# Speculation, Forward Exchange Demand and CIP Deviations in Emerging Economies*

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**Abstract**

We argue that currency speculation drives forward exchange demand and shapes covered interest parity (CIP) deviations in emerging economies. We propose a model in which global investors demand forward exchange to chase predictable currency returns, while local intermediaries, constrained by mismatch regulation and position limits, arbitrage between segmented spot and forward markets. Using data from Peru's forward market, we provide direct evidence that local intermediaries' forward balances tightly co-move with foreign customers' positions, simultaneously hedge in the spot market, and consistently profit from supplying forward contracts. The model explains several defining properties of CIP deviations in emerging economies as well as their relationship with UIP deviations and comovement with the U.S. dollar. This mechanism sheds light on the distinct drivers of CIP deviations between emerging and advanced economies.

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Deviations from covered interest parity (CIP) are large and volatile in emerging economies, displaying different conditional properties from those observed in advanced economies (Cerutti and Zhou, 2024). These deviations have real effects, influencing the cost of borrowing and currency hedging (Keller, 2024), the allocation of exchange rate risk (Keller, 2024), and the transmission of monetary policy (Cerutti et al., 2021; De Leo et al., 2024). To understand the dynamics of CIP deviations in emerging economies, this paper proposes an equilibrium model specifically designed for the forward exchange markets of emerging economies. The model generates a range of novel predictions regarding forward exchange positions and CIP deviations, which find empirical support in both micro and macro data.

Our proposed mechanism has two key features. First, forward exchange demand reflects global investors' desire to capitalize on predictable currency returns; yet, these forces are confined to the forward market as global investors lack *direct* access to *short-term* local bond and spot exchange markets—a form of market segmentation that is common in emerging economies.[1] Second, local intermediaries engage in arbitrage across forward and spot markets, constrained by limits on positions and currency mismatches—common regulations on financial intermediaries across emerging economies. These elements constrain the supply of forward contracts and result in CIP deviations. These CIP deviations can be understood as intermediaries' profits for supplying forward contracts to global investors. Using detailed data from Peru's forward market, described below, we show that indeed forward balances of local intermediaries are virtually the mirror image of forward balances of global investors, and that forward positions of local intermediaries systematically generate positive profits from the CIP deviations.

These features have unique implications for the equilibrium dynamics of forward positions, CIP deviations, and UIP deviations. First, global investors exhibit higher forward demand for currencies expected to deliver positive excess returns, i.e., UIP deviations. This forward demand pressure depresses the forward premium of such currencies below their interest dif-

[1] The notion that global investors use the forward market to chase predictable excess currency returns, such as carry-trade opportunities, is often evoked by policy makers (BIS, 2015; Patel and Cavallino, 2019).

ferential, pushing down CIP deviations. These dynamics make UIP deviations and CIP deviations to be negatively correlated. Consistent with this mechanism, empirically we find that cross-country differences in 3-month CIP deviations are negatively correlated with subsequent excess currency returns in a panel of emerging economies. The model also provides a framework to interpret Cerutti and Zhou's (2024) empirical findings linking CIP deviations to interest rate differentials or net external positions—well-established predictors of excess currency returns. In addition, we find that this relationship between UIP and CIP deviations does not arise in advanced economies, where CIP deviations are quantitatively smaller and slightly positive correlated with subsequent excess currency returns. We observe that if global investors can take advantage of carry-trade opportunities equally through bonds and forwards in advanced economies, one should naturally expect to find significantly smaller CIP deviations in these economies, and potentially distinct conditional properties.

Second, heightened global risk aversion reduces global investors' forward demand for emerging market currency, leading to U.S. dollar appreciation and an increase in CIP deviations. Empirically, we document that the first principal component of 3-month CIP deviations in emerging economies is positively correlated with proxies for global risk aversion such as the VIX, and with the U.S. dollar index. Additionally, we document significant co-movement between global investors' forward balances in Peru's forward market and the U.S. dollar index. Notably, CIP deviations in emerging economies exhibit the opposite relationship with the U.S. dollar compared to advanced economies. In advanced economies, CIP deviations typically decline further during periods of U.S. dollar appreciation (Avdjiev et al., 2019b; Du and Schreger, 2022), in line with theories of convenience yields (Jiang et al., 2021). However, CIP deviations in emerging markets rise during periods of dollar appreciation. These dynamics support our mechanism, where higher risk aversion reduces global investors' positions in these currencies, exerting downward pressure on forward prices and resulting in higher CIP deviations. We attribute these differences between advanced and emerging economies to the varying degrees of obstacles global investors face in freely trading

short-term bonds, highlighting that distinct forces can drive CIP deviations in each group of economies.

To gain intuition, consider the prospects of a global investor facing restrictions in accessing short-term bond and spot exchange markets in an emerging economies. The investor can exploit predictable excess currency returns by strategically trading in the (non-deliverable) forward market of the emerging economy. Its expected return from a long forward position on the local currency is the difference between the contracted forward rate and the expected spot rate when the contract falls due, which can also be expressed as the sum of UIP and CIP deviations:

$$f_t - E_t(s_{t+1}) = \underbrace{(r_t - r_t^{\$}) - (E_t(s_{t+1}) - s_t)}_{\text{UIP deviation}_t} + \underbrace{(f_t - [s_t + (r_t - r_t^{\$})]}_{\text{CIP deviation}_t}. \tag{1}$$

where $r_t$ and $r_t^{\$}$ represent local currency and dollar interest rates, while $f_t$ and $s_t$ denote forward and spot exchange rates (local currency per U.S. dollar), respectively.

This decomposition into UIP and CIP deviations provides several important insights. First, higher UIP deviations, *ceteris paribus*, induce larger forward demand by forward investors, as they generate higher expected returns on this forward trade. Second, if CIP deviations are negative, they decrease the global investor's returns. However, when UIP deviations are sufficiently large, global investors may be willing to take long forward positions *even when CIP deviations are negative.*

Consider now the prospects of a local intermediary (for example, a Peruvian bank) that operates in both forward and spot exchange markets and it *cannot* hold currency mismatches, consistent with prevailing regulatory regimes in emerging economies. To supply long forwards to global investors, while holding a matched portfolio, the local intermediary shorts local-currency forward *and* takes an offsetting long spot position. The return from this trade

is:

$$-\left[\underbrace{(f_t - [s_t + (r_t - r_t^{\$})]}_{\text{CIP deviation}_t}\right]. \tag{2}$$

Note that when global investors buy local currency in forward contracts, they simultaneously sell dollars forward to local intermediaries. These intermediaries can then profit by buying dollars at a forward price $f_t$ that is *lower* than the cost of unwinding such positions in the spot market, which would then yield negative CIP deviations. The cost of this unwind is the cost of borrowing dollars, selling these dollars while simultaneously gaining a yield of investing in local currency short-term bonds (i.e. $s_t + (r_t - r_t^{\$})$ in Equation (2)).

This trade does not involve currency risk. However, in our model, local intermediaries are subject to position limits—a regulatory constraint—and supply long forward contracts in proportion to the size of (negative) CIP deviations. This creates an upward sloping forward supply curve.

In summary, UIP and CIP deviations are jointly determined by the interplay of demand and supply forces and market clearing in both the forward and spot markets—where the latter is populated by risk-averse local investors, local intermediaries and inelastic investors, guaranteeing that UIP deviations exist in equilibrium as in leading portfolio-balance models (Gabaix and Maggiori, 2015). These deviations are influenced by global investors' fluctuating appetite for risk involved in taking uncovered positions—involving currency risk—in the forward market.

Our model is well grounded in observations from micro data on financial flows and prices in the bond, spot and forward market of Peru, an emerging economy. Peru is an ideal laboratory for our analysis as it features a significant degree of segmentation in access to local bond markets between local and foreign investors, as well as a developed, integrated forward market for foreign exchange. Besides, since the model attributes the patterns of CIP deviations to the demand and supply of forward of specific players (global investors,

local intermediaries, *etc.*), it is paramount to confront it with the patterns of *investor-specific* positions in the forward markets.

To test the model implications using micro-level data from Peru, we complement the public market data with rich and broad confidential data provided by the bank regulator, *Superintendencia de Banca y Seguros*, for a sample that spans from 2005 to 2018. The confidential data is composed by several datasets. First, we have access to forward contract-level data for the universe of forward trades done by local banks (the market makers). This contains information on the counterparties, pricing, maturity, notional, and, more generally, every detail pertaining the contract. Second, we also have information regarding local banks' activities regarding their money-market assets and liabilities. This allows us to compute estimated profits they obtain when arbitraging CIP deviations.

Using these data, we corroborate the main assumptions underlying the proposed framework, and provide support for its main predictions. In terms of the assumptions, our model has two important assumptions: market segmentation, where local banks have clear advantages over foreign investors in trading CIP deviations, and that local banks hedge their foreign currency positions. Data and regulations in Peru suggests that these assumptions are empirically relevant. First, in terms of market segmentation, we document that foreign investors have zero holdings of Central Bank's certificates of deposit, which is the main instrument local banks use to arbitrage negative CIP deviations. The reason is that, by regulation, in Peru, foreign investors need to pay a 4% fee over the notional amount when buying the Central Bank's certificates of deposit. Local intermediaries do not have to pay this fee. In such environment, the forward market thus became the primary avenue for foreign investors to exploit predictable currency returns. There are other constraints that segment the market, such as local banks' exclusive access to the spot interbank exchange rate market and to the Central Bank's primary auctions. Second, in terms of exchange rate hedging, by regulation, local intermediaries are mandated to have limited exchange rate risk. Therefore, the sum of their exchange rate spot and forward position is limited.

Hence, as in our model, domestic banks play a crucial role as intermediaries in this segmented market by providing the necessary forward contracts to foreign investors. These banks hedge their positions in the spot market while earning profits from the CIP deviations, as supplying forwards has balance-sheet costs.

We then verify the main predictions of our model that global investors and local intermediaries constitutes forward demand and supply, respectively. To this end, we first show that forward balances of foreign investors are significantly negatively correlated with those of local banks. In fact their net positions are almost the mirror image of each other. We also show that the forward positions of local banks is negatively correlated with CIP deviations and that these positions generate positive profits for the banking system. More specifically, we do this calculation exploiting very detailed-level data. These data contain, among other variables, banks' forward purchases and sales notional, pricing and spot price at which these forward transactions were closed. The data also has banks' funding and investment rates of assets likely used when arbitraging CIP deviations. We thus consider the side of the trade and estimate banks' profits from arbitraging CIP deviations. We show banks are consistently profiting from arbitraging CIP deviations, as predicted by our model.

**Related Literature** This paper presents a novel perspective on the determination of CIP deviations in emerging economies, which display contrasting features relative to advanced ones, and is related to several papers in international finance.

First, our analysis hinges on insights from a growing empirical literature that provides robust evidence for the presence of upward-sloping supply curves in the forward market, attributed to regulatory constraints limiting CIP arbitrage (Du et al., 2018b; Abbassi and Bräuning, 2020; Cenedese et al., 2021; Aldunate et al., 2023; Barbiero et al., 2024).[2]

Second, our analysis is related to papers with explicit models of forward demand (Liao and

[2] See also Ben Zeev and Nathan (2024); Ben Zeev and Nathan (2024); Bippus et al. (2023); Bräuer and Hau (2022).

Zhang, 2021; Bacchetta et al., 2024).[3] These papers primarily emphasize hedging motives of forward demand, or exogenous forward demand shocks, and are largely centered on advanced economies. Similar to these studies, particularly Bacchetta et al. (2024), we analyze how UIP and CIP deviations are jointly determined by equilibrium in the foreign exchange spot and forward markets. Our contribution is to propose a novel mechanism where currency-speculation motives, rather than hedging, drive forward demand along an upward-sloping forward supply curve, shaping the dynamics of CIP deviations across countries and over time. Our analysis focuses on emerging economies, where we argue that specific forms of market segmentation make these forces more prominent. This mechanism generates distinctive predictions about the joint behavior of UIP and CIP deviations and the patterns of investors' forward exchange market positions, which are supported by data and differ from those observed in advanced economies. In addition, we provide direct evidence from Peru forward market suggesting that forward demand does not uniquely, nor primarily, reflect hedging motives.

Third, our model provides a consistent interpretation of the evidence documenting CIP deviations around periods of global distress, or periods of appreciated U.S. dollar (Avdjiev et al., 2019b; Du and Schreger, 2022). During global risk-off episodes, CIP deviations tend to move in opposite directions in emerging economies compared to advanced ones (Cerutti and Zhou, 2024). Our model provides a natural interpretation to these dynamics. Higher risk aversion reduces global investors' positions on the emerging market currencies, forcing upward pressure on dollar forward prices and thus higher (less negative) CIP deviations, and appreciated dollar. When this currency speculation strategies operate symmetrically in home/foreign bond and forward markets, then CIP deviations are driven to be equal to zero, or to a convenience yield on U.S. bonds (Jiang et al., 2021), and thus display distinct unconditional and conditional properties.

Fourth, our paper adds to the literature examining the role of domestic intermediaries in

[3] See also Greenwood et al. (2023); Gourinchas et al. (2022); Fang and Liu (2021); Bacchetta et al. (2023).

the transmission of global shocks and asset price formation in emerging economies (Baskaya et al., 2017; di Giovanni et al., 2022; Fendoglu et al., 2019; Gutierrez et al., 2023; Keller, 2024; Bush, 2019). While this body of work primarily centers on bank lending markets—with the exception of Bush (2019)—we focus specifically on the forward market and characterize the properties of forward demand and supply.[4]

# 1 A Model of Forward Markets in Emerging Economies

There is continuum of small open economies, indexed by $c \in [0, 1]$, over two time periods $[t; t+1]$. This section describes the structure of forward and spot markets in the small open economy, and the properties of the agents operating in these markets.

## 1.1 Forward Market

In each forward market $c$, global investors—investors domiciled outside of economy $c$—take long or short forward position, determining forward demand.[5] We assume that their short-term bond position is predetermined and constant, and equal to zero in the baseline setting. Thus, global investors' only avenue to exploit short-run excess currency returns is through the forward market.[6] In each forward market $c$, a continuum a local intermediaries supply forwards to global investors. Because regulation prevents local intermediaries to hold currency risk, each forward position is associated with an offsetting spot position. As a result, local intermediaries effectively hold a risk-less portfolio. Because of position limits and participation costs, they require compensation for holding a given forward position, reflected in CIP deviations.[7] We provide evidence in support of these assumptions in Section 2.

[4] Liao (2020) Du and Schreger (2016) Du et al. (2018a) Diamond and Van Tassel (2021) Dávila et al. (2024) Hébert (2020) Wallen (2022) Patel and Xia (2019) Ben Zeev and Nathan (2024).

[5] Global investors represent global hedge funds and trading desks of global banks.

[6] Note that we abstract from making assumptions regarding global investors' *long-term* bond positions. Since, unlike short-term bonds, long-term bonds have price risk, these are arguably inferior instruments for profiting from short-run excess currency returns.

[7] The structure of local intermediaries is similar to "currency-forward traders" in Liao and Zhang (2021). A feature specific to this framework is that local intermediaries are distinct domestic agents for each market $c$, in line with actual emerging economies' market structures, rather than a unique global agent operating in every forward market.

We omit the indicators "$c$" for the remainder of this section and reintroduce them when analyzing the multi-country setting.

### 1.1.1 Global Investors

**Bond Position** A global investor holds a position in the home-currency bond $\frac{X_{t+1}}{R_t}$, and a corresponding opposite position in the U.S. dollar bond $\frac{X^\star_{t+1}}{R^\star_t}$. Denote $S_t$ as the spot exchange rate, defined as units of home currency per U.S. dollar, so that an increase in $S_t$ is a depreciation of home currency or appreciation of U.S. dollar. A zero-capital portfolio $\frac{1}{S_t}\frac{X_{t+1}}{R_t} + \frac{X^\star_{t+1}}{R^\star_t} = 0$ delivers a return of $\frac{1}{S_{t+1}}X_{t+1} + X^\star_{t+1}$ U.S. dollars. Thus, the realized excess return from a $\frac{X^\star_{t+1}}{R^\star_t}$ U.S. dollar position is $X^\star_{t+1}\left(1 - \frac{S_t}{S_{t+1}}\frac{R_t}{R^\star_t}\right)$ U.S. dollars.

In Section 2.2.1, we highlight that various financial regulations impose significant costs on foreign investors seeking to access the local bond and spot markets or adjust their positions in many emerging economies. Consistent with this empirical observation, we assume that global investors cannot re-evaluate their short-term bond positions, which remain constant over time.

**Assumption 1** *Global investors' position in home-currency bond $\frac{X_{t+1}}{R_t}$ is predetermined and constant, i.e. $X_{t+1} = X$.*

**Forward Demand** Global investors actively trade in the forward market by choosing a forward position ($H_{t+1}$). A 1 U.S. dollar short forward position (long home-currency forward position) returns $\frac{F_t}{S_{t+1}} - 1$ U.S. dollars (or $F_t - S_{t+1}$ home currency). Thus, the realized excess return from a $H_{t+1}$ short forward U.S. dollar position is $H_{t+1}\left(\frac{F_t}{S_{t+1}} - 1\right)$ U.S. dollars, and the realized return on the foreign investor's overall portfolio is, in U.S. dollars:

$$W_{t+1} \equiv X^\star\left(1 - \frac{S_t}{S_{t+1}}\frac{R_t}{R^\star_t}\right) + H_{t+1}\left(\frac{F_t}{S_{t+1}} - 1\right).$$

Taking the bond position $X^\star$ as predetermined and constant, global investors choose their forward position $H_{t+1}$ to maximize their mean-variance utility:

$$\max_{H_{t+1}} \quad E_t\left(W_{t+1}\right) - \frac{\gamma_t}{2}\operatorname{var}_t\left(W_{t+1}\right),$$

where $\gamma_t$ governs the global investors' aversion to risk.

