains zeros. Therefore, the domestic long-term bond yield is pinned down in equilibrium - but the constant for the exchange rate is not.

For the terms containing $\mathbf{z}_t$, note that $\mathbf{B}_0, \mathbf{B}_1$, and Φ are diagonal, and thus it follows that

$$[\mathbf{B}_0\mathrm{A} + \mathbf{B}_1\mathrm{A}\Phi] = \mathbf{A} \circ [\mathbf{B}_0\mathbf{E} + \mathbf{B}_1\mathbf{E}\Phi], \tag{A.23}$$

where $\circ$ is the element-wise matrix multiplication and $\mathbf{E}$ is a 3×5 matrix of 1s. Thus, we get

$$[\mathbf{B}_0\mathbf{E} + \mathbf{B}_1\mathbf{E}\Phi] = \begin{bmatrix} \frac{1-\delta\phi_i}{1-\delta} & \frac{1-\delta\phi_i}{1-\delta} & \frac{1-\delta\phi_g}{1-\delta} & \frac{1}{1-\delta} & \frac{1-\delta\phi_{s^y}}{1-\delta} & \frac{1-\delta\phi_{s^q}}{1-\delta} \\ 1-\phi_i & 1-\phi_i & 1-\phi_g & 1 & 1-\phi_{s^y} & 1-\phi_{s^q} \end{bmatrix}.$$

Using this, the terms containing $\mathbf{z}_t$ have to equate on both sides. That is,

$$[\mathbf{A} \circ (\mathbf{B}_0\mathbf{E} + \mathbf{B}_1\mathbf{E}\Phi) + \mathbf{R}_1]\mathbf{z}_t = \tau^{-1}(\mathbf{B}_1\mathbf{A}\Sigma\mathbf{A}'\mathbf{B}_1')\mathbf{S}_1\mathbf{z}_t. \tag{A.24}$$

Solving for the $\mathbf{A}$ in the LHS yields

$$\mathbf{A} = [\tau^{-1}\mathbf{B}_1\mathbf{A}\Sigma\mathbf{A}'\mathbf{B}_1'\mathbf{S}_1 - \mathbf{R}_1] \oslash [\mathbf{B}_0\mathbf{E} + \mathbf{B}_1\mathbf{E}\Phi], \tag{A.25}$$

where $\oslash$ is element-wise matrix division. To further characterize the solution to the problem in (A.25), we can partition $\mathbf{z}_t$ as $\mathbf{z}_t = [\mathbf{z}_{1,t}', \mathbf{z}_{2,t}', \mathbf{z}_{3,t}']'$, where $\mathbf{z}_{1,t} = [i_t - \bar{\iota}, i_t^* - \bar{\iota}, g_t]'$, $\mathbf{z}_{2,t} = q_{t+\infty}$, and $\mathbf{z}_{3,t} = [s_t^y - \bar{s}^y, s_t^q]'$. Similarly, we partition $\mathbf{A} = [\mathbf{A}_1, \mathbf{A}_2, \mathbf{A}_3]$, where $\mathbf{A}_1$ is the 2×3 matrix of loadings on $\mathbf{z}_{1,t}$, $\mathbf{A}_2$ is the 2×1 matrix of loadings on $\mathbf{z}_{2,t}$, and $\mathbf{A}_3$ is the 2×2 matrix of loadings on $\mathbf{z}_{3,t}$.

For an arbitrary matrix $\mathbf{X}$, denote $\mathbf{X}^{[n-m]}$ for $n < m$ be the submatrix of $\mathbf{X}$ consisting of columns $n, n+1, ..., m-1, m$. Therefore, given the form of $\mathbf{R}_1$ and $\mathbf{S}_1$ ($\mathbf{S}_1^{[1-3]} = \mathbf{0}_{2\times 3}$) we can define submatrix $\mathbf{A}_1$ as

$$\mathbf{A}_1 = -\mathbf{R}_1^{[1-3]} \oslash [\mathbf{B}_0\mathbf{E} + \mathbf{B}_1\mathbf{E}\Phi]^{[1-3]} = \begin{bmatrix} \frac{1-\delta}{1-\delta\phi_i} & 0 & \frac{1-\delta}{1-\delta\phi_g} \\ -\frac{1}{1-\phi_i} & \frac{1}{1-\phi_i} & 0 \end{bmatrix}.$$

This matrix displays the price-impact coefficients of the domestic short-term rate (first column), the foreign short-term rate (second column), and the bond-specific shock (third column), on the domestic long-term yield (first row), and on FX (second row).

