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

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March 11, 2025

Abstract

We argue that currency speculation drives forward exchange demand and CIP deviations in emerging economies. We present a model in which global investors, segmented out of short-term local bonds and spot markets, rely on forwards to chase predictable excess currency returns. Local intermediaries, benefiting from segmentation but constrained by position limits, supply forwards at a premium, causing CIP deviations. The model explains several defining properties of CIP deviations in emerging economies, including their comovement with UIP deviations and the U.S. dollar, as well as with the positions of global investors and local intermediaries in Peru's forward exchange market.

JEL classification: F31, G15, O16.

Keywords: CIP deviations, emerging economies, spot and forward exchange rates, currency speculation.

*First draft: September 7, 2024. We thank Wenxin Du, Mariana Garcia-Schmidt, Julien Pénasse, Claudio Raddatz, Esteban Tisnes, Haonan Zhou, and seminar and conference participants at the Federal Reserve Bank of Boston, LACEA-LAMES Annual Conference 2024, University of Maryland, University of Virginia, 14th Workshop on Exchange Rates for helpful comments.

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Deviations from covered interest parity (CIP) in emerging economies are large and volatile, and distinct from those in advanced economies (Du et al., 2018b; Cerutti and Zhou, 2024). These deviations have real economic consequences, affecting borrowing costs and currency hedging (Keller, 2024), as well as the transmission of monetary policy (Cerutti et al., 2021; De Leo et al., 2024). However, the underlying drivers of CIP deviations in emerging are not yet fully understood. This paper develops an equilibrium model tailored to the forward and spot foreign exchange markets of emerging economies. The model generates novel predictions about forward exchange positions and CIP deviations, which we empirically validate using both micro and macro data.

Our proposed mechanism builds on two key features, each grounded in common characteristics of emerging economies. First, forward exchange demand reflects the desire of *global investors*—those domiciled abroad—to capitalize on predictable currency returns. Absent restrictions, global investors could chase predictable currency returns either by trading in the forward market or by combining spot currency transactions with short-term local bond investments. However, due to market segmentation, they lack *direct* access to *short-term* local bond and spot exchange markets, leaving the forward market as their primary means of seeking excess currency returns.[1] Second, local intermediaries supply forward contracts and arbitrage between forward and spot markets, but their ability to supply forwards is constrained by position limits and currency mismatch regulations—common constraints in emerging economies. These constraints restrict the supply of forward contracts, leading to CIP deviations that compensate intermediaries for providing forwards to global investors.

These features have important implications for the equilibrium dynamics of forward positions, CIP deviations, and UIP deviations. First, when a currency offers high expected excess returns (UIP deviations), global investors increase their forward demand for these currencies. As global investors demand more local currency forwards, local intermediaries expand their forward supply but only at a higher profit. That is, they sell local currency (buy dollars) at a less favorable rate (*i.e.* buy cheaper dollars) relative to the cost of unwinding in the spot market—effectively lowering the forward premium and CIP deviations. Empirically, in

[1] Policymakers frequently cite the idea that global investors use the forward market to chase predictable excess currency returns, such as carry-trade opportunities (BIS, 2015; Patel and Cavallino, 2019).

a panel of emerging economies, we find that 3-month CIP deviations are indeed negatively correlated with excess currency returns. Our framework also rationalizes Cerutti and Zhou's (2024) empirical findings linking CIP deviations to interest rate differentials and net external positions—well-established predictors of excess currency returns.

Second, in the model heightened global risk aversion reduces global investors' forward demand for emerging market currencies, leading to an appreciation of the U.S. dollar and an increase in CIP deviations. Empirically, we document that the first principal component of 3-month CIP deviations in emerging economies is indeed positively correlated with proxies for global risk aversion such as the VIX, as well as with the U.S. dollar index.

Our model is also well supported by micro-level data on financial flows and prices in Peru's bond, spot and forward markets. As an emerging economy, Peru provides an ideal laboratory due to its significant segmentation between local and global investors in short-term local bond market access, alongside a well-developed and integrated (non-deliverable) foreign exchange forward market.[2] In this setting, we leverage both public market data and rich, confidential data provided by the bank regulator, *Superintendencia de Banca y Seguros*, for a sample spanning from 2005 to 2018. This confidential dataset includes forward contract-level data for the universe of forward trades done by local intermediaries (the market makers), containing information on counterparties, pricing, maturity, notional, and, more generally, every detail pertaining the contract. Additionally, we use information on local intermediaries' money-market assets and liabilities to estimate their profits from arbitraging CIP deviations.