The first-order condition for home-currency forward ($H_{t+1}$) reads:

$$\frac{\left(E_t \frac{S_t}{S_{t+1}} \frac{R_t}{R_t^\star} - \frac{R_t}{R_t^\star}\frac{S_t}{F_t}\right)}{\gamma_t \operatorname{var}_t\left(\frac{R_t}{R_t^\star}\frac{S_t}{S_{t+1}}\right)} = -X^\star + H_{t+1}\frac{R_t^\star}{R_t}\frac{F_t}{S_t} \tag{3}$$

In Section 2.2.1, we note that foreign investors' *short-term* bond positions in emerging economies are relatively small compared to their forward market positions. Based on this observation, we make the following simplifying assumption.

**Assumption 2** *Global investor's predetermined position in the short-term bond market is nil, i.e.* $X^\star = 0$.

Assumption 2 allows us to abstract from hedging motives of forward demand in the baseline model, and thus rewrite global investors' forward demand, eq. (3), as:

$$\frac{\left(E_t \frac{F_t}{S_{t+1}} - 1\right)}{\gamma_t \operatorname{var}_t\left(\frac{F_t}{S_{t+1}}\right)} = H_{t+1}. \tag{4}$$

Forward demand by global investors reflects their objective to take advantage of expected excess currency returns in the forward market in proportion to their risk-bearing capacity.[8]

### 1.1.2 Local Intermediaries

A continuum of local intermediaries, indexed by $j \in [0, \infty)$, supply forwards, while also operating in the spot market.

[8] Realized profits of the global investor are $\frac{\left(E_t \frac{F_t}{S_{t+1}} - 1\right)}{\gamma_t \operatorname{var}_t\left(\frac{F_t}{S_{t+1}}\right)}\left(\frac{F_t}{S_{t+1}} - 1\right)$.

Each individual intermediary $j$ holds a zero-capital portfolio in home and foreign bonds $(G_{j,t+1}, G^{\star}_{j,t+1})$ such that: $\frac{G^{\star}_{j,t+1}}{R^{\star}_t} + \frac{G_{j,t+1}}{S_t R_t} = 0$. A $(G_{j,t+1}, G^{\star}_{j,t+1})$ position in the bond market delivers $G^{\star}_{t+1}\left(1 - \frac{R_t}{R^{\star}_t}\frac{S_t}{S_{t+1}}\right)$ U.S. dollars. The intermediary also holds a $K_{t+1}$ short forward U.S. dollar position. The realized return from a $K_{t+1}$ short forward U.S. dollar position is $K_{t+1}\left(\frac{F_t}{S_{t+1}} - 1\right)$ U.S. dollars. Thus, the overall return on the intermediary's portfolio is:

$$G^{\star}_{j,t+1}\left(1 - \frac{R_t}{R^{\star}_t}\frac{S_t}{S_{t+1}}\right) + K_{j,t+1}\left(\frac{F_t}{S_{t+1}} - 1\right) \tag{5}$$

Consistent with prevailing regulation on financial institutions in emerging economies, we make the following two assumptions:

**Assumption 3** *Local intermediaries cannot hold exchange rate risk.*

**Assumption 4** *Local intermediaries are subject to position limits and participation costs.*

Intermediaries investment decisions are subject to two sets of restrictions. First, intermediaries cannot hold exchange rate risk (Assumption 3). In this model, this assumption implies a specific relationship between intermediaries spot and forward market positions that guarantees a deterministic portfolio return. Second, each intermediary is subject to a net open position limit face idiosyncratic participation costs (Assumption 4), similar to Alvarez et al. (2009) and Fanelli and Straub (2021). In Appendix A.1, we show that these restrictions imply the following total supply of (short-dollar) forward:

$$K_{t+1} = \frac{1}{\kappa}\underbrace{\left(\frac{R^{\star}_t}{R_t}\frac{F_t}{S_t} - 1\right)}_{\text{CIP Deviation}_t}. \tag{6}$$

Local intermediaries' forward supply is increasing in the CIP deviation. Because of these position limits, akin to balance sheet regulatory constraints, local intermediaries require compensation to supply forwards resulting in CIP deviations. Here $\kappa$ denotes the stringency of participation costs, and thus the elasticity of CIP deviations to changes in local interme-

diaries' forward supply.[9] In addition, in Appendix A.1 we show that local intermediaries' demand for U.S. dollar spot is:

$$G^{\star}_{t+1} = \frac{1}{\kappa} \underbrace{\left( \frac{R^{\star}_t}{R_t} \frac{F_t}{S_t} - 1 \right)}_{\text{CIP Deviation}_t} \frac{R^{\star}_t}{R_t} \frac{F_t}{S_t}. \tag{7}$$

Last, the combined spot/forward positions of local intermediaries delivers positive profits, and increasing in the size of the position that they take in their intermediation activity:

$$\frac{1}{\kappa} \left( \underbrace{\frac{R^{\star}_t}{R_t} \frac{F_t}{S_t} - 1}_{\text{CIP Deviation}_t} \right)^2. \tag{8}$$

### 1.1.3 Equilibrium in Forward Market

Forward market clearing requires that long-dollar forward position of local intermediaries (supply) equals of short-dollar forward position of foreign investors (demand):

$$-K_{t+1} = H_{t+1} \tag{9}$$

Equations (4), (6) and (9) describe the equilibrium in the forward market. Figure 1a depicts the supply and demand diagram of the forward market after taking the first-order approximation of these equations around a risky steady state (Coeurdacier et al., 2011) where period-$t+1$ log exchange rate is drawn from a normal distribution with $\text{var}_t(\Delta s_{t+1}) = \sigma_s^2$.

Equation (6) represents the supply of dollar forward, with its slope determined by the tightness of local intermediaries' position limits, parameterized by $\kappa$. When $\kappa = 0$, there are no position limits resulting in zero CIP deviations regardless of local intermediaries' position in the forward market—a flat forward supply curve. To the contrary, when local

[9] While we model frictions in forward supply as position limits and participation costs, we acknowledge other elements of financial intermediation, such as "monopolistic markups" can result in an upward sloping supply of forwards, *i.e.* in a relationship similar to eq. (6).

intermediaries are subject to position limits ($\kappa > 0$), the forward supply is upward sloping, and local intermediaries demand a higher CIP deviation to supply more U.S. dollars forward.

Equation (4) represents the demand of dollar forward. When global investors' risk-bearing capacity is unlimited ($\gamma_t = 0$), their position in the forward market will drive CIP deviations to be the inverse of UIP deviations, a point in which average returns on the forward trade are zero—a flat forward demand curve. Instead, if the risk-bearing capacity of global investors is limited ($\gamma_t > 0$), the forward demand curve is downward sloping. Everything else equal, foreign investors demand less dollar forwards when CIP deviations are larger.

There are two factors that shift the forward demand curve of foreign investors. First, larger UIP deviations—higher returns on the home currency, determined in equilibrium—push investors to demand more home currency forward, resulting in a left-ward shift in the demand curve for dollar forward and thus lower equilibrium CIP deviations. Second, fluctuations in global investors' risk bearing capacity also shift forward demand. The direction of these shifts depends on the original position of global investors, which is determined by the equilibrium UIP deviations. If UIP deviations are positive, tighter risk-bearing capacity leads foreign investors to require higher compensation on their forward trade. This results in a right-ward shift of the forward demand curve: to reduce their exposure to the forward trade, foreign investors demand less local-currency forward (more dollar forward). This will increase the equilibrium CIP deviations. We elaborate on these aspects below.

We outline a number of empirical predictions of the proposed model's forward market.

**Proposition 1** *Local intermediaries' long-dollar position in the forward market:*

*(a) is negatively correlated with the position of global investors in the forward market;*

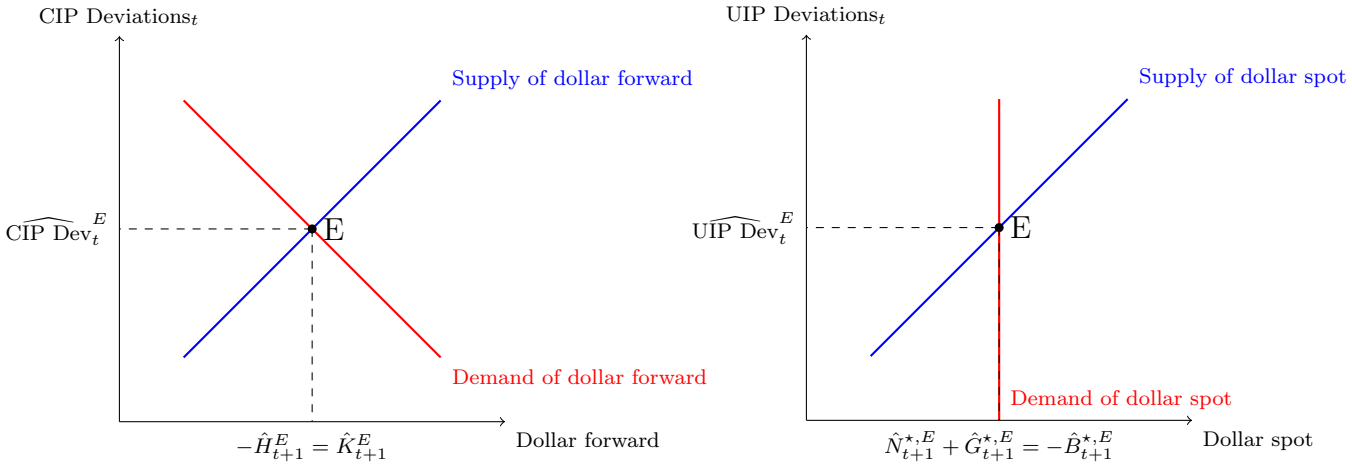
*(b) is negatively correlated with the CIP deviation;*

*(c) delivers positive profits on their CIP-trade.*

*Global investors' short-dollar forward position is positively correlated with the returns from the forward trade.*

**Proof.** See Appendix A.4 ■

Because global investors drive forward demand, their position is tightly linked with the position of domestic intermediaries—the suppliers of forwards. In our simple model, they are the mirror image of each other by forward market clearing (9). In turn, because CIP deviations emerge as compensation for domestic intermediaries' costly forward supply is, their forward dollar position is negatively correlated with CIP deviations, and their forward position must deliver positive profits. Last, a key prediction of the model is that the position of global investors (demand) respond to expected returns on the forward trade. We confront these prediction with data from Peru's forward market in Section 2.




**(a)** Equilibrium in the Forward Market **(b)** Equilibrium in the Spot Market

**Figure 1:** Equilibrium in Forward and Spot Markets

*Note*: The graphs depict the equilibrium in the forward market (Panel (a)) and in the spot market (Panel (b)). We take the first-order approximation of the relevant equilibrium conditions to depict these equilibrium relationships, as we describe in Appendix A.2.

## 1.2 Spot Market

In this section, we describe the equilibrium in the spot market, the determinants of equilibrium UIP deviations, and the interaction across spot and forward markets. The spot market includes currency spot transactions and short-term bonds. Henceforth, references to the "bond market" will pertain exclusively to short-term bonds.

**Domestic Currency-Spot Traders** We assume that a subset of local investors (*e.g.* firms, households, and other investors) can hold currency risk subject to limited risk bearing capacity, in a way that is similar to the "arbitrageurs" in Gabaix and Maggiori (2015).

They hold a zero-capital portfolio in home and foreign bonds $(B_{t+1}, B^\star_{t+1})$ such that $\frac{B^\star_{t+1}}{R^\star_t} + \frac{B_{t+1}}{S_t R_t} = 0$. A $(B_{t+1}, B^\star_{t+1})$ position in spot market delivers $B^\star_{t+1}\left(1 - \frac{R_t}{R^\star_t}\frac{S_t}{S_{t+1}}\right)$ in U.S. dollars. Currency-spot traders maximize mean-variance utility of returns in U.S. dollars:

$$\max_{B^\star_{t+1}} \quad B^\star_{t+1} E_t\left(1 - \frac{R_t}{R^\star_t}\frac{S_t}{S_{t+1}}\right) - \frac{\lambda}{2}\left(B^\star_{t+1}\right)^2 \mathrm{var}_t\left(1 - \frac{R_t}{R^\star_t}\frac{S_t}{S_{t+1}}\right),$$

where $\lambda$ denotes their risk aversion. The first-order condition reads:

$$\frac{\overbrace{\left(E_t \frac{R_t}{R^\star_t}\frac{S_t}{S_{t+1}} - 1\right)}^{\text{UIP Deviation}_t}}{\lambda\, \mathrm{var}_t\left(\frac{R_t}{R^\star_t}\frac{S_t}{S_{t+1}}\right)} = -B^\star_{t+1} \tag{10}$$

Equation (10) states that domestic currency-spot traders' position in foreign currency is increasing in foreign-currency excess returns, in proportion to their risk bearing capacity.[10]

**Inelastic Spot Investors** A set of inelastic domestic investors holds a zero-capital position in home and foreign bonds:

$$S_t \frac{N^\star_{t+1}}{R^\star_t} + \frac{N_{t+1}}{R_t} = 0. \tag{11}$$

The inelastic demand of currency spot is meant to capture the currency demand of domestic investors such as domestic pension funds or firms that export or import.

### 1.2.1 Equilibrium in Spot Exchange Market

Bond market clearing requires that the demand for foreign currency spot equals its supply:

$$N^\star_{t+1} + G^\star_{t+1} = -B^\star_{t+1}. \tag{12}$$

[10] We note that equation (10) characterizes the behavior of some firms in emerging economies whose spot currency positions respond to the size and sign of expected excess returns (Bruno and Shin, 2017).

Equations (7), (10), (11), and (12) determine the equilibrium in the spot market, also depicted in Figure 1b. If currency-spot traders are risk averse, the supply curve for dollar spot is upward sloping. Higher supply of dollar spot—to meet the demand of inelastic investors and local intermediaries—increases currency-spot traders' exposure to the possibility of a local currency depreciation. As a result, they require higher excess home currency returns, as per eq. (10), resulting in higher UIP deviations.

## 1.3 UIP and CIP Deviations in Equilibrium

UIP and CIP deviations result from the equilibrium in both forward and spot market. One can express equilibrium CIP and UIP deviations in closed form as (see Appendix A.3):

$$\underbrace{(r_t^\star - r_t + f_t - s_t)}_{\text{CIP Deviation}_t} = \frac{\Lambda\kappa}{\Gamma_t + \kappa + \Lambda}(\xi_t); \qquad \underbrace{(r_t - r_t^\star - E_t s_{t+1} + s_t)}_{\text{UIP Deviation}_t} = -\frac{\Lambda(\Gamma_t + \kappa)}{\Gamma_t + \kappa + \Lambda}(\xi_t), \quad (13)$$

where lower-case letters denote the logarithm of the respective upper-case variables, $\Gamma_t = \gamma_t \sigma_s^2$ and $\Lambda = \lambda \sigma_s^2$ are global investors' and domestic currency-spot traders' risk-bearing capacity, respectively, while $\xi_t$ denotes a shock to the demand for home currency bonds.[11] We assume that the exogenous processes, $\xi_t$, $\Gamma_t$, and $s_{t+1}$ are independent.

We can then use eq. (13) to express the expected return in the forward market:

$$\underbrace{(f_t - E_t s_{t+1})}_{\text{forward-market returns}_t} = -\frac{\Lambda\Gamma_t}{\Gamma_t + \kappa + \Lambda}(\xi_t). \quad (14)$$

We now outline another set of testable predictions that we take to the data.

**Proposition 2** *Consider a continuum of small-open economies, indexed by $c \in [0, 1]$, with idiosyncratic levels of currency imbalances, $\xi^c$. In equilibrium, the cross-currency correlation*

[11] The shock to home-currency bond demand is formally defined as:

$$\xi_t = -\left(\frac{R_t}{R_t^\star}\frac{S_t}{F_t}\right)^2 N_{t+1}^\star$$

*between average UIP deviations and average CIP deviations is negative.*

**Proof.** See Appendix A.4 ■

The mechanism we propose in this paper implies that countries with higher UIP deviations exhibit lower CIP deviations. In our model, a country with high UIP deviations, which results from a higher exogenous spot exchange demand for foreign-currency bonds, attracts global investors' demand for home-currency forward. To induce local intermediaries to supply home-currency forward, CIP deviations have to be lower. This basic mechanism, summarized in Figure A.1, stems naturally from our model where forward demand reflects investors' desire to take advantage of predictable excess returns.

**Proposition 3** *Consider the first-order approximation of economy c around a risky steady state with positive UIP deviations (i.e.* $\xi^c < 0$*). Then:*

*(a) Global financial disruptions* ($\hat{\Gamma}_t \uparrow$) *cause an increase in CIP deviations as well as UIP deviations, as well as a reduction in currency-c forward demand by global investors (and thus supply by local intermediaries).*

*(b) Furthermore, if the average UIP deviation across emerging-economies currencies is positive (i.e.* $\xi \equiv \int \xi^c \, dc < 0$*) the common component of CIP deviations is positively correlated with the tightness of global financial conditions* ($\hat{\Gamma}_t$)*, and with the value of the U.S. dollar* ($\hat{s}_t$)*.*

**Proof.** See Appendix A.4 ■

Proposition 3 outlines the dynamics of prices and quantities following a tightening in global investors' risk bearing capacity in countries where UIP deviations are positive—the relevant case for virtually all emerging economies (Kalemli-Ozcan and Varela, 2024). For a given positive return on their risky forward trade, global investors demand less home-currency forward in the forward market (to reduce their exposure). The ensuing movement along the forward supply curve result in increasing CIP deviations. In equilibrium, UIP deviations

increase as local intermediaries reduce their foreign-currency spot demand since they now have to supply less home-currency forward. These dynamics are summarized in Figure A.2.

When considering the dynamics for the average emerging economy, a similar logic applies. Higher global risk aversion leads to higher CIP and UIP deviations, along with an appreciation of the U.S. dollar (relative to the average value of emerging economies' currencies), provided that interest rate differentials are constant following the increase in global risk aversion. In this sense, the U.S. dollar in this model can be interpreted as a global risk factor. It appreciates during periods of heightened global risk aversion, and *vice versa*.

**Discussion** The mechanism we propose naturally predicts that CIP deviations increase, rather than decrease, during periods of heightened global risk aversion. This occurs because global investors, retrenching from emerging economies' forward markets during such periods, effectively exert demand for dollar forwards. This demand appreciates the U.S. dollar and pushes CIP deviations upward in emerging economies. (In Section 4, we highlight that this prediction contrasts with the implications of a model with time-varying convenience yields.)