For $\mathbf{A}_2$, which contains the FX-specific shock, we can already see from the equilibrium price in equation (A.16) that $\mathbf{A}_2 = [0, 1]'$. In other words, the specific shock on the price of

the exchange rate has no impact on the long-term bond price, while affecting the FX rate one-for-one.

Lastly, we now move to the supply shocks; that is, pinning down $\mathbf{A}_3$. Due to the orthogonality of the different shocks, the variance-covariance matrix Σ can be partitioned as

$$\Sigma = \begin{bmatrix} \Sigma_1 & 0_{3\times1} & 0_{3\times2} \\ 0_{1\times3} & \Sigma_2 & 0_{1\times2} \\ 0_{2\times3} & 0_{2\times1} & \Sigma_3 \end{bmatrix} \quad \text{where} \quad \Sigma_1 = \begin{bmatrix} \sigma_i^2 & \rho\sigma_i^2 & 0 \\ \rho\sigma_i^2 & \sigma_i^2 & 0 \\ 0 & 0 & \sigma_g^2 \end{bmatrix}, \quad \Sigma_3 = \begin{bmatrix} \sigma_{s^y}^2 & \sigma_{\eta^*}\sigma_{\gamma^*} \\ \sigma_{\eta^*}\sigma_{\gamma^*} & \sigma_{s^q}^2 \end{bmatrix},$$

and $\Sigma_2 = \sigma_q^2$. The variance-covariance matrix of excess returns ($\mathbf{V} \equiv \text{var}_t[\mathbf{rx}_{t+1}]$) becomes

$$\mathbf{V} = (\mathbf{B}_1\mathbf{A}_1\Sigma_1\mathbf{A}_1'\mathbf{B}_1') + (\mathbf{B}_1\mathbf{A}_2\Sigma_2\mathbf{A}_2'\mathbf{B}_1') + (\mathbf{B}_1\mathbf{A}_3\Sigma_3\mathbf{A}_3'\mathbf{B}_1'). \tag{A.26}$$

Making use of the form $\mathbf{S}_1$ and $\mathbf{R}_1$ ($\mathbf{R}_1^{[5-6]} = \mathbf{0}_{2\times2}$), the following fixed-point problem involving $\mathbf{A}_3$ is obtained

$$\mathbf{A}_3 = \mathbf{F}_3(\mathbf{A}_3) \equiv \tau^{-1}[(\mathbf{B}_1\mathbf{A}_1\Sigma_1\mathbf{A}_1'\mathbf{B}_1')+(\mathbf{B}_1\mathbf{A}_2\Sigma_2\mathbf{A}_2'\mathbf{B}_1')+(\mathbf{B}_1\mathbf{A}_3\Sigma_3\mathbf{A}_3'\mathbf{B}_1')]\oslash[\mathbf{B}_0\mathbf{E}+\mathbf{B}_1\mathbf{E}\Phi]^{[5-6]}. \tag{A.27}$$

The operator $\mathbf{F}_3(\mathbf{A}_3)$ gives the price function $\mathbf{y}_t = \text{g}(\mathbf{A}_3) + \mathbf{A}_1\mathbf{z}_{1,t} + \mathbf{A}_2\mathbf{z}_{2,t} + \mathbf{F}_3(\mathbf{A}_3)\mathbf{z}_{3,t}$ that will clear the markets for long-term bonds and FX when agents conjecture that the risk of holding of assets is determined by the price function $\mathbf{y}_{t+1} = \mathbf{a}_0+\mathbf{A}_1\mathbf{z}_{1,t+1}+\mathbf{A}_2\mathbf{z}_{2,t+1}+\mathbf{A}_3\mathbf{z}_{3,t+1}$.

From equation (A.27), and using $\mathbf{V}$ in its matrix form, the equilibrium price-impact coefficients must satisfy

$$\begin{bmatrix} \alpha_{s^y}^y & \alpha_{s^q}^y \\ \alpha_{s^y}^q & \alpha_{s^q}^q \end{bmatrix} = \tau^{-1} \begin{bmatrix} \frac{1-\delta}{1-\delta\phi_{s^y}} V_y & \frac{1-\delta}{1-\delta\phi_{s^y}} C_{y,q} \\ \frac{1-\delta}{1-\delta\phi_{s^y}} C_{q,y} & \frac{1-\delta}{1-\delta\phi_{s^y}} V_q \end{bmatrix}. \tag{A.28}$$