Peru's micro-level data corroborate the key assumptions underlying our framework: (i) local intermediaries have clear advantages over global investors in trading CIP deviations (market segmentation); and (ii) local intermediaries hedge their foreign currency positions. First, consistent with patterns in other emerging economies (Schmittmann and Teng, 2020), global investors in Peru face significant restrictions in accessing the currency spot and short-term funding/investment markets. Unlike local intermediaries, they cannot participate in the interbank spot exchange market, access the Central Bank's primary auctions for funding and investment securities critical for CIP arbitrage, or easily acquire short-term securities. For

[2] Non-deliverable forwards (NDFs) are forward contracts that do not require the physical exchange of currencies. Instead, they are settled in a single U.S. dollar payment at maturity, based on the difference between the actual exchange rate and the pre-agreed rate.

instance, Peru imposes a 4% fee on global investors purchasing Central Bank certificates of deposit (the main instruments local intermediaries use to arbitrage negative CIP deviations) while local intermediaries are exempt. These constraints force global investors to rely on the forward market as their primary means of chasing predictable currency returns. Second, local intermediaries are subject to regulatory limits on exchange rate risk. Consistent with this regulation, in the data, the sum of their foreign exchange spot and forward position is indeed limited. Thus, domestic banks are key intermediaries in this segmented market and supply forward contracts to global investors while hedging their positions in the spot market.

Peru's micro-level data provide strong support for the main predictions of the model. First, the data confirm that global investors drive forward demand while local intermediaries act as the constrained suppliers. Consistent with local intermediaries providing liquidity to global investors, the forward balances of global investors and local intermediaries are significantly negatively correlated, with their net positions almost mirroring each other. Second, local intermediaries' behavior aligns with CIP arbitrage (as in Keller, 2024). Since they must hedge their positions and operate under balance sheet constraints, they supply forwards only at a premium, resulting in CIP deviations. The data show that intermediaries' long dollar forward positions are negatively correlated with CIP deviations, indicating that as these intermediaries supply more dollars forwards (*i.e.*, sell dollars), they demand higher compensation. This compensation takes the form of higher forward premia, as they sell dollars at a higher forward price relative to the cost of unwinding in the spot market. Hence, these deviations enable intermediaries to consistently earn positive CIP arbitrage profits.[3] Third, global investors' forward balances in Peru align with *currency speculation*, *i.e.* increasing currency risk exposure to take advantage of expected excess currency returns, rather than hedging. Global investors' positions are closely tied to both expected excess currency returns and proxies for global risk aversion. At the same time, their forward positions are *not* systematically negatively correlated with their local currency asset holdings, as would be expected under hedging. This behavior in Peru mirrors patterns observed in other emerging

[3] We estimate these profits using detailed data on banks' forward purchases and sales, including notional values, pricing, settlement spot rates, and the funding and investment rates of assets used for CIP arbitrage. For this calculation, we take into account the direction of the trade as well as the individual bank money market and exchange rate prices at which they entered into the position.

economies. Chen and Zhou (2025) document that U.S. mutual funds frequently use foreign exchange derivatives to amplify exposure to emerging-market currencies rather than to hedge, particularly in countries with stricter capital controls. Similarly, De Leo et al. (2025) show that global investors' purchases of Colombian sovereign bonds do not correspond to offsetting positions in the forward market.

CIP deviations exhibit different properties in emerging and advanced economies. While relatively small in advanced economies, averaging around 20 basis points, they are significantly larger in emerging markets, averaging approximately 100 basis points in absolute value. Moreover, CIP deviations display different dynamics around periods of global financial stress as well as U.S. dollar appreciations: during these periods, CIP deviations in emerging economies tend to rise, whereas they decline in advanced economies.

Several structural and institutional factors may explain these differences. First, in emerging economies, market segmentation can sustain large and persistent CIP deviations, as global investors face frictions in accessing short-term bond markets. Instead, in advanced economies, where global investors can exploit carry-trade opportunities similarly through short-term bonds and forwards, it is natural that CIP deviations are significantly smaller. Moreover, when market segmentation is attenuated, as in advanced economies, CIP deviations may instead reflect other forces, such as time-varying convenience yields on U.S. assets (Jiang et al., 2021), which naturally generate a negative comovement between CIP deviations and U.S. dollar. Last, a key difference between emerging and advanced economies is the size of the local investors demanding forward to hedge dollar exposure (Du and Huber, 2023). If local investors' demand for U.S. dollar hedging plays a key role in shaping forward market dynamics, and if this hedging demand rises during periods of heightened risk aversion, then global risk aversion could increase the overall demand for home-currency forwards, leading to a decline in CIP deviations.

We integrate these different insights into formal extensions of our baseline framework, providing a unified perspective on how financial imperfections influence CIP deviations across different economic settings.

Related Literature A recent strand of literature, initiated by Du et al. (2018b), shows that banking regulation constrains banks' ability to engage in CIP arbitrage, leading to persistent CIP deviations (see also Cenedese et al., 2021; Barbiero et al., 2024). When forward supply is constrained, fluctuations in the volume of currency forwards that "arbitrageurs" must intermediate can influence CIP deviations. There is mounting evidence that identified demand or supply shocks in the forward market indeed affect CIP deviations (Abbassi and Bräuning, 2020; Aldunate et al., 2023; Ben Zeev and Nathan, 2024a,b; Borio et al., 2018; Bush, 2019; Kekre and Lenel, 2023).