In the baseline model, if UIP deviations are positive—implying negative CIP deviations—then changes in global risk aversion can only increase CIP deviations until they reach zero (this occurs when global risk aversion becomes infinite). However, we note that a simple extension of the model, relaxing simplifying Assumption 2 to allow global investors to hold a non-zero, yet still predetermined, position in emerging economies' bonds, would imply that CIP deviations not only can increase but also can become positive following global financial disruptions, without altering the rest of the analysis.

# 2 Positions and Returns in Peru Forward Market

We now leverage detailed confidential data from Peru forward market to speak to the main features of the framework of Section 1.

Peru is a small open economy in Latin America. Local banks in Peru act as our model's local intermediaries. This is because they are market makers in the USDPEN forward

currency market, where PEN is the Peruvian currency international abbreviation. In most cases, these local banks are also commercial banks. Since Peru is a partially dollarized economy, these banks obtain both soles (Peru's currency) and dollar deposits and lend both of these currencies. Hence, as described in Keller (2024), these deposits, particularly term deposits, can be important sources of funding for CIP-trading activities.

An important aspect to highlight is that Peru's FX market operates in a similar fashion to those in other emerging economies. For example, emerging economies are typically partially dollarized, their local banks are market makers in the FX market (including forward market) and they are subject to similar regulations and structure.

In what follows of this section, Section 2.1 describes Peru forward market data, Section 2.2 describes how the model's setting captures well the setting in Peru, and finally Section 2.3 confronts the model's propositions to Peru forward market data.

## 2.1 Peru Forward Market Data

Our data consists of market data as well as rich foreign-exchange and money market data that allows us to have a detailed picture of the forward market and banks' CIP arbitrage transactions. The sample of our confidential data goes from 2005 to 2018.

**Market Data.** We collected foreign-exchange data on spot and forward transactions from *Bloomberg*. We also retrieve Peru's official closing spot foreign-exchange data from Peru's bank regulatory agency, *Superintendencia de Banca y Seguros* (SBS). We complement this data with banks' interbank funding from Peru's Central Bank, as well as reserve requirements applicable to each bank.

We also collect information regarding foreign investors' holdings of fixed income in Peru. The safest short-term Peru-sovereign-risk security are Peru's Central Bank's certificates of deposit. These are typically less than 1-year. As we explain later, foreign investors used to briefly hold some of these securities, until regulation made it prohibitively expensive for them to do so and since October 2010, foreign investors have had a zero balance of

these. The data for these holdings was hand-collected from various reports published by the Central Bank of Peru. Regarding longer-dated bonds, these are issued by *Ministerio de Economia y Finanzas* (Peru's finance ministry). We manually collect data from PDFs from Ministerio de Economá y Finanzas (2023) to obtain the number of sovereign bonds held by foreign investors. These holdings are important to validate our model's assumption that foreign investors do not hold significant levels of government short-term debt of the emerging market economy.

**Forward Data.** We complement our market data with a vast number of confidential data on banks' foreign exchange trading that comes from confidential mandatory reports local banks in Peru make to the SBS. The main dataset we use consists of a weekly snapshot of all forward contract holdings of banks. This snapshot has all contract details, such as the name of the local bank, date of the trade, maturity, direction of the trade, notional, forward price and counterparty name. Additionally, banks have to report the spot price at the time they closed the forward contract. This is useful to compute trade-level forward premia.

**Investment and Borrowing Data.** In addition to the forward contract level data, local banks have to report to the SBS various money-market assets and liabilities. These information allow us to compute banks' CIP profits. We follow Keller (2024) and use those liabilities and assets that are most probably used when arbitraging CIP deviations. Hence, for funding we use rates and balances of new term deposits for both soles and dollars. For soles investments, we use a dataset that has monthly snapshots of fixed-income holdings of banks. While the snapshots are monthly, the dataset has the transaction date, so we can proxy for investments on a particular date. From this dataset, the relevant asset in soles used for CIP arbitrage is Peru's Central Bank's certificates of deposit. For dollar investments, on the other hand, we use another confidential dataset from the SBS which contains the rates at which local banks in Peru invest in dollar deposits at the Central Bank of Peru.

## 2.2 Structure of Forward and Spot Markets

We use the data above to first corroborate the main assumptions underlying the model setup.

First, the model's Assumption 1 and Assumption 2 intend to capture that foreign investors find it difficult to invest in the short-term bonds (our model does not have long-term bond holdings) and hence, any position foreign investors engage when borrowing in a currency and investing in another comes through forward contracts. Below, we use Peruvian data to describe the financial regulations that make it costly, and sometimes prohibitive, for foreign investors to access local bond and exchange rate spot markets, which would be needed if they wanted to replicate their forward positions in the spot cash market. This generates market segmentation, where foreign investors faces differential costs to accessing forward and spot markets of emerging economies. Therefore, we refer to the combination of Assumption 1 and Assumption 2 as the main assumptions about market segmentation.

### 2.2.1 Assumption 1 and Assumption 2: Market Segmentation

The setting of the model assumes there is market segmentation, where local banks have an advantage in accessing the cash market. Keller (2024, Online Appendix) describes such market segmentation. We also discuss it below in more detail.

**1. Only local banks can access Central Bank's primary auctions** Local banks have an advantage compared to foreign banks when arbitraging CIP deviations because only local banks can participate in the Central Bank's primary auctions. These auctions include money market instruments that are key in arbitraging CIP deviations (both in terms of investing and funding).

**2. Only local banks can access interbank USDPEN spot market** They are also the only ones that can trade in the interbank USDPEN spot market, which is the main reference market for USDPEN spot. To buy and sell currency spot, foreign investors must resort to local intermediaries.

**3. It is costly for foreigners to invest in short-term government debt** There are a number of limitations, already outlined above, that indicate that it is costly, and sometimes prohibitive, for foreign investors to access local bond and exchange rate spot markets. Moreover, during periods of significant carry trade inflows, such as at the end of 2007 and early 2008, the Central Bank made it more difficult for foreign investors to invest in the secondary market for its certificates of deposit (CDs). Since these are the lowest-risk short-term securities denominated in soles—ideal for carry trades and arbitraging CIP deviations—foreign investors looking to engage in either activity had to invest in longer-term sovereign bonds, exposing them to price risk if they did not hold the bonds until maturity.

Figure 2 shows that after the Central Bank imposed a 4% fee over notional to foreign investors when purchasing CDs, which is depicted by the dotted red line in early 2008, foreign holdings of CDs drops gradually to zero as these certificates mature. This is not due to lack of appetite for soles securities. While foreign investors decreased their holdings of soles sovereign debt during the crisis, after 2010, when inflows in Peru resumed, they increased their positions of sovereign debt but found it very costly to re-enter the market for CDs.[12]

**4. Foreigners have a disadvantage compared to local banks in borrowing soles.** At times when foreign investors expect the sol to depreciate further than the interest rate differential (*i.e.* there are negative excess returns), they may want to profit by borrowing in soles and investing in dollars. Similarly, if they wanted to arbitrage from positive CIP deviations, they would also need soles funding.

However, foreigners typically cannot easily access soles funding and if they do, it would come at additional transactions costs. First, soles can only be liquidated in Peru. Therefore, a foreign investor would need to have a soles account in Peru. Second, a foreigner cannot get soles deposits. This is because the banking regulation in Peru prohibits any entity in Peru,

[12] In November 2010 and February 2012, they bought the new issuance of sovereign debt with a maturity of 10 years. This issuance targeted foreign investors since these were issued as Global Depository Notes. That is, they are issued by a foreign bank to have the advantage of being traded, settled, and paid interest and principal in dollars. However, the terms are those of the soles Peruvian sovereign debt being issued.

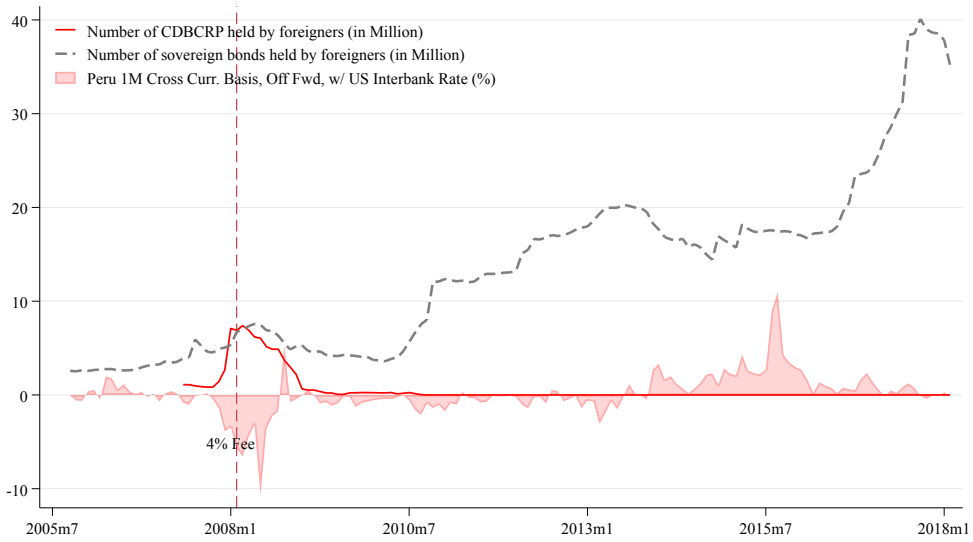



**Figure 2:** Foreign Holdings of Bond and Certificates of Deposit of the Central Bank

*Note:* The solid red line shows the number of CDs of the Central Bank that foreigners hold (in millions). The dotted gray line shows the number of sovereign bonds foreigners hold (in millions). The shaded red area shows the cross-currency basis. The dotted red line in January 2008 indicates the time when the Central Bank imposed the 4% fee on purchases of soles CDs charged to foreign investors. The significant increases in bond holdings in November 2010 and February 2012 correspond to bond issuance the government did. In both cases, the government issues these bonds as Global Depository Notes (GDN) and therefore were targeted more to foreign investors.

apart from local banks, from receiving deposits from households and firms. An alternative would be to borrow from local banks. However, as shown in Keller (2024), soles are scarce when CIP deviations increase, and local banks use such soles funding to do the CIP arbitrage themselves. Therefore, any lending from local banks to foreign investors will likely involve a higher interest rate than compensates local banks for not being able to use such funds to do the arbitrage.

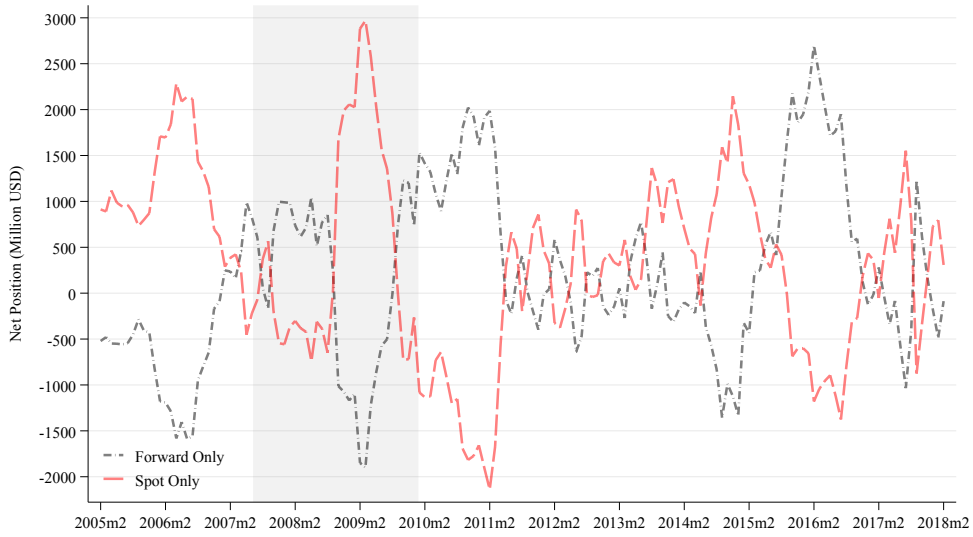
### 2.2.2 Assumption 3: Local Intermediaries Hedge

In the theoretical model of Section 1, local intermediaries hedge their exchange rate risk. This is a general emerging-market characteristic due to regulation. For example, Canta et al. (2007) shows a large list of emerging economies and the regulatory limits local banks have on their total exchange rate risk. More recently, Keller (2024, Online Appendix) shows this was the case in Peru for the sample of the paper (that is, until 2013). Alfaro et al. (2023)

also highlight that financial intermediaries in Chile do not hold exchange rate risk. Similar regulations are also in place in Colombia (Autorregulador del Mercado de Valores, 2019).

Next we use banks' forward, swap and spot positions in Peru to replicate Figure A.1 from Keller (2024, Online Appendix), but prolonging the sample until 2018, the last data point in our sample. The figure in Keller (2024) uses a sample until 2013 to show that banks' FX spot position is matched with an inverse forward (plus FX swap) position, so banks' net FX position is minimal.[13] Figure 3 is the extended series and again shows banks FX positions are minimal. This is expected as regulation explicitly limits banks' FX positions (Canta et al., 2007).

**Figure 3:** Bank hedging: Forward and Spot Positions




We compute Peru's banking system's long dollar spot and forward and swap FX positions. As expected when they hedge most of their currency foreign exchange position of forwards with spot, the spot position is inversely related to the forward position.

An important note is that the regulations we are referring to here and that apply broadly to emerging economies limits banks' *total* FX position, which derive from the sum of spot

[13] FX swaps were traded in 2015 and were in traded with the Central Bank of Peru, who in this period of time decided to intervene in the FX market by using FX swaps rather than intervening in the spot market as they usually had done in the past. This is also why the balances of banks' forward plus swap position differs in this plot compared to the other figures. The figure decomposing the FX forward and swap into its components is Figure B.1 in the Appendix.

positions and forward positions. This means that a bank can have a large net spot position, as long as it is offset by the forward position so as to the net FX position is less than the permitted limit.[14,15]

## 2.3 Positions and Returns in Forward Market

### 2.3.1 Positions and returns for different market participants

Proposition 1 highlights three key properties of the forward position of local intermediaries.

Proposition 1(a) states that domestic banks' positions are negatively correlated with the position of foreign investors. It would be the case if foreign investors are a very important counterparty driving banks' positions. Using trade-level data from Peru for all of our sample, we find that the correlation between the balance of dollars forward of foreigners and banks is $-0.80$ ($-0.88$ using flows). This is also seen in Figure 4, which plots foreigners' long dollar forward balances in red, and banks' long dollar forward balances in dotted gray. The red shaded area in that plot are the CIP deviations, while the gray shaded dates correspond to the NBER recession dates associated with the Great Financial Crisis (GFC).

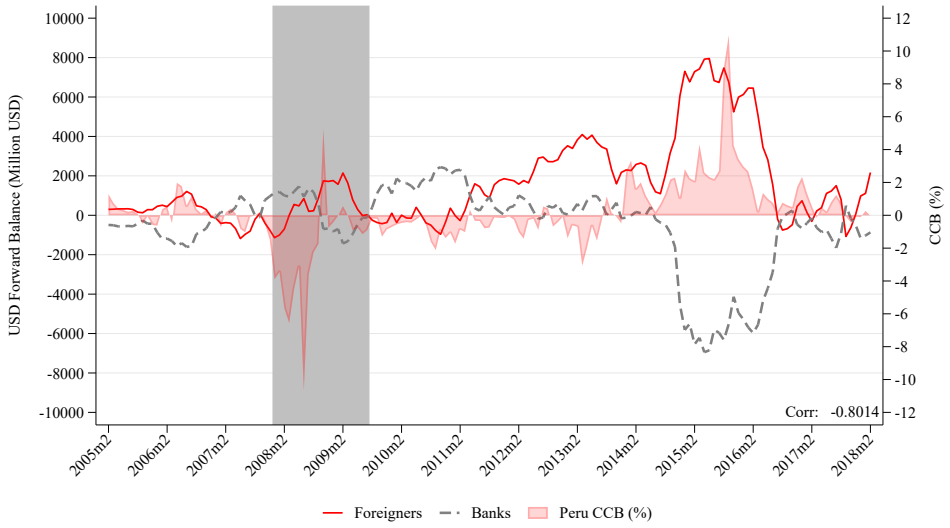
Additionally, a simple (unreported) regression of banks' positions on foreigners' positions shows that a 1 dollar increase in foreigners' long forward dollar position is associated with a decrease of 0.8 dollars in banks' long forward positions. Before the Taper Tantrum in 2013, this relationship was even stronger, with the coefficient showing a one-to-one relationship. After the taper tantrum, when the sol and other emerging-market currencies depreciated, more firms starting using forwards, explaining the decrease of the coefficient. Yet, still, foreigners remain the most important counterparty of local banks in the forward market.

Overall, forward balances of local intermediaries are virtually the mirror image of forward balances of global investors, even though local intermediaries routinely trade forwards with other local entities such as corporates, pension funds, and occasionally the central bank.

[14] The limit has varied over time.

[15] In Peru, in 2011 banks also had a limit on their purchases. In 2015, a new regulation increased the costs of banks when trading forwards (as described in Keller (2024)'s Online Appendix E).

**Figure 4:** Forward balances from foreigner investors and banks




*Note:* The solid red line shows foreign investor's net long dollar forward balances, while the dotted gray line shows that of local banks. The red shaded area is the 1-month USDPEN cross-currency basis. The NBER recession dates corresponding to the Great Financial Crisis (GFC) are shaded in gray. The correlation coefficient shown in the figure is the correlation between foreign investors and local banks' net long dollar forward balances.

In Proposition 1(b) and Proposition 1(c), we outline two key predictions of our model regarding banks' holdings, based on local banks uniquely conducting CIP arbitrage while facing position limits.

Specifically, Proposition 1(b) states that CIP deviations are negatively correlated with banks' holdings. This relationship is a natural outcome of the model; for local banks to be incentivized to supply dollar forward contracts (i.e., to maintain a negative net long dollar forward position), CIP deviations must be positive. Our analysis of Peruvian data confirms this prediction, revealing a correlation of $-0.36$ between the net long dollar forward balance of local banks and CIP deviations, as shown in Figure 4. We observe similar findings when looking at flows instead of balances.