The var.-cov. matrix in the absence of supply risk is $[(\mathbf{B}_1\mathbf{A}_1\Sigma_1\mathbf{A}_1'\mathbf{B}_1') + (\mathbf{B}_1\mathbf{A}_2\Sigma_2\mathbf{A}_2'\mathbf{B}_1')] =$

$$\begin{bmatrix} \left(\frac{\delta}{1-\delta\phi_i}\right)^2 \sigma_i^2 + \left(\frac{\delta}{1-\delta\phi_g}\right)^2 \sigma_g^2 & -\frac{\delta}{1-\delta\phi_i}\frac{1}{1-\phi_i}\sigma_i^2(1-\rho) \\ -\frac{\delta}{1-\delta\phi_i}\frac{1}{1-\phi_i}\sigma_i^2(1-\rho) & \left(\frac{1}{1-\phi_i}\right)^2 2\sigma_i^2(1-\rho) + \sigma_q^2 \end{bmatrix}. \tag{A.29}$$

Solving for the contribution of supply risk to the variance-covariance matrix, one can additionally find $\mathbf{B}_1\mathbf{A}_3\Sigma_3\mathbf{A}_3'\mathbf{B}_1'$. Note that one can recast the fixed-point problem in terms of the variance-covariance matrix, instead of using the 2×2 matrix $\mathbf{A}_3$. This is convenient because $\mathbf{V}$ is symmetric, effectively reducing the fixed-point problem to one involving three unknowns instead of four. One needs to find a fixed point in the form $\mathbf{V} = \mathbf{G}(\mathbf{V})$. Plugging the α's of equation (A.28) in the contribution of supply risk to the variance-covariance matrix,

and using this and (A.29) in (A.26), along with denoting the constants

$$g_y \equiv \tau^{-1}\frac{\delta}{1-\delta\phi_{s^y}}\sigma_\eta,\;\; g_y^* \equiv \tau^{-1}\frac{\delta}{1-\delta\phi_{s^y}}\sigma_{\eta^*},\;\; g_q \equiv \tau^{-1}\frac{\delta}{1-\delta\phi_{s^q}}\sigma_\gamma,\;\; g_q^* \equiv \tau^{-1}\frac{\delta}{1-\delta\phi_{s^q}}\sigma_{\gamma^*},$$
$$h_y \equiv \tau^{-1}\frac{1}{1-\phi_{s^y}}\sigma_\eta,\;\; h_y^* \equiv \tau^{-1}\frac{1}{1-\phi_{s^y}}\sigma_{\eta^*},\;\; h_q \equiv \tau^{-1}\frac{1}{1-\phi_{s^q}}\sigma_\gamma,\;\; h_q^* \equiv \tau^{-1}\frac{1}{1-\phi_{s^q}}\sigma_{\gamma^*}. \tag{A.30}$$

we get that $\mathbf{V}$ must satisfy the following system of three equations in three unknowns:

$$V_y = \left(\frac{\delta}{1-\delta\phi_i}\right)^2\sigma_i^2 + \left(\frac{\delta}{1-\delta\phi_g}\right)^2\sigma_g^2 + (V_y)^2(g_y^2+g_{y^*}^2) + (C_{y,q})^2(g_q^2+g_{q^*}^2) + 2g_{y^*}g_{q^*}V_yC_{y,q}; \tag{A.31a}$$

$$V_q = \left(\frac{1}{1-\phi_i}\right)^2 2\sigma_i^2(1-\rho) + \sigma_q^2 + (C_{y,q})^2(h_y^2+h_{y^*}^2) + (V_q)^2(h_q^2+h_{q^*}^2) + 2h_{y^*}h_{q^*}V_qC_{y,q}; \tag{A.31b}$$

$$\begin{aligned} C_{y,q} = &-\frac{\delta}{1-\delta\phi_i}\frac{1}{1-\phi_i}\sigma_i^2(1-\rho) + V_yC_{y,q}(g_yh_y + g_{y^*}h_{y^*}) + V_qC_{y,q}(g_qh_q + g_{q^*}h_{q^*}) \\ &+ (C_{y,q})^2g_{q^*}h_{y^*} + V_yV_qg_{y^*}h_{q^*}. \end{aligned} \tag{A.31c}$$

where $C_{y,q} = C_{q,y}$ and

$$\mathbf{V} = \mathrm{var}_t[\mathbf{rx}_{t+1}] = \begin{bmatrix} V_y & C_{y,q} \\ C_{y,q} & V_q \end{bmatrix}.$$

which completes the full write-down of the solution method. One must now combine these three equations to find qualitative properties of the three unknowns. Instead, in the next subsection we prove Proposition 3, which effectively reduces this system of equations into a more manageable set that yields qualitatively siimlar implications.