Finally, Proposition 1(c) states that local banks gain positive profits from their CIP trade. Below we show that banks' profits from trading CIP deviations, being these positive or negative, increase when deviations (in absolute value) increase. Since the 1-month forward

is the most traded contract, we take only the profits from trading 1-month forwards and compare them with 1-month CIP deviations.

We measure local banks' profits from arbitraging CIP deviations by first computing for each bank the approximate CIP deviations they lock into for each trade, and multiplying this by the volume of the trade. This would give the CIP profit of the trade. We then aggregate these profits for the banking system.

Several important factors must be taken into account for this calculation. First, the direction of the trade is crucial, as the calculation of profits varies depending on whether banks are buying or selling dollars forward. To estimate banks' profits from trading forwards—presumably unwinding these positions at the reported spot rate at the time the forward contracts were executed—we analyze profits at the trade level and then aggregate them at the banking system level. Additionally, the funding and investment currency are influenced by the trade direction, which we also factor into our analysis.

Second, banks do not disclose the funding and investment rates associated with their covered interest parity (CIP) arbitrage activities, making it difficult to ascertain the exact rates they employ. To address this, we estimate banks' arbitrage profits in two ways.

The first method employs a straightforward assumption that the funding and investment rates correspond to 1-month term deposits. Since we have access to the daily rates at which each bank acquires new deposits, our profit computations are conducted at the bank level. We also adjust the corresponding costs to account for the reserve requirement rates applicable to each bank.

The second method involves identifying the most likely investment and funding rates used by each bank in the CIP arbitrage. As noted in Keller (2024), banks primarily fund their activities through term deposits. Thus, we use the 1-month dollar term deposit rate—adjusted for reserve requirements—as the funding rate for both dollars and soles. Additionally, Keller (2024) highlights that most short-term dollar investments are held in deposits at the Central Bank, while short-term investments in soles typically consist of purchases of Central Bank

certificates of deposit. Therefore, we adopt these rates as the investment rates. Notably, this calculation is conducted using each bank's specific investment and deposit rates on every trading day. More precisely, the computation at the trade-level works as follows. When banks buy dollars forward, they profit by buying at a lower forward price than the synthetic forward they could do in the spot market. That is, they profit when the cross-currency basis is negative by buying dollars forward and unwinding in the spot market. The negative of the basis becomes their profit margin. The opposite will occur when banks sell dollars forward. In this case, positive basis proxy the profit of banks. Therefore, the trade-level profit is given by:

$$\begin{aligned}
\text{Profit}_{\text{Buy fwd}} &= Not^{\text{Fwd}} \times (-CCB) \\
&= Not^{\text{Fwd}} \Big[ (1 + y^{inv}_{t,t+n})^n - \frac{F_{t,t+n}}{S_t} (1 + y^{\$,borrow}_{t,t+n})^n - 1 \Big] \\
\text{Profit}_{\text{Sell fwd}} &= Not^{\text{Fwd}} \times (CCB) \\
&= Not^{\text{Fwd}} \Big[ \frac{F_{t,t+n}}{S_t} (1 + y^{\$,inv}_{t,t+n})^n - 1 - (1 + y^{borrow}_{t,t+n})^n \Big]
\end{aligned}$$

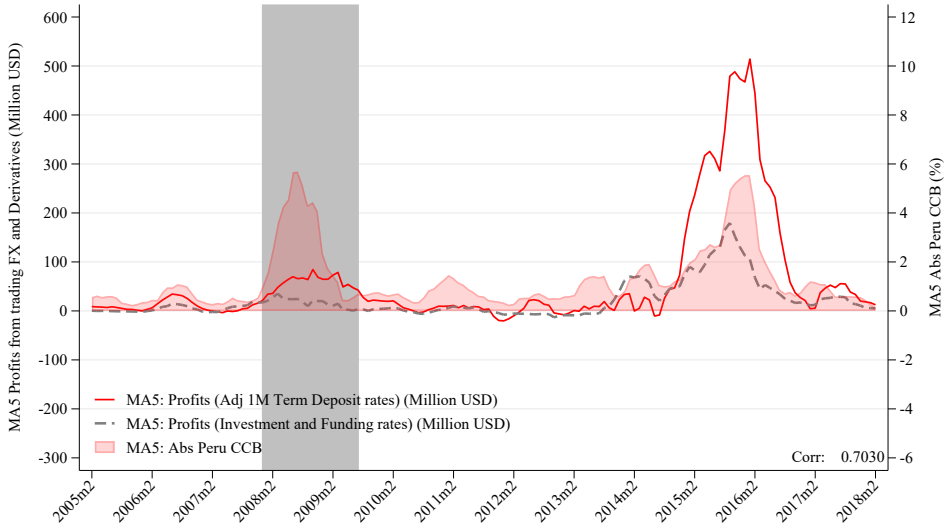
Where $\text{Profit}_{\text{Buy fwd}}$ is the profits banks make by buying dollars forward (and selling them spot), while $\text{Profit}_{\text{Sell fwd}}$ is the profits banks make from selling dollars forward and buying them spot.

As previously described, the interest rates in soles and dollars used depend on the direction of the trade. When banks buy dollars forward and sell dollars in spot, they need dollar funding for the spot transaction. In exchange, they receive soles cash, which needs to be invested. Therefore, to compute $\text{Profit}_{\text{Buy fwd}}$, the dollar rate used is the dollar funding rate while the soles rate used is the soles investment rate. In contrast, to compute $\text{Profit}_{\text{Sell fwd}}$, we use the dollar investment rate and soles funding rate.

The result of these calculations are shown in Figure 5. The shaded red area corresponds to the de-trended 6-months moving average of the absolute value of CIP deviations overlapped with the two profit measures. The red line is the moving average of the profits calculation

when using only deposit rates, while the gray line is the proxy we use when adjusting for investment and funding rates.

**Figure 5:** CIP deviations and profitability




We compute six-month moving averages of profits from trading, and of Peru's absolute CIP deviations. The red line is the de-trended 6-months moving average of the sum of FX spot and FX derivatives profits. The gray line is the proxy I use when adjusting for investment and funding rates. The shaded red area is the de-trended 6-months moving average of the absolute value of CIP deviations.

In Table 1 we also show that profits across CIP regimes (either positive or negative) have always been positive for banks. For completeness, it also shows summary statistics across various samples.

**Table 1:** Summary Statistics: CIP deviations and profitability

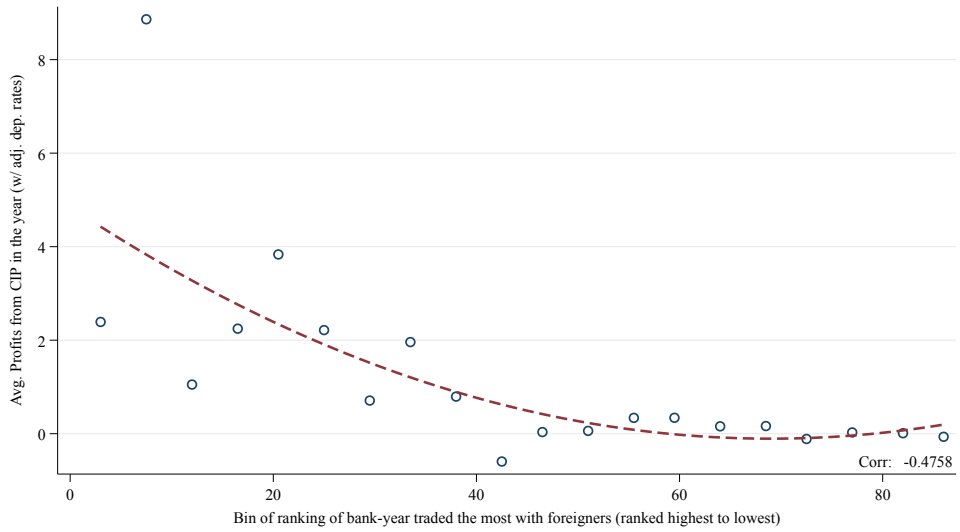
| | 2005-2018 | | 2005-2013 | | 2005-2018 no GFC | | 2005-2013 no GFC | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | Mean | SD | Mean | SD |
| Panel A. $CIP > 0$ | | | | | | | | |
| Profits (Adj 1M Term Deposit rates) | 108.37 | 183.64 | 21.11 | 43.40 | 107.35 | 185.89 | 10.81 | 17.94 |
| Profits (Investment and Funding rates) (Million USD) | 39.45 | 56.05 | 6.13 | 16.48 | 39.55 | 56.42 | 3.64 | 8.21 |
| Peru CCB (%) | 1.52 | 1.83 | 0.72 | 1.05 | 1.48 | 1.80 | 0.54 | 0.51 |
| Panel B. $CIP \leq 0$ | | | | | | | | |
| Profits (Adj 1M Term Deposit rates) | 17.27 | 34.36 | 16.68 | 31.51 | 8.77 | 30.69 | 5.90 | 24.27 |
| Profits (Investment and Funding rates) (Million USD) | 5.84 | 20.58 | 3.55 | 15.41 | 4.19 | 21.09 | 0.72 | 13.54 |
| Peru CCB (%) | -1.12 | 1.62 | -1.20 | 1.71 | -0.66 | 0.59 | -0.65 | 0.49 |

Additionally, since foreign investors are the largest counterparty of local banks, it is natural that banks trading the most with foreign investors also derive higher profits. From our model,

CIP deviations represent compensation that banks charge when intermediating forward flows from foreigners. As such, one could expect that the banks intermediating most with foreign investors also derive higher profits from CIP.

We exploit the cross-section of banks and find that those banks trading the most with foreign investors are also those that derive higher profits from CIP. Due to confidentiality we cannot show this scatterplot as there are 12 banks that are involved in forward trades. Instead, Figure 6 displays the binscatter plot of profits per bank-year. The $x$-axis shows the bin of the ranking of bank-years with with respect to the volume traded by that bank-year. A lower number in the ranking means greater ranking in the volume traded with foreigners. The $y$-axis corresponds to the average profits of the bin, computed using deposit rates (using investment and funding individual rates yields similar results).

**Figure 6:** Profitability derived from CIP and bank-year ranking of those trading the most with foreign investors

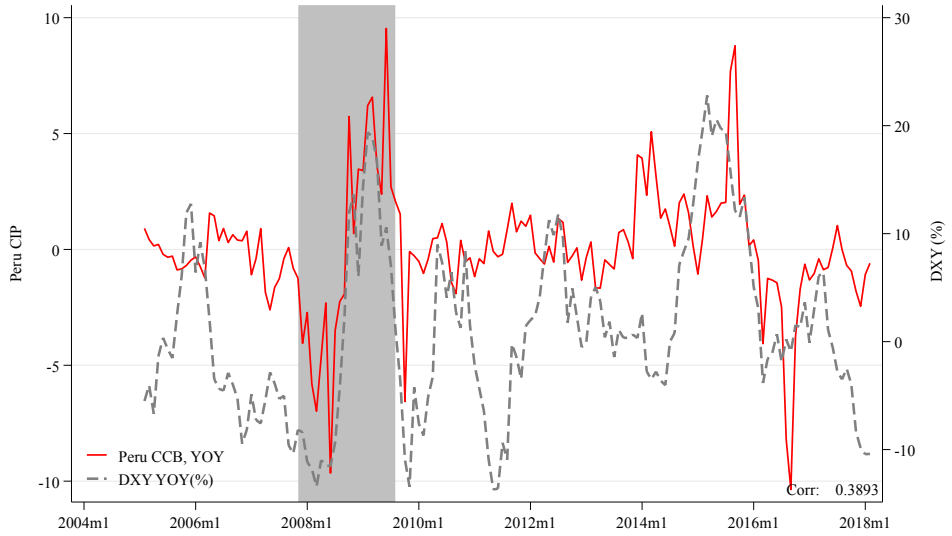



### 2.3.2 Positions and Returns during Global Financial Disruptions

Proposition 3 states that global financial disruptions are associated with increasing CIP deviations, appreciated U.S. dollar, as well as larger foreigners' demand of dollars forwards,

and consequently, larger supply of dollars forwards by local banks. Below, in Section 3 show that both the VIX and the dollar index (DXY) are positively associated with CIP deviations. In Peru, the strong positive association with CIP deviations also holds as shown in Figure 7. This is particularly the case for the Global Financial Crisis (NBER recession corresponding to this event is shaded in gray).

**Figure 7:** Year-over-year (YOY) change of dollar index and Peru's cross-currency basis

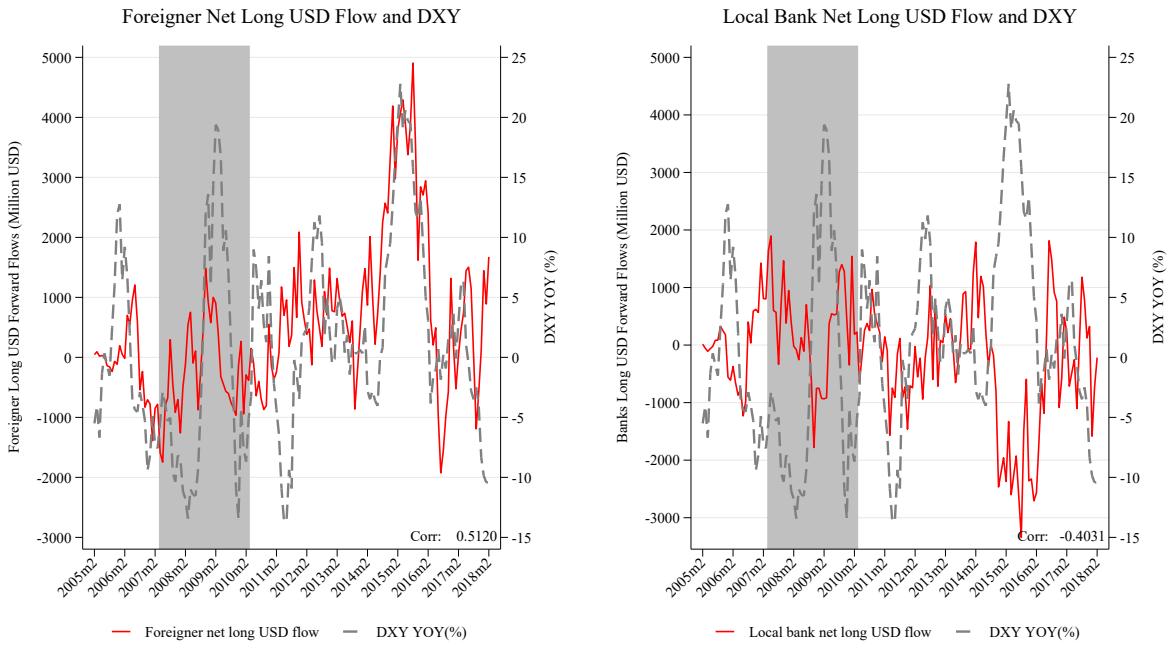



*Note:* The red line corresponds to the YOY change of USDPEN cross-currency basis, while the dotted gray line corresponds to the YOY change in the dollar index. The NBER recession corresponding to the Global Financial Crisis (GFC) is shaded in gray. The correlation is computed for the period 2005-2018.

Looking directly at holdings of forward contracts in Peru, we find that, as predicted by the model, foreign investors demand more dollars forward and local banks supply dollars forward during periods of appreciated U.S. dollar. This is shown in Figure 8, where the left subplot corresponds to the year-over-year (YoY) dollar index, DXY, and foreigner net long dollar flows while the right subplot corresponds to the flows of local banks. The red line in both subplots corresponds to the net long dollar forward flows while the dotted gray is the YoY DXY. An increase in foreigners net long dollar forward flows corresponds to greater foreigner demand of dollars forwards. As in the model, this has a strong positive correlation with the dollar index ($\rho = 0.51$). Given that local banks are dealers in the forward market,

their flows depict the supply of dollars forward. A decrease in net dollar flows of local banks means that there is more demand of dollars forward by their counterparties (which includes foreign investors), and therefore an increase in the net supply of dollars forward. Given that we observe that local banks' net long dollar forward flows are negatively associated with the dollar index, we corroborate our model's prediction that higher risk aversion, associated with stronger U.S. dollar, corresponds to a greater supply of dollars forward provided by local banks.

**Figure 8:** Year-over-year (YOY) change of dollar index and net long dollar forward flows




*Note:* The red line corresponds to the YOY change of USDPEN cross-currency basis, while the dotted gray line corresponds to the YOY change in the dollar index. The NBER recession corresponding to the Global Financial Crisis (GFC) is shaded in gray. The correlation is computed for the period 2005-2018 and is between the YOY DXY and the corresponding flow series.

## 2.4 Forward Demand: Speculation vs. Hedging Motives

We observe that the literature on CIP deviations often equates forward demand to hedging demand. In our framework, we modeled a distinct motive behind forward demand—a " speculation" motive—whereby global investors do not engage in forward trade to offset

currency risk exposure held elsewhere, but, to the contrary, to expose themselves currency risk with a positive expected return.

We argue that speculative motives are the primary force driving forward demand in emerging economies (while certainly not the only one). To this end, we provide evidence suggesting that global investors' positions does not align with a view where hedging motives dominate. To begin with, in the Peruvian market, investors can only hold long positions in assets, meaning that when foreign investors hold Peruvian assets, they would need to hedge currency risk by being long dollars in the forward market. This is because if they hold Peruvian assets (denominated in soles), they would hedge by selling soles forward (i.e., buying dollars forward). However, as shown in Figure 4, foreign investors' total long forward positions were mostly *negative* before February 2011, with the exception of the global financial crisis, when these positions turned positive from late 2008 to late 2009. The possible shift in February 2011 likely stems from a Peruvian regulation specifically targeting carry trades involving forward contracts.[16] The trend has since been for foreign investors to hold long positions in dollars forward. However, it remains difficult to distinguish whether these positions are primarily driven by speculation on a Sol depreciation or by hedging their holdings in Peruvian bonds and stocks. For example, after 2013, the increase in foreigners' short-Soles forward positions coincided with the so-called Taper Tantrum, which led to outflows from emerging economies, a rise in the dollar index (as shown in Figure 7), and higher likelihood of future Sol depreciation. To shed light on this question, Appendix B.2 further investigates foreign investors' use of forward exchange contracts in relation to their other soles exposure. While comprehensive data on all positions in soles is unavailable, the analysis focuses on the correlation between foreign investors' forward dollar positions and their Peru sovereign bond

[16] In particular, at the end of January 2011, the Peruvian bank regulator (SBS) introduced a regulation that imposed limits on local banks' net forward positions. The regulation explained that this was necessary because *"low interest rates abroad and expectations of an appreciation of the sol are attracting carry trade operations via foreign exchange derivatives, generating excessive volatility in the exchange rate market"* (Superintendencia de Banca y Seguros, 2011). News reports began to speculate that if the sol continued to appreciate, regulators might impose further measures. For instance, Bloomberg reported on January 28, 2011, that a Moody's Analytics economist remarked, *"If the pressure continues on the currency to appreciate, they will have to start using alternative measures like taxes"* (Bloomberg, 2011).

holdings. The results show no consistent evidence of hedging, with a weak and statistically insignificant negative correlation (−0.03) between changes in forward positions and bond holdings. We show that this correlation is fairly unstable across subperiods, with rolling correlations sometimes reaching significantly negative values (−0.6). We conclude that if foreign investors were hedging their purchase of soles-denominated assets, a negative correlation would not be expected, as hedging would involve buying dollars forward, not selling them forward.

A growing literature documents the use of FX derivatives by U.S. fixed-income mutual funds (Sialm and Zhu, 2024; Chen and Zhou, 2025) and U.S. equity mutual funds (Opie and Riddiough, 2024; Kaniel and Wang, 2025) who invest outside of the U.S., as well as the use of FX derivatives of different non-U.S. investors (Du and Huber, 2023; Hacioğlu-Hoke et al., 2024; Kubitza et al., 2024; Bräuer and Hau, 2024).

Across this literature, two recurring themes frequently emerge. First, FX derivatives usage is often limited across institutional investors. Second, FX derivatives usage is often related to expected currency returns, and even used to amplify, rather than dampen, market exposure, indicating that hedging, in the sense of simply removing currency exposure, is unlikely to be the main purpose for using currency forward contracts. Sialm and Zhu (2024) document that the average hedge ratio of U.S. mutual funds is around 18% and FX derivatives positions responds to return-enhancement motives such as currency momentum and carry trade. Chen and Zhou (2025) show that emerging-market currency hedge ratios of U.S. mutual funds is often negative, that is they amplify rather than hedge their currency risk through net long positions in short-term currency forwards. Chen and Zhou (2025) also document that net long positions in short-term currency forwards are larger towards countries with more stringent capital controls measures, suggesting that offshore-traded derivatives offer fund managers the option to gain direct, long exposure and flexibly adjust positions while overcoming barriers to capital movement. Opie and Riddiough (2024) document that the majority of U.S. international equity mutual funds adopt a hedge ratio close to zero, and

commonly enter both long and short currency forward contracts (in different currencies) to build, essentially, separate currency portfolios that frequently contain currencies that are not part of the underlying equity portfolio but provide exposure to various sources of currency excess returns, including carry and momentum. Kaniel and Wang (2025) show that around one quarter of equity funds use derivatives and that derivatives are frequently used to amplify market exposure. Du and Huber (2023) document that U.S. dollar hedging ratios among foreign investors in 2020 are around 44%, 35%, and 21%, for insurance companies, pension funds, and mutual funds, respectively. They also document that a significant portion of unhedged U.S. dollar allocations is explained by UIP deviations, proxied by interest rate differentials, as well CIP deviations. Kubitza et al. (2024) document that U.S. dollar hedge ratios are heterogeneous across Euro Area investors, with insurance companies hedging on average 38% of U.S. dollar bond positions, investment funds 35%, and pension funds 57%. They also show that CIP deviations are an important determinant of both FX derivative and U.S. dollar bond holdings among Euro Area investors (see also Bräuer and Hau, 2024). Hacioğlu-Hoke et al. (2024) document that the position of hedge funds active in the UK FX derivatives reflects trading activity consistent with carry trade, momentum, and macroeconomic news investment strategies.

# 3 CIP Deviations in Emerging Economies

This section confronts Proposition 2 and Proposition 3 with financial-market data from a large panel of emerging economies.

## 3.1 Data: Spot and Forward Market Returns

We collect the data on spot exchange rates, FX forward rates, interbank rates, and U.S. LIBOR rates from *Bloomberg*. To complement missing values in *Bloomberg* data we resort to data from *Datastream*. Our baseline sample focuses 19 emerging economies, while we report results for advanced economies (G10) in Appendix C. Our data range is from January 2002 to December 2022 to maximize the coverage of emerging market currencies. We follow Du

et al. (2018a) and Cerutti and Zhou (2024) to construct the variables. The list of variable tickers is provided in Table C.1.

We construct the annualized 3-month CIP basis using the spot exchange rate, 3-month interbank rates and FX forward rates as the following:

$$\text{CIP}_{c,t} = \frac{360}{ACT}\left(\frac{\text{FWD}_{c,t}}{\text{IRD}_{ct}} - 1\right), \quad \text{FWD}_{c,t} = \frac{F_{c,t}^{(3\text{M})}}{S_{c,t}}, \quad \text{IRD}_{c,t} = \frac{1 + r_{c,t}^{(3M)} \times \frac{ACT}{360}}{1 + r_{\$,t}^{(3M)} \times \frac{ACT}{360}}$$

where FWD is the forward premium, computed as the 3-month FX forward rate divided by the spot rate, quoted in FX per USD. IRD is the interest rate differential, computed as the gross domestic 3-month inter-bank rate divided by the gross 3-month US LIBOR rate. Both rates are annualized. $ACT$ is the number of days in the 3-month period.

We compute excess currency returns relative to the USD using interbank rates, as follows:

$$rx_{c,t+3M} = -\Delta s_{c,t+3M} + r_{c,t}^{(3M)} \times \frac{ACT}{360} - r_{\$,t}^{(3M)} \times \frac{ACT}{360}$$

We also compute the returns from the "forward trade" as follows:

$$rx_{c,t+3M}^{FWD} = -s_{c,t+3M} + f_{it}^{(3M)} \frac{ACT}{360}$$

where $s$, $f$, and $r$ are respectively the logarithm of the spot exchange rate, forward exchange rate, and interbank rate. $\Delta s_{t+3M}$ is the 3-month difference in the logged exchange rate.

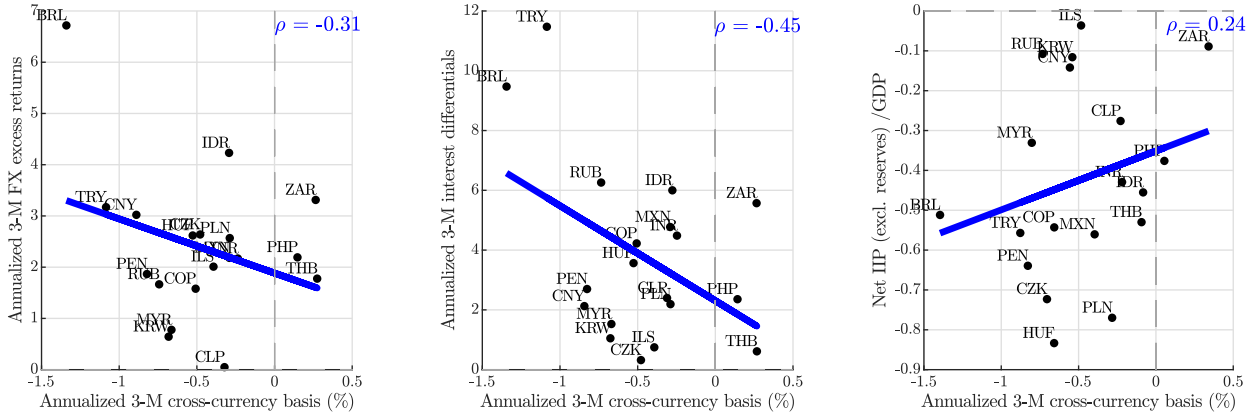
We construct the 3-month excess return at *daily frequency*, with the following steps: first, for each date $t$ with available spot rate, we search the date that is 3 months ahead according to $ACT$, as $t+1$. If $t+1$ happens to be Saturday or Sunday, we use the values on the nearest Friday. We then compute the 3-month change $\Delta s$ as the difference of logged spot rates between the two dates. Finally, we add the daily interest rate differentials to compute the 3-month returns.

Table C.2 reports the summary statistics of 3-month cross-currency basis and FX excess

returns across emerging market currencies. Over the sampling period, the average cross-currency bases among emerging economies are generally negative, while the average FX excess returns are mostly positive.

## 3.2 UIP and CIP Deviations across Currencies

We document a significant negative correlation between CIP deviations and excess currency returns, to speak to Proposition 2. Panel (a) of Figure 9 shows the cross-sectional means of 3-month FX excess returns (UIP deviations) versus the corresponding mean 3-month CIP deviations. Among emerging market currencies, currency returns and CIP deviations exhibit a negative relationship (while it is positive among G10 economies, see Figure C.2). This negative relationship among emerging market currencies is consistent with the model's predition.




**(a)** FX Excess Returns **(b)** Interest Differentials **(c)** NFA positions

**Figure 9:** UIP and CIP deviations across emerging currencies

Note: The figure depicts scatter plots of mean cross-currency basis with FX excess returns, interest rate differentials (IRDs), and net internation investment (net IIP) positions across emerging economies. The cross-currency bases, FX excess returns, and IRDs are based on 3-month interbank rates, annualized, and quoted in percentage points. The net IIPs are from the the external wealth of nations database by Lane and Milesi-Ferretti (2017); the annual positions exclude FX reserves and are scaled by GDP. For illustration, variables are winsorized at the 5% level. The date range for FX excess returns and IRDs is 2002-2022, for net IIP 2010-2022.

Panels (b) and (c) of Figure 9 illustrate the cross-sectional relationship between the mean 3-month CIP basis and the mean 3-month interest rate differentials (IRDs) as well as the net

international investment positions (Net IIP) excluding FX reserves, scaled by GDP. In line with the results of Cerutti and Zhou (2024), the 3-month CIP bases for emerging economies exhibit a negative correlation with IRDs and a positive correlation with Net IIPs. Our theoretical framework, where currency-speculation drives the demand for forwards, offers a clear explanation for these findings. Since IRDs and Net IIPs are well-established predictors of future excess currency returns (Lustig et al., 2011; Della Corte et al., 2016), our mechanism naturally implies that CIP deviations should be linked to these variables. Specifically, countries with higher IRDs and lower Net IIPs—both indicators of higher expected excess currency returns—tend to have lower CIP deviations. Liao and Zhang (2021) had originally observed a negative relationship between NFAs and CIP deviations in advanced economies (see, for example, Figure C.2). Their interpretion for this relationship hinges on a hedging model of forward demand, whereby countries with more positive NFAs have a larger exposure to exchange rate risk, and thus have a larger incentive to hedge against the risk. The hedging motive depresses the cross-currency basis vis-a-vis the U.S. dollar.

Furthermore, we run the following set of panel regressions:

$$rx_{c,t+3M} = \alpha_c + \delta_t + \beta \text{CIP basis}_{c,t}^{3M} + \varepsilon_{c,t+3M}$$

where $\alpha_c$ is the currency FE; $\delta_t$ is the time FE. We conduct the regression using daily observations, following a procedure outlined below. Specifically, we calculate the 3-month change in the exchange rate $\Delta s_{c,t+3M}$ by taking the difference between the current spot rate and the rate observed three months ahead. The exact number of days constituting the three-month period for a given date is determined by the maturity of the corresponding 3-month forward contract. The 3-month FX excess return for each trading day is computed by adding the interest rate differentials to the exchange rate difference on that date. Similarly, the cross-currency basis is derived from the daily 3-month forward rate and spot rate, after adjusting for the interest rate differentials. We use Driscoll and Kraay (1998) standard errors

to account for the overlapping observational periods.

Table 2 reports the regression results with OLS and fixed effects specifications. The negative coefficient indicates that a more negative CIP basis is associated with a higher FX premium. [17] Overall, these regression results suggest that the negative cross-currency basis is tied to both the spot rate and the interest rate differential components of FX excess returns. Furthermore, these relationships persist whether we include either Currency FE or Time FE, implying that these findings hold both across countries on average and within a given country over time.

**Table 2:** UIP deviations and CIP deviations

**FX excess returns** $rx_{i,t+3M}$

| | OLS | FE | FE |
|---|---|---|---|
| CIP basis | -0.660*** | -0.669*** | -0.659*** |
| | (0.22) | (0.23) | (0.18) |
| Currency FE | No | Yes | No |
| Month FE | No | No | Yes |
| N | 87332 | 87332 | 87332 |
| $R^2$ | 0.007 | 0.004 | 0.455 |

Note: The table reports the regression results for 3-month FX excess returns on 3-month cross-currency basis with daily observations. Driscoll and Kraay (1998) standard errors are reported in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

## 3.3 CIP Deviations and Global Risk Factors

To test Part (b) of Proposition 3, we first isolate the common variation in emerging-market CIP deviations. We perform the principal component (PC) analysis of the monthly changes in 3-month cross-currency bases *vis-a-vis* the U.S. dollar across emerging market currencies.[18]

Then, we examine the comovement properties of the common driver of emerging-market CIP deviations, especially in relationship to variables that proxy for global financial risk-

[17] Table C.3 reveals that in emerging markets a more negative CIP deviation is associated with an appreciation of the domestic currency and a more positive interest rate differentials.

[18] The first principal component significantly explains 22% of the cross-sectional variation in CIP deviations in emerging economies.

bearing capacity ($\hat{\Gamma}_t$), and to the U.S. dollar. Table 3 describes the correlations between the first PC of the monthly changes in 3-month cross-currency bases among emerging economies and selected global risk factors. From the first column of the table, the first principal component is 90% correlated with the changes in the mean CIP deviations in emerging markets, indicating that the latent factor that captures the most common variations in CIP deviations across emerging markets resembles a level factor.

**Table 3:** Correlation between first Principal Component (PC1) of emerging-market CIP deviations and global risk factors

| | PC1 | CIP-AE | CIP-EME | Dollar | VIX | VXEEM | US Market | HKM |
|---|---|---|---|---|---|---|---|---|
| PC1 | 1.00 | | | | | | | |
| CIP-AE | -0.25 | 1.00 | | | | | | |
| CIP-EME | 0.91 | -0.08 | 1.00 | | | | | |
| Dollar | 0.55 | -0.17 | 0.60 | 1.00 | | | | |
| VIX | 0.47 | -0.18 | 0.41 | 0.38 | 1.00 | | | |
| VXEEM | 0.49 | -0.12 | 0.39 | 0.40 | 0.92 | 1.00 | | |
| US Market | -0.38 | 0.19 | -0.40 | -0.45 | -0.67 | -0.65 | 1.00 | |
| HKM | -0.29 | 0.13 | -0.33 | -0.43 | -0.55 | -0.58 | 0.78 | 1.00 |

Note: The table shows the correlations between the first principal (PC) component of the monthly changes in the 3-month cross-currency basis of emerging market currencies *vis-a-vis* the USD and the monthly changes in selected global risk factors. PC1 is the first principal component. CIP-AE and CIP-EME are respectively the monthly changes in the average CIP deviations across G10 and emerging currencies. Dollar denotes the monthly percentage change in the Federal Reserve Board broad dollar index (DTWEXBGS). VIX is the monthly change in the logarithm of implied volatility of the S&P options. VXEEM denotes the monthly change in the logarithm of implied volatility of the MSCI Emerging Market Index. US Market denotes the monthly excess return of the US market from Fama and French (1993), and HKM is the monthly innovations to the intermediary capital ratio in He et al. (2017). The data range from 2002-2022.

Furthermore, emerging economies CIP bases comoves positively with the U.S. dollar and measures of implied volatility, and with declines in market and HKM factors, variables typically interpreted as barometers of global financial conditions (Avdjiev et al., 2019b). We note that Proposition 3 highlighted that the U.S. dollar appreciates during periods of financial disruption in the model economy.[19] The results suggest that the tightening of global financial conditions is associated with and increase in emerging-market CIP deviations. The positive

[19] The literature on the U.S. dollar as a global factor includes, among others, Lustig et al. (2014); Avdjiev et al. (2019a); Hofmann et al. (2022); Obstfeld and Zhou (2022); Bruno and Shin (2023); Bruno et al. (2022).

relationship between CIP bases among emerging economies and global financial conditions is consistent with Proposition 3. In particular, when the UIP premium is positive (which is true on average across emerging economies, shown in Table C.2), a higher risk aversion reduces global investors' incentive to take open forward positions the emerging market currencies, putting downward pressure on forward prices and upward pressure on CIP deviations.

It is worth noting that the relationship between CIP deviations and the U.S. dollar in emerging economies is opposite to the one documented for advanced economies (see, for example, Avdjiev et al. (2019b) and Du and Schreger (2022)). In bad times, when the U.S. dollar is appreciated, the cross-currency bases for G10 currencies become more negative.[20,21] These pieces of evidence suggest that cross-currency bases respond to different forces in emerging and advanced economies. We elaborate on this question in the next section.

# 4 CIP Deviations in Emerging vs. Advanced Economies

In this section, we extend our framework to speak to the the different unconditional and conditional properties of CIP deviations between advanced and emerging economies.

First, we highlight that global investors' limitations to adjusting their short-term bond positions in emerging economies (Assumption 1) are *essential* for CIP deviations to be non-zero. If foreign investors had direct and frictionless access to bond/spot market they would be able to perform the "UIP trade" not only through forward contracts, like they do in our model (the "forward trade"), but also through bonds. In that case, returns on these two trading strategies must be equalized by arbitrage, which requires CIP deviations to be equal to zero. We formalize these observations in the next Proposition:

**Proposition 4** *Consider the problem of an otherwise identical global investor that actively*

[20] Relatedly, the first PC of emerging economies has an negative and modest correlation with the mean basis in advanced economies, which suggests that the factors that depresses the advanced market CIP deviations could drive up the emerging market CIP deviations.