A.4 Proofs

Proof of Proposition 1. [to be written up] □

Proof of Proposition 2. Using equation (11), one can show that

$$\mathbb{E}(d_t^y rx_{t+1}^y) = \tau^{-1}\left[\mathrm{var}_t(rx_{t+1}^y)\mathbb{E}\left((d_t^y)^2\right) + \mathrm{cov}_t(rx_{t+1}^y, rx_{t+1}^q)\mathbb{E}\left(d_t^q d_t^y\right)\right]; \tag{A.32}$$

$$\mathbb{E}\left(d_t^q rx_{t+1}^q\right) = \tau^{-1}\left[\mathrm{var}_t(rx_{t+1}^q)\mathbb{E}\left((d_t^q)^2\right) + \mathrm{cov}_t(rx_{t+1}^y, rx_{t+1}^q)\mathbb{E}\left(d_t^y d_t^q\right)\right]. \tag{A.33}$$

Using the market clearing condition (19), the processes of net supplies, (12) and (8), the properties of foreign and home investors' flows, (15) and (16), as well as Proposition 3, one can show that $\mathbb{E}(d_t^y rx_{t+1}^y) \geq 0$ and $\mathbb{E}(d_t^q rx_{t+1}^q) \geq 0$.

Furthermore, equation (19) then implies that inelastic demand of local and foreign investor

delivers negative excess returns, on average. □

Proof of Proposition 3. Assumption 1 implies that $V_y = V_q$, which simplifies our system of equations (A.31a)–(A.31c) as follows:

$$V_y = \sigma_g^2 + (V_y)^2\tau^{-2}(\sigma_\eta^2 + \sigma_{\eta^*}^2) + (C_{y,q})^2\tau^{-2}(\sigma_\eta^2 + \sigma_{\eta^*}^2) + 2V_yC_{y,q}\tau^{-2}\sigma_{\eta^*}^2; \tag{A.34a}$$

$$C_{y,q} = 2V_yC_{y,q}\tau^{-2}(\sigma_\eta^2 + \sigma_{\eta^*}^2) + (C_{y,q})^2\tau^{-2}\sigma_{\eta^*}^2 + (V_y)^2\tau^{-2}\sigma_{\eta^*}^2. \tag{A.34b}$$

We can use equation (20) to rewrite this system as

$$V_y = \sigma_g^2 + \tau^{-2}(\sigma_\eta^2 + \sigma_{\eta^*}^2)\left[(V_y)^2 + (C_{y,q})^2 + 2\Omega V_yC_{y,q}\right]; \tag{A.35a}$$

$$C_{y,q} = \tau^{-2}(\sigma_\eta^2 + \sigma_{\eta^*}^2)\left[2V_yC_{y,q} + (C_{y,q})^2\Omega + (V_y)^2\Omega\right]. \tag{A.35b}$$

First, setting $\Omega = 0$, it can be readily seen from equations (A.35a)-(A.35b) that the only real solution implies $C_{y,q} = 0$. Second, differentiating both sides of this equation with respect to Ω, we achieve

$$\frac{d(C_{y,q})}{d\Omega} = \tau^{-2}(\sigma_\eta^2 + \sigma_{\eta^*}^2)\left[2V_y\frac{d(C_{y,q})}{d\Omega} + 2C_{y,q}\frac{d(C_{y,q})}{d\Omega}\Omega + C_{y,q}^2 + V_y^2\right]. \tag{A.36}$$

Next, collecting all terms that contain $\frac{dC_{y,q}}{d\Omega}$ on the left-hand side yields

$$\frac{d(C_{y,q})}{d\Omega} = \frac{\tau^{-2}(\sigma_\eta^2 + \sigma_{\eta^*}^2)\left[C_{y,q}^2 + V_y^2\right]}{1 - \tau^{-2}(\sigma_\eta^2 + \sigma_{\eta^*}^2)\left(2V_y + 2C_{y,q}\Omega\right)}. \tag{A.37}$$

To ensure that the denominator is positive, we require agents to be risk-tolerant enough. That is, for τ sufficiently large, we get that $\frac{d(C_{y,q})}{d\Omega} > 0$, which completes our proof. □

Proof of Proposition 4. Consider a unit decrease in η_t in (12), which implies a reduction in bond net supply s_y without a corresponding movement in currency net supply (i.e. $s_q = 0$). By the equilibrium solution of the exchange rate, eq. (A.16) derived in Appendix A.3, such impulse causes a currency appreciation if and only if $\text{cov}_t(rx_{t+1}^y, rx_{t+1}^q) > 0$. This proves part (b). The proof of part (a) is analogous, and follows from considering a unit increase in γ_t in (18). □

Table A.1
Baseline calibration

Parameter	Interpretation	Value
$1/\tau$	Risk-tolerance	0.03
δ	Maturity of long-term bonds	0.90
ϕ_i	Persistence of short-term rates	0.965
ρ	Correlation of short-term rates	0.69
ϕ_g	Persistence of bond-specific shocks	0
ϕ_{s^y}; ϕ_{s^q}	Persistence of net supply shocks	0.85
σ_i	Std. dev. of interest rate shocks	0.0015
σ_g	Std. dev. of bond-specific shocks	0.05
σ_q	Std. dev. of long-term q shocks	0.05
α	Currency hedge ratio	0

B Global investor type and hedging in fixed income

B.1 Global investor type in Colombia

Our evidence from Colombia suggests that foreigners tend to produce correlated flows in bond and currency markets. Additionally, the extent of currency hedging from foreigners that purchase local-currency government bonds seems negligible. In this section, we explore the type of global investor present in Colombia's sovereign bond market.