[21] Cerutti and Zhou (2024), through a distinct and complementary empirical analysis, find a similar difference in how CIP deviations move with global risk factors in emerging relative to advanced economies. To our knowledge, this is the first paper to provide a mechanism for the pattern of CIP deviations with global risk factors.

*trades in home/foreign bond and spot/forward market. That is, relax Assumption 1 in the baseline model. In the extended model, equilibrium CIP deviations are zero.*

**Proof.** See Appendix D.1 ■

Through Proposition 4, we stress that frictional access to short-term borrowing/lending in emerging-market currency by foreign investors is the key feature in generating CIP deviations in our mechanism. To the extent that this specific form of market segmentation is more prevalent in emerging economies, one can rationalize the fact that CIP deviations are significantly larger in emerging economies (100 basis points on average in absolute value), relative to advanced one (20 basis points). However, when it comes to explaining the dynamic properties of CIP deviations in emerging economies, the sources of global investors' forward exchange demand (chasing excess currency returns) are crucial.

Second, we note that other *demand* factors can give rise to equilibrium CIP deviations in models without the segmentation implied by Assumption 1. A prominent candidate is fluctuations in convenience yields derived from U.S. bonds (Engel and Wu, 2018; Jiang et al., 2021). Convenience yield are indeed a natural source of CIP deviations. If investors have a preference for holding assets issued by U.S. entity, such as U.S. treasuries, they would be willing to forgo a safe dollar return when investing dollar cash relative to a comparable synthetic dollar trade. As Jiang et al. (2021) highlight, the basic logic of convenience yield can explain why CIP deviations in advanced economies tend to decline when the dollar appreciates. We summarize these considerations in the following Proposition:

**Proposition 5** *Consider the problem of a risk-neutral global investor that actively trades in home/foreign bond and spot/forward market, and derives a convenience benefit, $\eta_t$, from holding a U.S. bond. Under these conditions:*

*(a) CIP deviations are equal to this specific convenience benefit:*

$$\underbrace{r_t^\star - r_t + f_t - s_t}_{CIP\ Deviation_t} = -\eta_t$$

*(b) CIP deviations are negatively correlated with the value of the U.S. dollar:*

$$\text{cov}(\textit{CIP Deviation}_t, \textit{USD}_t) < 0$$

**Proof.** See Appendix D.1 ■

The statements in Proposition 5 are natural implication of models of convenience yields: convenience yield are a possible source of CIP deviations, and they naturally imply that CIP deviations comove negatively with the value of the U.S. dollar. Intuitively, when investors attribute a higher convenience benefit to U.S. bonds, the U.S. dollar is appreciated while CIP deviations decline. In emerging economies, we document that the average CIP deviation in emerging economies is positively correlated with the value of the U.S. dollar (Table 3). Thus, CIP deviations in emerging economies are unlikely to be predominantly driven by fluctuations in convenience yields.

# 5 Conclusions

In our model, a key driver of such deviations reflects global investors' desire to capitalize predictable currency returns (i.e. UIP deviations). In the face of restrictions to access local spot markets (both foreign currency spot and money markets), positive UIP deviations stimulate demand for currency forwards. Local intermediaries, who have an advantage accessing both the currency spot and forward market, as well as money markets, arbitrage across the forward and the segmented spot market. In the face of limit constraints on the amount they can intermediate, CIP deviations arise as a compensation to local intermediaries for supplying forward contracts.

We use rich data from Peru forward market to test key implications of the model regarding forward positions by counterparty, the patterns of profits from CIP arbitrage. Consistent with our model, we document that local intermediaries consistently earn profits when supplying forward contracts and simultaneously hedge these positions in the spot market (i.e.

conducting CIP arbitrage). Additionally, we show that local intermediaries' forward positions is primarily influenced by time-varying global investor's demand of forward contracts. This indicates that forward currency demand is an important driver of CIP deviations in emerging economies.

Using data from a broad panel of emerging economies, we verify the model implied inverse relationship between UIP deviations and CIP deviations, and a positive comovement between CIP deviations and the U.S. dollar value. We highlight that these correlations appear in emerging economies, but not in advanced economies. We discuss the possible sources of these differences, which we attribute to differences in market structure.

Our paper emphasizes the distinctive dynamics of emerging markets, focusing on how global investors' forward demand can influence the pricing of instruments originally intended for hedging currency risk. Specifically, we show that heightened global demand for forwards increases CIP deviations during global recessions. This, in turn, raises the cost of synthetic peso borrowing—the predominant form of external financing in many emerging economies—during downturns. Such dynamics deteriorate financing conditions in recessions, undermining the effectiveness of counter-cyclical monetary policy (De Leo et al., 2024) and potentially motivating the adoption of policies aimed at "basis control" (Gourinchas, 2021).

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# Appendix

## A Appendix to Section 1

This appendix uses the following approximation:

**Approximation 1** *Let $X_t$ being a variable sufficiently close to 1, set $x_t \approx X_t - 1$, where lower-case letters are the logarithm of the respective upper-case variables. For example, $\frac{R_t^\star}{R_t}\frac{F_t}{S_t} - 1 \approx r_t^\star - r_t + f_t - s_t$.*

### A.1 Derivations of local intermediaries' forward supply

To obtain a deterministic return in U.S. dollars (Assumption 3), the local intermediary $j$'s portfolio, described in Section 1.1.2, implies the following relationship between its spot and forward market positions:

$$K_{j,t+1} = G_{j,t+1}^\star \frac{R_t}{R_t^\star}\frac{S_t}{F_t}. \tag{A.1}$$

As a result, the overall return on the intermediary's portfolio, eq. (5), becomes:

$$K_{j,t+1}\left(\frac{R_t^\star}{R_t}\frac{F_t}{S_t} - 1\right). \tag{A.2}$$

Furthermore, intermediaries investment decisions are subject to the following set of restrictions (Assumption 4). First, each intermediary is subject to a net open position limit $K > 0$, and, second, intermediaries face heterogeneous participation costs, as in Alvarez et al. (2009) and Fanelli and Straub (2021). In particular, each intermediary $j$ active in the foreign bond market at time $t$ is obliged to pay a participation cost of $j$ U.S. dollars per unit of foreign currency position.

Putting these features together, intermediary $j$ optimally takes a $K_{j,t+1}$ position in forwards (short U.S. dollar), solving

$$\max_{K_{j,t+1}^\star \in [-K,K]} K_{j,t+1}\left(\frac{R_t^\star}{R_t}\frac{F_t}{S_t} - 1\right) - j\left|K_{j,t+1}\right|,$$

Intermediary $j$'s cash flow conditional on investing is $K\left|\left(\frac{R_t^\star}{R_t}\frac{F_t}{S_t}-1\right)\right|$ while participation costs are $jK$. Thus, investing is optimal for all intermediaries $j \in [0, \bar{j}]$, with the marginal active intermediary $\bar{j}$ given by $\bar{j} = \left|\left(\frac{R_t^\star}{R_t}\frac{F_t}{S_t}-1\right)\right|$. The aggregate investment volume is then $K_{t+1} = \bar{j}K \operatorname{sign}\left\{\frac{R_t^\star}{R_t}\frac{F_t}{S_t}-1\right\}$. Defining $\kappa \equiv K^{-1}$ and substituting out $\bar{j}$, we obtain the total supply of (short-dollar) forward:

$$K_{t+1} = \frac{1}{\kappa}\underbrace{\left(\frac{R_t^\star}{R_t}\frac{F_t}{S_t}-1\right)}_{\text{CIP Deviation}_t}. \tag{A.3}$$

Equation (A.3) represent local intermediaries' forward supply, *i.e.* equation (6). In addition, local intermediaries' demand for U.S. dollar spot, eq. (7), is obtained by combining equation (A.3) with the aggregate version of equation (A.1).

## A.2 Equations underlying Figure 1

Figure 1 depicts the first-order approximation of the equilibrium equations in the forward and spot market around a risky steady state (Coeurdacier et al., 2011). We use hat variables to express the first-order change around the steady state, that is $\hat{X}_t \approx X_t - X$. The derivations below also use Approximation 1.

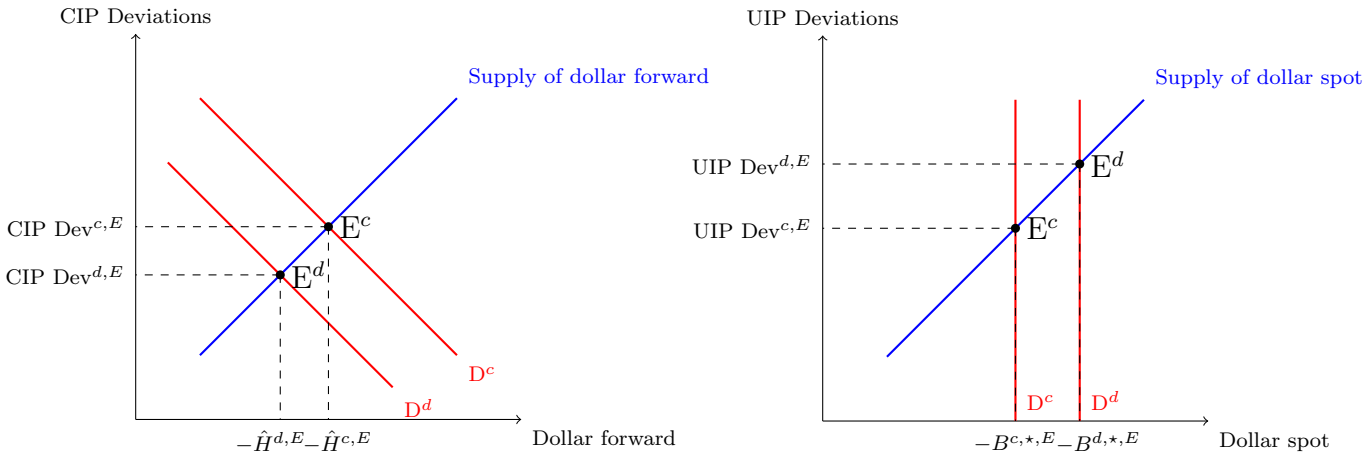
**Equilibrium in forward market (Figure 1a)** The supply of dollar forward is represented by the first-order approximation of eq. (6):

$$\underbrace{\left(\hat{r}_t^\star - \hat{r}_t + \hat{f}_t - \hat{s}_t\right)}_{\widehat{\text{CIP Deviation}}_t} = \kappa \hat{K}_{t+1};$$

The demand of U.S. dollar forward is the first-order approximation of eq. (4):

$$\underbrace{\left(\hat{r}_t^\star - \hat{r}_t + \hat{f}_t - \hat{s}_t\right)}_{\widehat{\text{CIP Deviation}}_t} = -\underbrace{\left(\hat{r}_t - \hat{r}_t^\star - E_t\hat{s}_{t+1} + \hat{s}_t\right)}_{\widehat{\text{UIP Deviation}}_t} + \Gamma(\hat{H}_{t+1}) + H(\hat{\Gamma}_t).$$

**Graphical analysis of Proposition 2**




**(a)** Equilibrium in the Forward Market **(b)** Equilibrium in the Spot Market

**Figure A.1:** Steady-state Equilibrium in Forward and Spot Markets

*Note*: The graphs depict the steady-state equilibrium in the forward market (Panel (a)) and in the spot market (Panel (b)). In the graph superscripts $c$ and $d$ represents two different countries.

**Equilibrium in spot market (Figure 1b)** The supply of dollar spot represents the first-order approximation of eq. (10):

$$\underbrace{(\hat{r}_t - \hat{r}_t^\star - E_t\hat{s}_{t+1} + \hat{s}_t)}_{\widehat{\text{UIP Deviation}}_t} = -\Lambda(\hat{B}^\star_{t+1}).$$

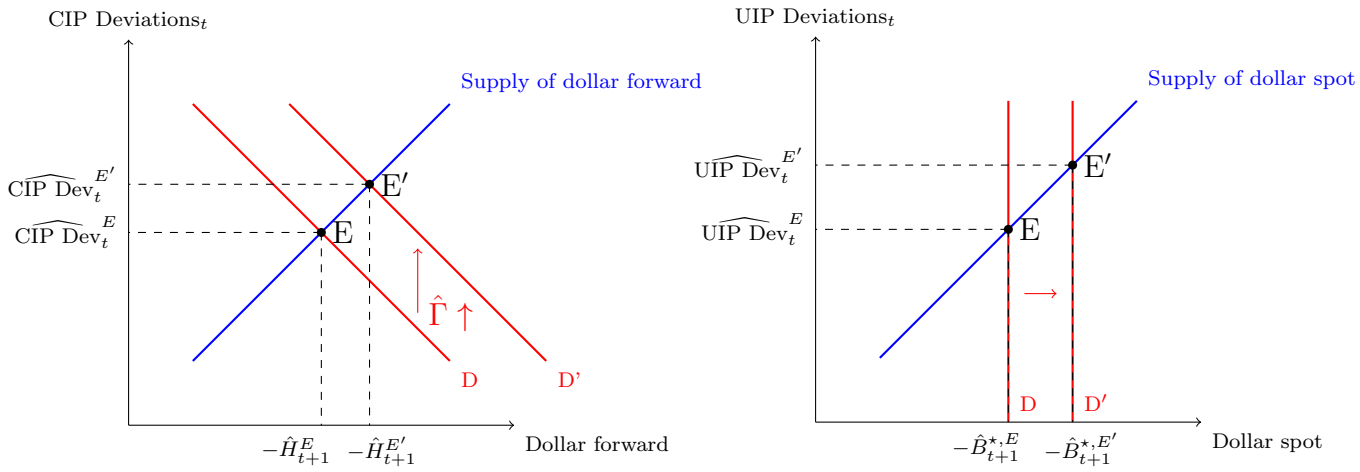
The demand of dollar spot is the first-order approximation of eq. (7):

$$\hat{G}^\star_{t+1} = \frac{1 + 2\text{CIP Dev.}}{\kappa} \underbrace{\left(\hat{r}_t^\star - \hat{r}_t + \hat{f}_t - \hat{s}_t\right)}_{\widehat{\text{CIP Deviation}}_t}.$$

## A.3 Derivations of equilibrium UIP and CIP deviations

Throughout our derivations, we assume that the conditional variance of exchange rate changes *vis a vis* the U.S. dollar is constant, and it is the same across small open economies. That is $\text{var}_t(\Delta s^c_{t+1}) = \text{var}_t(\Delta s^d_{t+1}) = \sigma_s^2$ for each $c \neq d$. The structure of shocks ensures that

**Graphical analysis of Proposition 3**




**(a)** Equilibrium in the Forward Market **(b)** Equilibrium in the Spot Market

**Figure A.2:** Equilibrium in Forward and Spot Markets following Global Risk Aversion Shock (around a Steady State with Positive UIP Deviations (*i.e.* $\xi^c < 0$))

*Note*: The graphs depict the equilibrium in the forward market (Panel (a)) and in the spot market (Panel (b)). We take the first-order approximation of the relevant equilibrium conditions to depict these equilibrium relationships, as we describe in Appendix A.2.

this is the case.

Equilibrium in the forward market (eqs. (4), (6), and (9)) implies:

$$-\frac{1}{\kappa}\left(\frac{R_t^\star}{R_t}\frac{F_t}{S_t}-1\right)=\frac{\left(E_t\frac{F_t}{S_{t+1}}-1\right)}{\gamma_t \operatorname{var}_t\left(\frac{F_t}{S_{t+1}}\right)} \tag{A.4}$$

Equilibrium in the spot market (eqs. (10), (7), and (12)) implies:

$$-\xi_t+\frac{1}{\kappa}\left(1-\frac{R_t}{R_t^\star}\frac{S_t}{F_t}\right)=\frac{\left(E_t\frac{R_t}{R_t^\star}\frac{S_t}{S_{t+1}}-1\right)}{\lambda \operatorname{var}_t\left(\frac{F_t}{S_{t+1}}\right)}. \tag{A.5}$$

Use Approximation 1 to rewrite eqs. (A.4)-(A.5) as:

$$-\frac{1}{\kappa}\left(r_t^\star-r_t+f_t-s_t\right)=\frac{\left(r_t-r_t^\star-E_t s_{t+1}+s_t\right)+\left(r_t^\star-r_t+f_t-s_t\right)}{\gamma_t\sigma_s^2} \tag{A.6}$$

$$-\xi_t + \frac{1}{\kappa}\left(r_t^\star - r_t + f_t - s_t\right) = \frac{\left(r_t - r_t^\star - E_t s_{t+1} + s_t\right)}{\lambda\sigma_s^2}, \tag{A.7}$$

where we used $\text{var}_t\left(f_t - s_{t+1}\right) = \text{var}_t\left(\Delta s_{t+1}\right) = \sigma_s^2$.

Let us, then, define:

$$\Gamma_t = \gamma_t\sigma_s^2; \qquad \Lambda = \lambda\sigma_s^2$$

as the foreign investors and local spot traders risk-bearing capacity, respectively.

Using (A.6) and (A.7) we reach closed-form expressions for CIP and UIP deviations (eq. (13)):

$$\underbrace{\left(r_t^\star - r_t + f_t - s_t\right)}_{\text{CIP Deviation}_t} = \frac{\Lambda\kappa}{\Gamma_t + \kappa + \Lambda}(\xi_t);$$

$$\underbrace{\left(r_t - r_t^\star - E_t s_{t+1} + s_t\right)}_{\text{UIP Deviation}_t} = -\frac{\Lambda(\Gamma_t + \kappa)}{\Gamma_t + \kappa + \Lambda}(\xi_t^c).$$

## A.4 Proofs

**Proof of Proposition 1.** Proposition 1(a) directly follows from the forward market clearing condition (9); Proposition 1(b) directly follows from the forward supply equation (6); Proposition 1(c) derives from equation (8). The prediction on global investors' forward position and returns from the forward trade follows directly from the forward demand equation (4). Note that we express the predictions in terms of dollar positions because this is the notional amount of forward contracts traded. ■

**Proof of Proposition 2.** Consider a continuum of small-open economies, indexed by $c \in [0, 1]$, with idiosyncratic levels of currency imbalances, $\xi^c$. The steady-state version of closed form expressions of CIP and UIP deviations (see eq. (13)) for country $c$ read:

$$\underbrace{\left(r^\star - r^c + f^c - s^c\right)}_{\text{CIP Deviation}^c} = \frac{\Lambda\kappa}{\Gamma + \kappa + \Lambda}\xi^c; \qquad \underbrace{\left(r^c - r^\star - s^{c,\prime} + s^c\right)}_{\text{UIP Deviation}^c} = -\frac{\Lambda(\Gamma + \kappa)}{\Gamma + \kappa + \Lambda}\xi^c$$

Thus:

$$\text{cov}_c(\text{UIP Deviation}^c, \text{CIP Deviation}^c) = -\frac{\Lambda^2\kappa(\Gamma+\kappa)}{(\Gamma+\kappa+\Lambda)^2}\,\text{var}_c(\xi^c) < 0.$$

Note that the covariance between UIP and CIP deviations is negative as long as global investors are present. Absent global investors ($\Gamma = \infty$), the covariance is zero. ■

**Proof of Proposition 3.** Consider a continuum of small-open economies, indexed by $c \in [0,1]$, with idiosyncratic levels of currency imbalances, $\xi^c$. The first-order approximation of the closed-form solutions of currency-$c$ CIP and UIP deviations (see eq. (13)) are, respectively:

$$\underbrace{\left(\hat{r}_t^\star - \hat{r}_t^c + \hat{f}_t^c - \hat{s}_t^c\right)}_{\widehat{\text{CIP Deviation}}_t^c} = \frac{\Lambda\kappa}{\Gamma+\kappa+\Lambda}\hat{\xi}_t^c - (\xi^c)\frac{\kappa}{(\Gamma+\kappa+\Lambda)^2}\Lambda\hat{\Gamma}_t \tag{A.8}$$

$$\underbrace{\left(\hat{r}_t^c - \hat{r}_t^\star - E_t\Delta\hat{s}_{t+1}^c\right)}_{\widehat{\text{UIP Deviation}}_t^c} = -\frac{\Lambda(\Gamma+\kappa)}{\Gamma+\kappa+\Lambda}\hat{\xi}_t^c - (\xi^c)\frac{1}{(\Gamma+\kappa+\Lambda)^2}\Lambda^2\hat{\Gamma}_t \tag{A.9}$$

Proof of Part (a) of Proposition 3. Using (A.8) and (A.9), one can derive the response of currency-$c$ UIP and CIP deviations to an increase in global risk aversion, $\hat{\Gamma}_t$:

$$\frac{\partial\widehat{\text{CIP Deviation}}_t^c}{\partial\hat{\Gamma}_t} = \frac{\kappa}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation}^c \tag{A.10}$$

$$\frac{\partial\widehat{\text{UIP Deviation}}_t^c}{\partial\hat{\Gamma}_t} = \frac{\Lambda}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation}^c \tag{A.11}$$

where $\text{UIP Deviation}^c \equiv -\frac{\Lambda(\Gamma+\kappa)}{\Gamma+\kappa+\Lambda}\xi^c$ is currency-$c$ average UIP deviation.

Using the first-order approximation of eq. (6), $\hat{K}_{t+1}^c = \frac{1}{\kappa}\left(\hat{r}_t^\star - \hat{r}_t^c + \hat{f}_t^c - \hat{s}_t^c\right)$, as well as the the forward market clearing condition (9), one can also derive the responses of forward-market positions to an increase in global risk aversion, $\hat{\Gamma}_t$:

$$\frac{\partial\hat{K}_{t+1}^c}{\partial\hat{\Gamma}_t} = \frac{1}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation}^c \tag{A.12}$$

$$\frac{\partial \hat{H}^c_{t+1}}{\partial \hat{\Gamma}_t} = -\frac{1}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation}^c \tag{A.13}$$

Equations (A.10)-(A.13) prove the statements in Part (a) of Proposition 3.

Proof of Part (b) of Proposition 3. Define the common component of CIP deviations across all currencies as:

$$\text{CIP } \widehat{\text{Deviation}}_t \equiv \int_0^1 \text{CIP } \widehat{\text{Deviation}}^c_t \, \mathrm{d}c = \frac{\Lambda\kappa}{\Gamma+\kappa+\Lambda}\hat{\xi}_t - (\xi)\frac{\kappa}{(\Gamma+\kappa+\Lambda)^2}\Lambda\hat{\Gamma}_t \tag{A.14}$$

$$\text{UIP } \widehat{\text{Deviation}}_t \equiv \int_0^1 \text{UIP } \widehat{\text{Deviation}}^c_t = -\frac{\Lambda(\Gamma+\kappa)}{\Gamma+\kappa+\Lambda}\hat{\xi}_t - (\xi)\frac{1}{(\Gamma+\kappa+\Lambda)^2}\Lambda^2\hat{\Gamma}_t \tag{A.15}$$

where

$$\text{UIP } \widehat{\text{Deviation}}_t = \hat{r}_t - \hat{r}^\star_t - E_t\Delta\hat{s}_{t+1}$$

and $\hat{r}_t \equiv \int \hat{r}^c_t$, $\hat{\xi}_t \equiv \int \hat{\xi}^c_t \, \mathrm{d}c$ and $\xi \equiv \int \xi^c \, \mathrm{d}c$. In addition, $\hat{s}_t \equiv \int \hat{s}^c_t$ is the value of the U.S. dollar (relative to the average of emerging economies' currencies). We label it $\widehat{\text{USD}}_t$.

Then, using (A.14) and (A.15):

$$\frac{\partial \text{CIP } \widehat{\text{Deviation}}_t}{\partial \hat{\Gamma}_t} = \frac{\kappa}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation} \tag{A.16}$$

$$\frac{\partial \text{UIP } \widehat{\text{Deviation}}_t}{\partial \hat{\Gamma}_t} = \frac{\Lambda}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation} \tag{A.17}$$

where UIP Deviation $\equiv \int$ UIP Deviation$^c$ $\mathrm{d}c \equiv -\frac{\Lambda(\Gamma+\kappa)}{\Gamma+\kappa+\Lambda}\xi$ is the average UIP deviation across countries and time.

Furthermore, the value of the U.S. dollar responds as:

$$\frac{\partial \widehat{\text{USD}}_t}{\partial \hat{\Gamma}_t} = \frac{\Lambda}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation.} \tag{A.18}$$

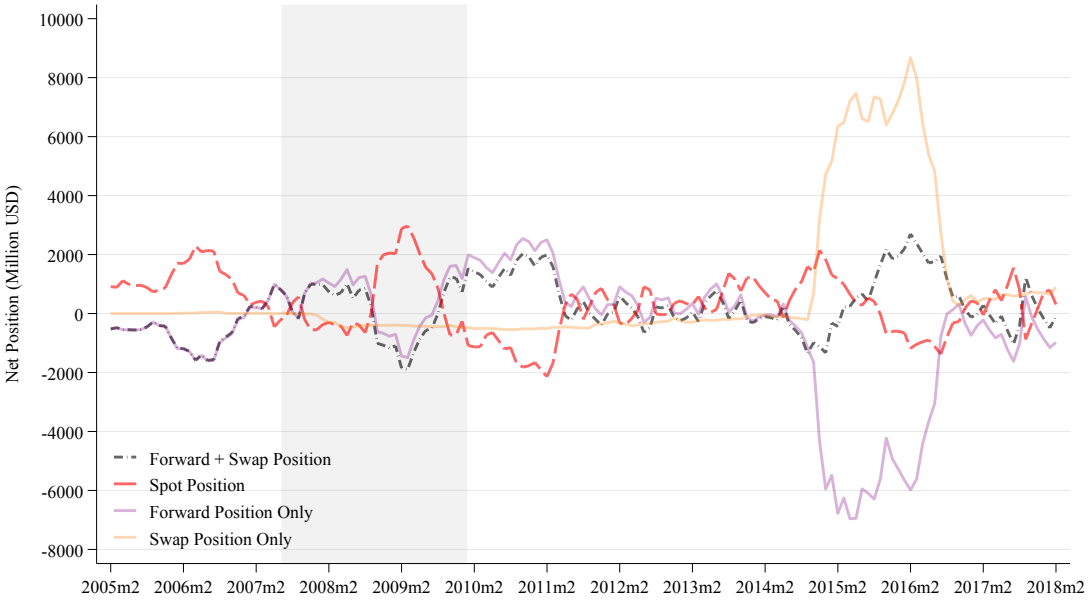
The last equation follows from the response of UIP deviations and the assumptions that interest differentials are constant following a global financial disruption.

Equations (A.16)-(A.18) indicate that when the cross-country-time average UIP deviation is positive, a global financial disruption is associated with an increase in CIP deviations, UIP deviations, and in the value of the U.S. dollar, as stated in Part (b) of Proposition 3. ■

# B Appendix to Section 2

## B.1 Additional Figures

**Figure B.1:** Banks' Forward Position, Swap Position and Spot Position




Note: This figure decomposes the forward plus swap position shown in Figure 3, into its swap and forward components. These are shown in light purple and light orange. As shown, swaps was barely existent before 2015. In 2015 and through a portion of 2016, banks' FX swap balances were a crucial component of banks' FX derivatives position. This is because the Central Bank decided at the time to intervene in the FX market through swaps instead of intervening in the spot market as it had done before. The Central Bank's reaction was to offset the depreciation of the sol, which was coming from global investors who were selling soles in the forward market.

## B.2 Evidence on foreigners' bond holdings and forward positions

A prevailing view in the literature is that forward exchange contracts are primarily used for hedging purposes. To fully assess global investors' hedging activities, one would need comprehensive data on all their positions and flows in soles across various asset classes. Unfortunately, such data is unavailable. What we do have is data on foreign holdings of Peruvian sovereign bonds denominated in soles, which represents the largest and most liquid market for foreign investment in Peru. While analyzing foreign positions in this market alongside their forward positions offers valuable insights, we recognize the limitations of this approach.

Assuming that the sovereign debt market in Peru accounts for the majority of flows into Peruvian soles assets – a plausible assumption – we examine the correlation between global investors' forward positions and their sovereign bond holdings. Our analysis does not provide evidence that foreign investors are consistently hedging their sovereign bond holdings. Specifically, we find a slightly negative correlation (around $-0.03$) between changes in foreign investors' forward balances and their bond holdings. A regression of foreigners' monthly changes in long dollar forward positions on monthly changes in their bond holdings indicates that a 1-million soles increase in foreign bond holdings[22] is associated with a 21-million-dollar decrease in long dollar forward holdings. However, this coefficient is statistically insignificant (using robust standard errors, with correction for 1-month autocorrelation).

The dynamics of these changes over time are illustrated in Figure B.2, where, as observed, the correlation can be negative during certain periods. Given the noisiness of this data, we also examine the 12-month rolling correlation between the two series. The resulting rolling correlation is shown in Figure B.3, which further highlights the instability of the correlation coefficient. At several points, it reaches significantly negative values, dropping as low as $-0.6$.

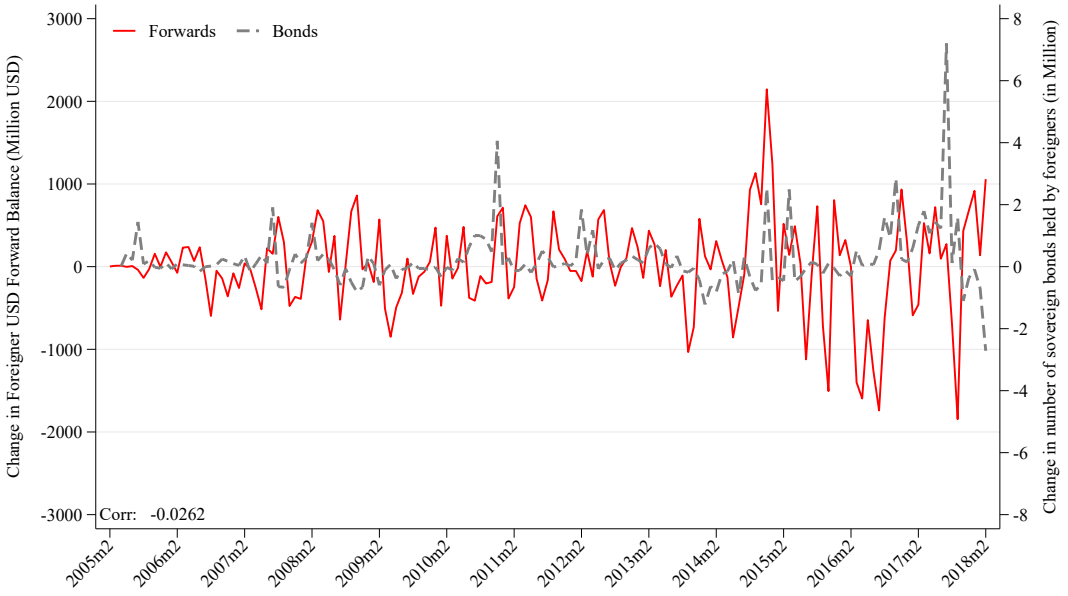
If foreign investors' were hedging the exchange rate risk in their soles-denominated assets,

[22] One bond is equivalent to 1,000 soles of notional value, approximately 260 US dollars as of September 2024.

we would not expect to observe a negative correlation between their soles asset purchases and their forward sales of dollars. To hedge soles exposure from soles assets, foreign investors would need to buy dollars, not sell them forward. Therefore, their long forward position in dollars should not be inversely related to their soles asset holdings.[23]

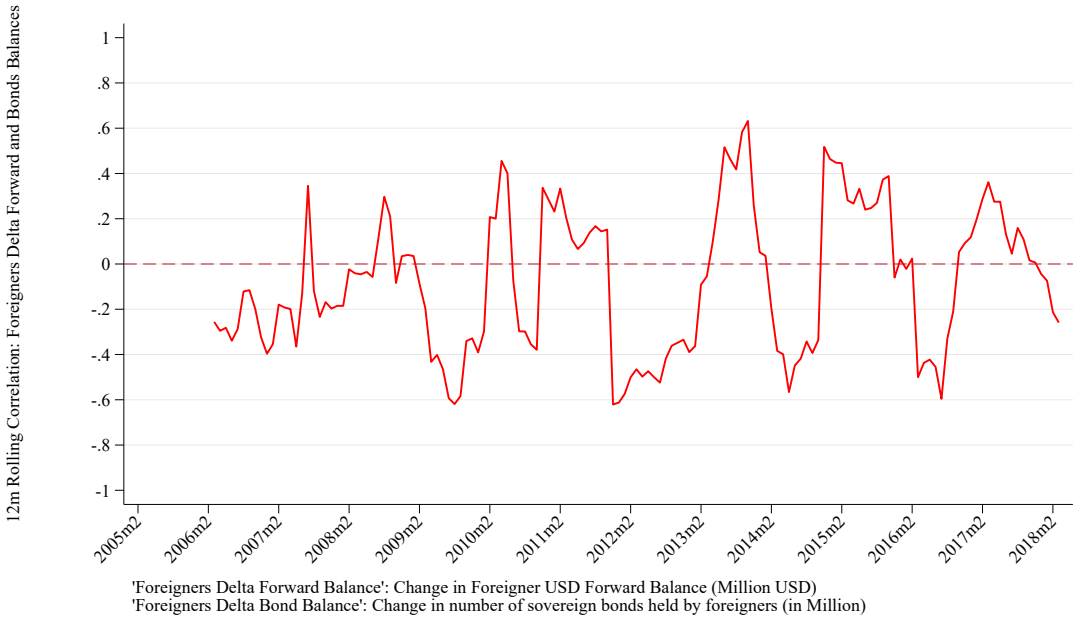
[23] That said, it's also important to note that a positive correlation between soles asset holdings and forward dollar purchases does not necessarily indicate hedging. A foreign investor could be shifting their soles exposure from one type of asset to another, such as moving from holding soles bonds to using soles forwards. In this case, the investor would sell soles bonds while simultaneously selling dollars forward (i.e., buying dollars forward). Thus, a positive correlation could reflect a change in the instrument through which the investor maintains exposure to soles assets, rather than a hedging activity.

**Figure B.2:** Change in Foreigners' Forward Balance and Change in Foreigners' Bond Holdings




Note: This figure shows the month-over-month change in foreigners' forward long dollar balances and the month-over-month change in the units of their bonds holdings.

**Figure B.3:** Rolling Correlation Between the Change in Foreigners' Forward Balance and the Change in Their Bond Holdings




Note: This figure shows the month-over-month change in foreigners' forward long dollar balances and the month-over-month change in the units of their bonds holdings.

# C Appendix to Section 3

**Table C.1:** Data for 1-month and 3-month variables

| Country/Region | Currency | FX Forward rate | | Domestic interbank rate | |
|---|---|---|---|---|---|
| | | 1M | 3M | 1M | 3M |
| Brazil | BRL | BCN1M | BCN3M | PREDI30 | PREDI90 |
| | | | | *BRDPR1M* | *BRDPR3M* |
| Chile | CLP | CHN1M | CHN3M | CHSWPC | CHSWPC |
| | | | | *CLTAB1M* | *CLTAB3M* |
| China | CNY | CCN1M | CCN3M | SHIF1M | SHIF3M |
| Colombia | COP | CLN1M | CLN3M | COOVIBR1 | DTF RATE |
| Czech Rep. | CZK | CZK1M | CZK3M | PRIB01M | PRIB03M |
| Hungary | HUF | HUF1M | HUF3M | BUBOR01M | BUBOR03M |
| Indonesia | IDR | IHN1M | IHN3M | JIIN1M | JIIN3M |
| Israel | ILS | ILS1M | ILS3M | TELBOR01 | TELBOR03 |
| India | INR | IRN1M | IRN3M | MIFORIM1 | IROS3M |
| | | *USINR1F* | *USINR3F* | | |
| South Korea | KRW | KWN1M | KWN3M | KRBO1M | KRBO3M |
| Mexico | MXN | MXN1M | MXN3M | MXIBTIIE | MXIB91DT |
| Malaysia | MYR | MRN1M | MRN3M | KLIB1M | KLIB3M |
| Peru | PEN | PSN1M | PSN3M | PRBOPRB1 | PRBOPRB3 |
| | | *USPEN1F* | *USPEN3F* | | |
| Philippines | PHP | PPN1M | PPN3M | PREF1MO | PREF3MO |
| Poland | PLN | PLN1M | PLN3M | WIBR1M | WIBR3M |
| Russia | RUB | RUB1M | RUB3M | MOSKP1 | MOSKP3 |
| Thailand | THB | THB1M | THB3M | BOFX1M | BOFX3M |
| Turkey | TRY | TRY1M | TRY3M | TRLIB1M | TRLIB3M |
| Taiwan | TWD | NTN1M | NTN3M | TAIBOR1M | TAIBOR3M |
| South Africa | ZAR | ZAR1M | ZAR3M | JIBA1M | JIBA3M |

Note: Bloomberg FX Forward tickers are with suffix CURNCY, which are abbreviated here. Bloomberg interbank rate tickers have suffix INDEX except for Chile's CHSWPC (CURNCY). Datastream tickers are in italics. Bloomberg FX forward rates are in forward points, and Datastream rates are outright rates.