As shown in Figure B.1a, foreign participation in Colombia's bond market was limited before 2012 but increased significantly thereafter. This growth was partly driven by regulatory reforms implemented between 2010 and 2013, which facilitated investment through local managers and simplified tax reporting for fixed-income securities. Furthermore, a 2012 tax reform reduced income tax on TES for non-resident investors from 33% to 14%. The country's investment-grade credit rating, awarded in 2011 by credit rating agencies such as *S&P*, *Moody's*, and *Fitch Ratings*, and its increased weight in *J.P. Morgan*'s emerging market debt indices in 2014, also played a key role in attracting international capital.

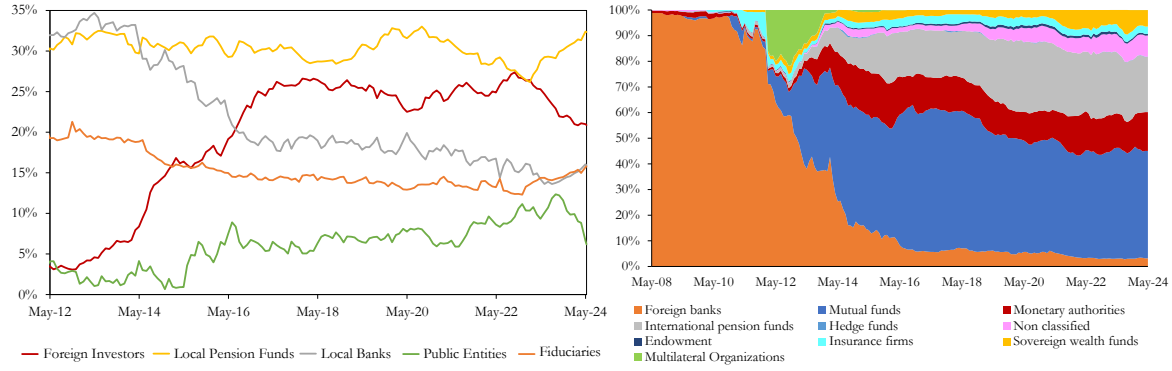
Figure B.1b shows the share of bond holding across foreign investors. Before 2014 foreign banks held the largest share of sovereign bonds among foreign investors, although their overall market participation was relatively low. Since 2014, mutual funds have become the dominant investors, followed by international pension funds and monetary authorities, collectively holding about 80% of the foreign investor base, which is now more significant relative to the total outstanding debt.

B.2 Additional Cross-Country Evidence on Comovement and Ω

In Figure B.2 we reproduce Figure 4, but replacing $\alpha = 0$ for emerging economies that we estimated have $\alpha < 0$ using the data from Chen and Zhou (2025).

In Figure B.3 we re-compute Ω under two different assumptions. First, we assign the median hedge ratio across countries to all countries (Panel a). Second, we assign the median standard deviation for foreign investors and other domestic investors to all countries (Panel b). In this way, we can keep fixed one of the two reasons why Ω might vary. We observe that both the hedge ratios and the relative volatility of foreign to non-bank domestic investors are relevant to explain the comovement between bond and currency returns across countries.