**Table C.2:** Summary statistics of CIP and UIP deviations in emerging economies

**(a) 3-month cross-currency basis**

| | N | Mean | Std | 25% | Median | 75% |
|---|---|---|---|---|---|---|
| BRL | 5036 | -1.780 | 3.162 | -1.929 | -1.219 | -0.732 |
| CLP | 3791 | -0.292 | 0.972 | -0.659 | -0.166 | 0.238 |
| CNY | 3829 | -1.263 | 3.240 | -2.972 | -0.321 | 0.615 |
| COP | 5126 | -0.555 | 1.413 | -1.122 | -0.409 | 0.201 |
| CZK | 5151 | -0.479 | 0.567 | -0.641 | -0.408 | -0.035 |
| HUF | 5139 | -0.527 | 0.638 | -0.808 | -0.313 | -0.087 |
| IDR | 5028 | 0.375 | 4.527 | -1.501 | -0.430 | 0.835 |
| ILS | 4902 | -0.393 | 0.483 | -0.511 | -0.280 | -0.112 |
| INR | 5053 | -0.136 | 2.153 | -1.179 | -0.196 | 0.742 |
| KRW | 4343 | -0.763 | 1.491 | -0.760 | -0.474 | -0.268 |
| MXN | 4092 | -0.283 | 0.746 | -0.751 | -0.294 | 0.006 |
| MYR | 5032 | -0.662 | 0.976 | -1.161 | -0.614 | -0.271 |
| PEN | 4073 | -0.905 | 1.900 | -1.369 | -0.621 | -0.152 |
| PHP | 5047 | 0.310 | 1.876 | -0.315 | -0.002 | 0.415 |
| PLN | 5206 | -0.286 | 0.552 | -0.416 | -0.207 | -0.093 |
| RUB | 3993 | -0.428 | 3.066 | -1.166 | -0.759 | -0.472 |
| THB | 4892 | 0.459 | 1.754 | -0.443 | 0.073 | 0.612 |
| TRY | 4796 | -0.607 | 4.032 | -1.722 | -1.143 | -0.722 |
| ZAR | 5200 | 0.266 | 0.405 | 0.011 | 0.159 | 0.436 |

**(b) 3-month FX excess returns**

| | N | Mean | Std | 25% | Median | 75% |
|---|---|---|---|---|---|---|
| BRL | 4918 | 6.252 | 35.471 | -11.923 | 11.410 | 28.101 |
| CLP | 3639 | -0.362 | 24.643 | -15.124 | 2.045 | 13.722 |
| CNY | 3587 | 3.012 | 8.813 | 0.028 | 3.851 | 8.349 |
| COP | 5008 | 1.063 | 26.975 | -13.077 | 4.364 | 17.523 |
| CZK | 5203 | 2.536 | 23.933 | -11.996 | 2.792 | 18.729 |
| HUF | 5158 | 2.383 | 27.746 | -13.165 | 2.808 | 20.397 |
| IDR | 4827 | 4.274 | 19.367 | -4.717 | 4.005 | 12.631 |
| ILS | 5119 | 2.077 | 15.081 | -6.939 | 3.386 | 10.990 |
| INR | 4744 | 2.145 | 13.908 | -4.609 | 3.911 | 10.365 |
| KRW | 4292 | 0.371 | 20.736 | -9.700 | 1.295 | 12.274 |
| MXN | 4098 | 1.328 | 24.420 | -10.016 | 4.990 | 16.334 |
| MYR | 4870 | 0.761 | 13.216 | -4.953 | 1.804 | 8.750 |
| PEN | 4247 | 2.069 | 10.727 | -3.235 | 2.701 | 7.880 |
| PHP | 4777 | 2.193 | 11.955 | -5.297 | 2.790 | 9.648 |
| PLN | 5193 | 1.871 | 26.905 | -11.639 | 3.157 | 19.260 |
| RUB | 3865 | -0.204 | 34.778 | -10.621 | 5.697 | 16.922 |
| THB | 4754 | 1.771 | 12.751 | -6.357 | 3.295 | 10.165 |
| TRY | 4861 | 2.771 | 37.970 | -17.272 | 6.886 | 24.710 |
| ZAR | 5196 | 3.637 | 32.176 | -15.102 | 3.970 | 22.458 |

**Table C.3:** Regressions on 3-month cross-currency basis for emerging economies

**(a) Spot rate change $\Delta s_{i,t+3M}$**

| | OLS | FE | FE |
|---|---|---|---|
| CIP basis | 0.428* | 0.518** | 0.441*** |
| | (0.24) | (0.23) | (0.17) |
| Currency FE | No | Yes | No |
| Month FE | No | No | Yes |
| N | 87332 | 87332 | 87332 |
| $R^2$ (within) | 0.002 | 0.019 | 0.455 |

**(b) Interest rate differentials $r_{it}^{(3M)} - r_{\$t}^{(3M)}$**

| | OLS | FE | FE |
|---|---|---|---|
| CIP basis | -0.230** | -0.147** | -0.215** |
| | (0.10) | (0.07) | (0.10) |
| Currency FE | No | Yes | No |
| Month FE | No | No | Yes |
| N | 89729 | 89729 | 89729 |
| $R^2$ | 0.012 | 0.553 | 0.151 |

Note: The table reports the regression results for 3-month spot rate changes and interbank interest rate differentials on 3-month cross-currency basis with daily observations. Driscoll and Kraay standard errors are reported in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

**Table C.4:** Regressions on 3-month cross-currency basis for advanced economies

**(a) FX excess returns $rx_{i,t+3M}$**

| | OLS | FE | FE |
|---|---|---|---|
| CIP basis | 7.325*** | 7.017** | 4.125** |
| | (2.62) | (3.40) | (1.86) |
| Currency FE | No | Yes | No |
| Month FE | No | No | Yes |
| N | 52111 | 52111 | 52111 |
| $R^2$ | 0.007 | 0.010 | 0.656 |

**(b) Spot rate change $\Delta s_{i,t+3M}$**

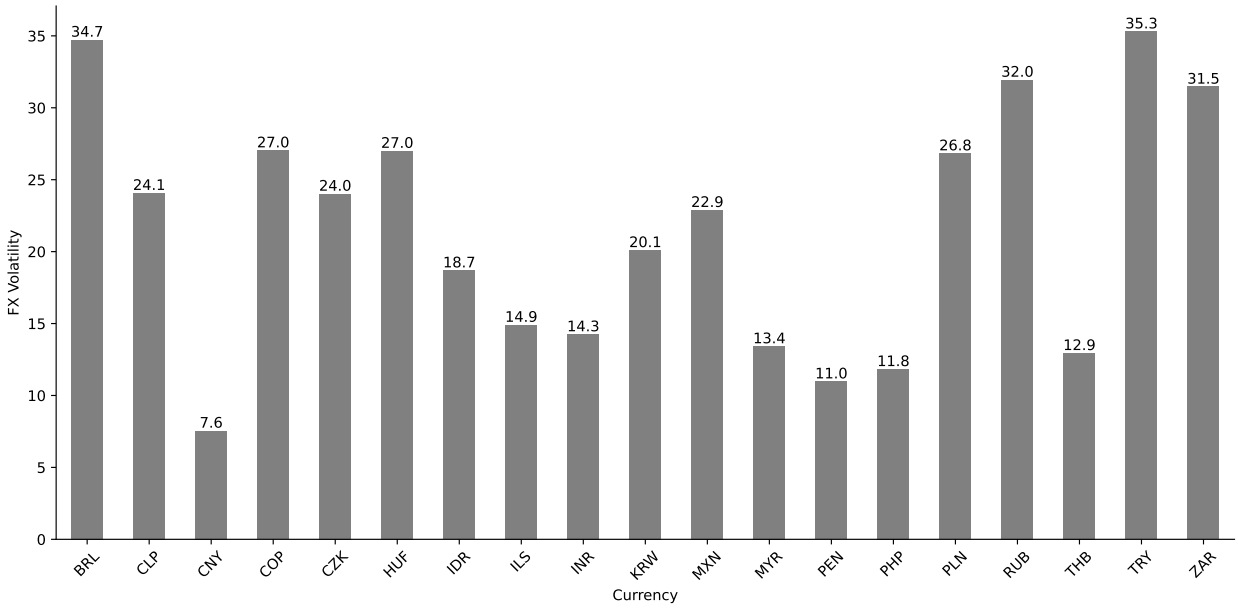
| | OLS | FE | FE |
|---|---|---|---|
| CIP basis | -7.047*** | -8.535** | -2.997 |
| | (2.65) | (3.38) | (1.89) |
| Currency FE | No | Yes | No |
| Month FE | No | No | Yes |
| N | 52111 | 52111 | 52111 |
| $R^2$ | 0.007 | 0.010 | 0.654 |

**(c) Interest rate differentials $r_{it}^{(3M)} - r_{\$t}^{(3M)}$**

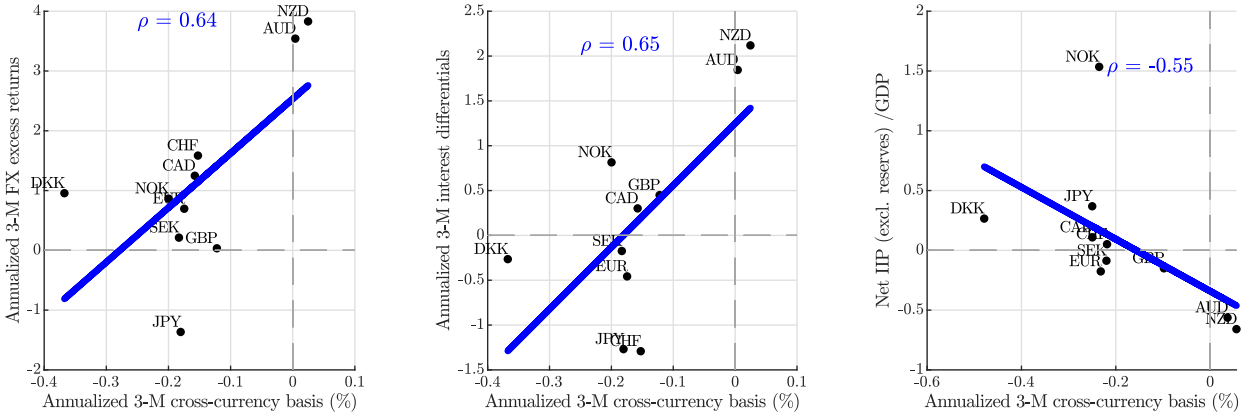
| | OLS | FE | FE |
|---|---|---|---|
| CIP basis | 0.278 | -1.518*** | 1.127*** |
| | (0.29) | (0.25) | (0.26) |
| Currency FE | No | Yes | No |
| Month FE | No | No | Yes |
| N | 52111 | 52111 | 52111 |
| $R^2$ | 0.001 | 0.412 | 0.432 |

*Note:* The table reports the regression results for 3-month FX excess returns, spot rate changes and interbank interest rate differentials on 3-month cross-currency basis with daily observations. Driscoll and Kraay standard errors with 30-day lag are reported in parenthesis. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

**Figure C.1:** Annualized FX volatility across emerging market currencies




*Note:* The figure shows the annualized FX volatility across the emerging economies. The FX volatility is of similar magnitude across currencies, ranging from 7.6% for Chinese Yuan, to 35% for Turkish Lira. Though there exists heteroskedasticity among the currencies, there is little evidence of an outlier in terms of exchange rate volatility.




**(a)** FX Excess Returns **(b)** Interest Differentials **(c)** NFA positions

**Figure C.2:** UIP and CIP deviations across G10 currencies

Note: The figure depicts scatter plots of mean cross-currency basis with FX excess returns, interest rate differentials (IRDs), and net internation investment (net IIP) positions across advanced economies. The cross-currency bases, FX excess returns, and IRDs are based on 3-month interbank rates, annualized, and quoted in percentage points. The net IIPs are from the the external wealth of nations database by Lane and Milesi-Ferretti (2017); the annual positions exclude FX reserves and are scaled by GDP. For illustration, variables are winsorized at the 5% level. The date range for FX excess returns and IRDs is 2002-2022, for net IIP 2010-2022.

# D Appendix to Section 4

## D.1 Proofs

**Proof of Proposition 4.** Consider the problem of a global investor that actively trades in *both* forward and bond markets of country $c$. We thus relax Assumption 1 and Assumption 2. Using the notation of Section 1, the realized return on the foreign investor's overall portfolio is, in U.S. dollars:

$$W_{t+1}^c \equiv X_{t+1}^{c,\star}\left(1-\frac{S_t^c}{S_{t+1}^c}\frac{R_t^c}{R_t^\star}\right)+H_{t+1}^c\left(\frac{F_t^c}{S_{t+1}^c}-1\right),$$

while its expected value and variances are, respectively:

$$E_t W_{t+1}^c \equiv X_{t+1}^{c,\star}\left(1-E_t\frac{S_t^c}{S_{t+1}^c}\frac{R_t^c}{R_t^\star}\right)+H_{t+1}^c\left(E_t\frac{F_t^c}{S_{t+1}^c}-1\right)$$

$$\operatorname{var}_t W_{t+1}^c \equiv \left(-X_{t+1}^{c,\star}\frac{R_t^c}{R_t^\star}+H_{t+1}^c\frac{F_t^c}{S_t^c}\right)^2 \operatorname{var}_t\left(\frac{S_t^c}{S_{t+1}^c}\right)$$

Unlike in the baseline setting of Section 1, the global investors now choose both its bond position $X_{t+1}^{c,\star}$ and forward position $H_{t+1}^c$ to maximize their mean-variance utility:

$$\max_{X_{t+1}^{c,\star},\, H_{t+1}^c} \quad E_t W_{t+1}^c-\frac{\gamma_t}{2}\operatorname{var}_t W_{t+1}^c, \tag{D.1}$$

where $\gamma_t$ governs the global investors' aversion to risk.

The first-order condition for $X_{t+1}^{c,\star}$ and $H_{t+1}^c$ read, respectively:

$$\frac{\left(E_t\frac{S_t^c}{S_{t+1}^c}\frac{R_t^c}{R_t^\star}-1\right)}{\gamma_t\operatorname{var}_t\left(\frac{R_t^c}{R_t^\star}\frac{S_t^c}{S_{t+1}^c}\right)}=-X_{t+1}^{c,\star}+H_{t+1}^c\frac{R_t^\star}{R_t^c}\frac{F_t^c}{S_t^c} \tag{D.2}$$

$$\frac{\left(E_t\frac{S_t^c}{S_{t+1}^c}\frac{R_t^c}{R_t^\star}-\frac{R_t^c}{R_t^\star}\frac{S_t^c}{F_t^c}\right)}{\gamma_t\operatorname{var}_t\left(\frac{R_t^c}{R_t^\star}\frac{S_t^c}{S_{t+1}^c}\right)}=-X_{t+1}^{c,\star}+H_{t+1}^c\frac{R_t^\star}{R_t^c}\frac{F_t^c}{S_t^c} \tag{D.3}$$

Equations (D.2)-(D.3) together imply that, in equilibrium:

$$\frac{R_t^c}{R_t^\star}\frac{S_t^c}{F_t^c} - 1 = 0.$$

That is, if global investors can freely trade in both home/foreign bonds and forwards, their maximizing behavior drives CIP deviations to zero. Intuitively, if global investors can chase excess currency returns through both bonds and forwards their equilibrium returns should be equalized—which occurs if and only if CIP deviations are zero. ■

**Proof of Proposition 5.** Consider a global investor that actively trades in both bond and forward markets of a continuum of economies. For simplicity, assume that the global investor is risk neutral ($\gamma_t \to 0$), and it attaches a convenience benefit $\eta_t \geq 0$ to holding a U.S. dollar-denominated bond. The global investor formally solves:

$$\max_{X_{t+1}^\star,\, H_{t+1}} \quad X_{t+1}^\star \left(1 - E_t \frac{S_t}{S_{t+1}} \frac{R_t}{(1+\eta_t)R_t^\star}\right) + H_{t+1}\left(E_t \frac{F_t}{S_{t+1}} - 1\right) \tag{D.4}$$

where $\eta_t$ is the convenience yield. The first order condition of this problem imply:

$$\frac{R_t}{R_t^\star}\frac{S_t}{F_t} - 1 = \eta_t \qquad E_t \frac{S_t}{S_{t+1}}\frac{R_t}{R_t^\star} - 1 = \eta_t \tag{D.5}$$

or, using Approximation 1:

$$\underbrace{r_t^\star - r_t + f_t - s_t}_{\text{CIP Deviation}_t} = -\eta_t \qquad \underbrace{r_t - r_t^\star - E_t \Delta s_{t+1}}_{\text{UIP Deviation}_t} = \eta_t \tag{D.6}$$

As a result:

$$\text{cov}(\text{CIP Deviation}_t, \text{USD}_t) < 0 \tag{D.7}$$

where $\text{USD}_t \equiv s_t$ is the value of the U.S. dollar, as in Proposition 3. As in Proposition 3, we assumed that (i) $\text{USD}_t \equiv s_t$ is stationary and (ii) interest differentials are constant following a change in convenience yields. ■