Figure B.1
Participation in the Colombian TES market

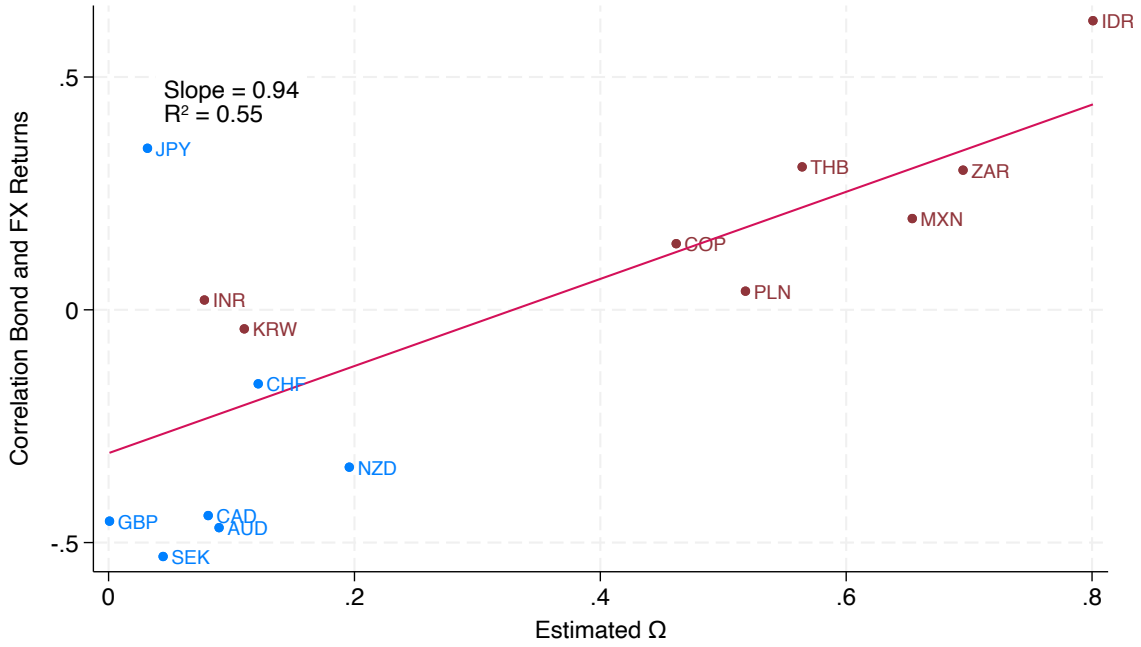


(a) Total bond holdings by entity

(b) Bond holdings across foreign investors

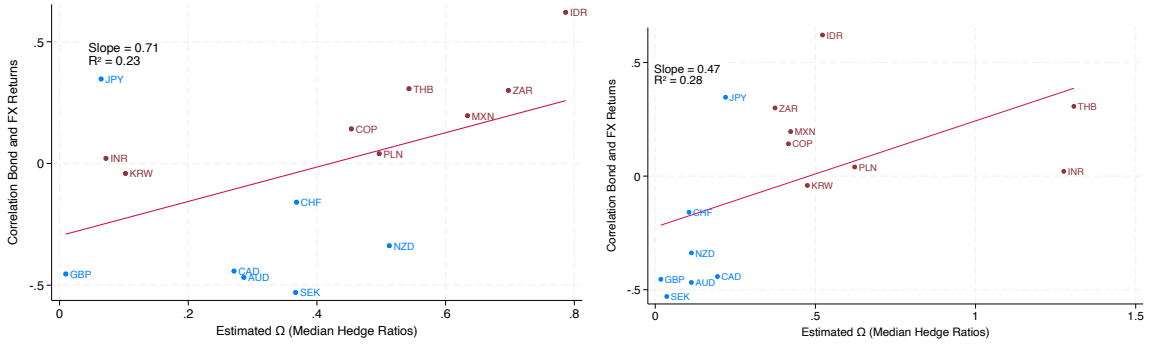
Note: The data presented correspond to all trades registered with the Central Securities Depository (DCV), which operates under the supervision of the Central Bank of Colombia. Panel A shows the TES participation (percentage of total outstanding TES volume) across major entities, while Panel B focuses specifically on the share held by foreign investors, detailing the distribution among different types of foreign investors within the total foreign share.

Figure B.2
Comovement in Excess Returns and Ω



Note: This figure displays the correlation of bond and currency excess returns (y-axis) and the Estimated Ω from equation (20) (x-axis). In the computation for Estimated Ω we restrict $\alpha \geq 0$. Countries in red (blue) are part of the emerging (advanced) economies sample.

Figure B.3
Comovement in Excess Returns and Ω



(a) Ω with median hedge ratios

(b) Ω with median volatilities

Note: This figure displays the correlation of bond and currency excess returns (y-axis) and the Estimated Ω from eq. (20) (x-axis). In the computation for Estimated Ω in Panel (a) we restrict α to be the median hedge ratio for all countries. In Panel (b) we restrict the standard deviation for foreign and other domestics investors to the median across countries. Countries in red (blue) are part of the emerging (advanced) economies sample.

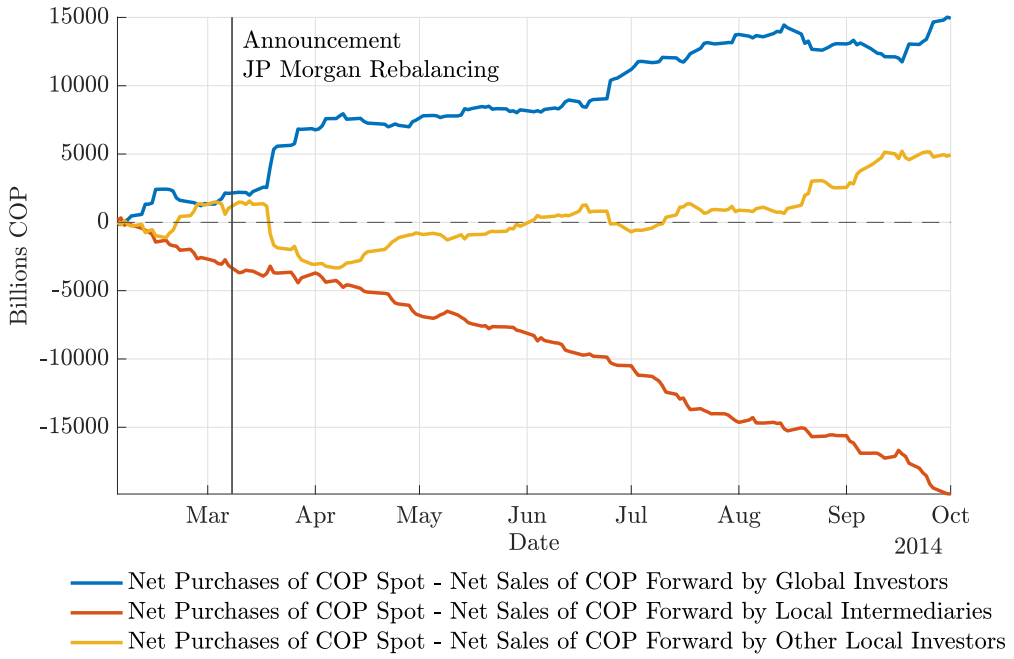
Table B.1
Summary of FX and bond excess returns (1-month excess returns)

			Residualized excess returns	
Country	Regression coefficient	Correlation	Regression coefficient	Correlation
Australia	-0.70^{***}	-0.35	-0.78^{***}	-0.39
	(0.15)	$[-0.47, -0.22]$	(0.17)	$[-0.52, -0.24]$
Canada	-0.65^{***}	-0.39	-0.81^{***}	-0.47
	(0.12)	$[-0.50, -0.26]$	(0.13)	$[-0.59, -0.33]$
Colombia	0.25^{***}	0.27	0.34^{**}	0.34
	(0.09)	[0.13, 0.40]	(0.15)	[0.19, 0.48]
India	0.10	0.09	-0.06	-0.05
	(0.10)	$[-0.06, 0.23]$	(0.12)	$[-0.22, 0.12]$
Indonesia	0.57^{***}	0.59	0.64^{***}	0.60
	(0.11)	[0.46, 0.70]	(0.13)	[0.46, 0.71]
Japan	1.32^{***}	0.37	1.43^{***}	0.39
	(0.26)	[0.24, 0.49]	(0.34)	[0.24, 0.52]
Korea	-0.12	-0.07	-0.22	-0.12
	(0.15)	$[-0.25, 0.11]$	(0.18)	$[-0.31, 0.07]$
Mexico	0.65^{***}	0.40	0.69^{***}	0.39
	(0.17)	[0.25, 0.53]	(0.21)	[0.22, 0.54]
New Zealand	-0.55^{***}	-0.25	-0.52^{**}	-0.24
	(0.19)	$[-0.38, -0.11]$	(0.22)	$[-0.39, -0.08]$
Poland	0.43^{**}	0.21	0.50^{**}	0.25
	(0.17)	[0.07, 0.34]	(0.21)	[0.09, 0.40]
South Africa	0.96^{***}	0.53	1.11^{***}	0.58
	(0.11)	[0.42, 0.62]	(0.13)	[0.46, 0.68]
Sweden	-0.79^{***}	-0.41	-0.95^{***}	-0.47
	(0.15)	$[-0.52, -0.29]$	(0.17)	$[-0.59, -0.33]$
Switzerland	-0.17	-0.08	-0.07	-0.03
	(0.18)	$[-0.22, 0.06]$	(0.21)	$[-0.20, 0.13]$
Thailand	0.39^{*}	0.25	0.39^{*}	0.25
	(0.23)	$[-0.05, 0.51]$	(0.23)	$[-0.05, 0.51]$
United Kingdom	-0.57^{***}	-0.40	-0.58^{***}	-0.41
	(0.12)	$[-0.51, -0.27]$	(0.15)	$[-0.54, -0.26]$

Note: Column (1) of the table reports the estimated slope coefficient for the following baseline regression $rx^{q}_{j,t+1} = \alpha + \beta rx^{(10y)}_{j,t+1} + \epsilon_{j,t+1}$. Column (2) reports the correlation between $rx^{q}_{j,t+1}$ and $rx^{(10y)}_{j,t+1}$. Column (3) reports the estimated slope coefficient of a regression of the residualized component of $rx^{q}_{j,t+1}$ on the residualized component of $rx^{(10y)}_{j,t+1}$. We residualize local-currency bond and FX excess returns according to the following regression $rx^{m}_{j,t+1} = \sum_{k=0}^{1} \phi_k (\text{Prob. default})_{j,t-k} + \epsilon^{rx^m}_{j,t+1}$, for $m = \{10y, q\}$. Probability of default is the 10-year sovereign default probability, retrieved from *Refinitiv*. Column (4) reports the correlation between the residualized component of $rx^{q}_{j,t+1}$ and the residualized component of $rx^{(10y)}_{j,t+1}$. Stars denote significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Values in parenthesis are standard errors, and values in square brackets represent the 95 percent confidence interval.

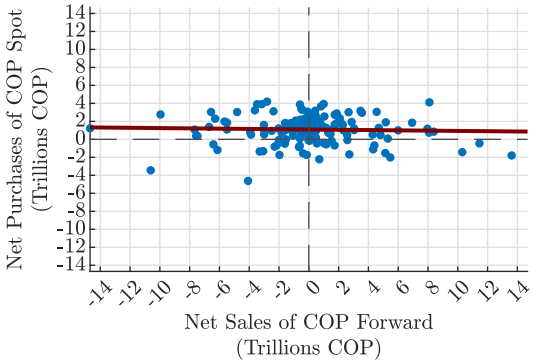
C Additional Tables and Figures

Figure C.1
Flows in COP Spot and Forward markets during J.P. Morgan Index Rebalancing



Note: The figure displays the evolution of the daily accumulated purchases of COP in the spot market net of sales of COP in the forward market during 2014 for different investor groups (described in Section 1 and Section 3). The black vertical line denotes 19th of March 2014, the day the rebalancing was announced.

Figure C.2
Purchases of COP spot and sales of COP forward by global investors



Note: This figure displays the monthly-level purchases of COP in the spot market (x-axis) and the monthly-level sales of COP in the forward market (y-axis) by global investors. The fitted OLS regression line is also shown.

Figure C.3
Secondary market prices after FXI auction

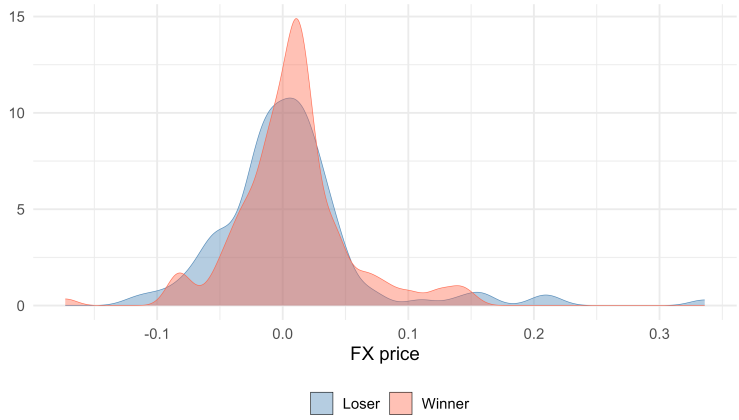


Table C.1
RDD estimates for bond and FX prices

VARIABLES	Bond Price	Bond Price	FX Price	FX Price
Rank	0.250	-0.0460	-0.0205**	-0.00312
	(0.450)	(0.175)	(0.0100)	(0.00352)
Dummy	-1.151*	0.0157	0.0310*	0.0115*
	(0.677)	(0.280)	(0.0181)	(0.00662)
Dummy*Rank	-0.475	-0.0175	0.0196	-0.00163
	(0.495)	(0.194)	(0.0132)	(0.00450)
Dummy*Exposure	-0.000749		-2.83e-05*	
	(0.000478)		(1.54e-05)	
Constant	-2.551***	-0.963	-0.0223	-0.00320
	(0.654)	(0.588)	(0.0146)	(0.00522)
Observations	431	6,487	247	2,403

Note: Authors' calculations. Standard errors in parentheses. (*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$). The *Exposure* variable (centered) refers to the trading volume of sovereign bonds that each bank conducts with foreign investors. Bond (TES) prices are expressed as deviations from the daily mean price. FX selling prices are denoted in COP/USD. A bandwidth of rank 2 was used for this estimation, consistent with Calonico et al. (2014).