We contribute to this literature in three key ways. First, we propose a formal model of forward demand and supply that highlights the role of global investors' currency speculation in segmented foreign exchange markets. Existing models of forward demand have primarily focused on hedging motives or exogenous forward demand shocks (Liao and Zhang, 2021; Bacchetta et al., 2024; Du and Huber, 2023), with the notable exception of Chen and Zhou (2025). Second, we provide a systematic explanation for the distinctive properties of CIP deviations of emerging economies—both in the cross-section and during periods of global distress (Avdjiev et al., 2019; Cerutti and Zhou, 2024; Du and Schreger, 2022). Third, using transaction-level data from Peru's forward market, we show that local intermediaries predominantly supply forwards to global investors, whose demand is closely linked to fluctuations in expected currency returns, and, in doing so, local intermediaries earn CIP deviations. We thus confirm the critical role of local intermediaries in transmitting global shocks to emerging economies (De Leo et al., 2025; di Giovanni et al., 2022; Gutierrez et al., 2023; Keller, 2024).

1 A Model of Forward Markets in Emerging Economies

This section describes the structure of forward and spot markets in the small open economy. Our framework consists of a continuum of small open economies, indexed by $c \in [0, 1]$, over two time periods $[t; t + 1]$.

1.1 Forward Exchange Market

In each forward market c, global investors—investors domiciled outside of economy c—take long or short forward positions, determining forward demand.[4] We assume that their *short-term* bond position is predetermined and constant. Thus, global investors' only avenue to exploit short-run excess currency returns is through the forward market.[5] 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-free portfolio. Because of position limits and participation costs, they require compensation for holding a given forward position, reflected in CIP deviations.[6] We provide evidence to support the assumptions around market segmentation and financial regulations in Section 2.

We omit the indicators "c" for the remainder of this section and reintroduce them when analyzing the multi-country setting. We use the superscript $\star$ to denote variables of the foreign economy, representing the U.S..

1.1.1 Global Investors

Bond Position A global investor holds a position in the home-currency short-term bond $\frac{X_{t+1}}{R_t}$, and a corresponding opposite position in the short-term 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 show that various financial regulations impose significant costs on global investors seeking access to the local bond and spot markets or adjust their positions in many emerging economies. Consistent with this empirical observation, we assume that

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

[5] We abstract from considering 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. Henceforth, references to "bonds" will pertain exclusively to short-term bonds.

[6] 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.

global investors cannot re-evaluate their short-term bond positions.

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 long home-currency/short U.S. dollar forward position (H_{t+1}), where the position is expressed in U.S. dollars. 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 global investor's overall portfolio is, in U.S. dollars:

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

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 γ_t governs the global investors' aversion to risk.

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

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

In Section 2.2.1, we note that global 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. (1), as:

$$\frac{\left(E_t \frac{F_t}{S_{t+1}} - 1\right)}{\gamma_t \operatorname{var}_t \left(\frac{F_t}{S_{t+1}}\right)} = H_{t+1}. \tag{2}$$

Forward demand by global investors responds to expected currency returns in the forward market in proportion to their risk-bearing capacity.[7] We elaborate on equation (2) below.

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.

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:

$$G^\star_{j,t+1}\left(1 - \frac{R_t}{R^\star_t}\frac{S_t}{S_{t+1}}\right) + K_{j,t+1}\left(\frac{F_t}{S_{t+1}} - 1\right) \tag{3}$$

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 and 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 forward (*i.e.* short-dollar forward for the local

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

intermediary):

$$K_{t+1} = \frac{1}{\kappa} \underbrace{\left(\frac{R_t^\star}{R_t} \frac{F_t}{S_t} - 1 \right)}_{\text{CIP Deviation}_t}. \tag{4}$$

Local intermediaries' supply of U.S. dollars forward is increasing in the CIP deviation. Because of position limits, akin to balance sheet regulatory constraints, local intermediaries require compensation to supply forwards, resulting in CIP deviations. Here κ denotes the stringency of participation costs, and thus the elasticity of CIP deviations to changes in local intermediaries' forward supply.[8]

The relationship between the CIP deviation sign and local intermediaries' forward supply is intuitive. To understand this relationship, first express CIP deviations in log, that is $r_t^\star - r_t + f_t - s_t$. When $K_{t+1} > 0$, local intermediaries sell dollars forward, while unwinding this short dollar position in the spot market (*i.e.* buying dollars spot). CIP deviations represent the profit from this trade. In fact, the revenue from selling dollars forward is f_t, while the cost of buying dollars spot is $s_t + r_t - r_t^\star$. In particular, buying dollars spot would require local intermediaries to borrow in the home-currency at a rate r_t, buying dollars with the home-currency at a price of s_t dollars, and investing those dollars at a rate $r_t^\star$. To the contrary, when $K_{t+1} < 0$, local intermediaries supply home-currency forwards (*i.e.* take a long U.S. dollar forward position) and benefit from a negative CIP deviation.

In Appendix A.1 we show that local intermediaries' demand for U.S. dollar spot is:

$$G_{t+1}^\star = \frac{1}{\kappa} \underbrace{\left(\frac{R_t^\star}{R_t} \frac{F_t}{S_t} - 1 \right)}_{\text{CIP Deviation}_t} \frac{R_t^\star}{R_t} \frac{F_t}{S_t}. \tag{5}$$

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

$$\frac{1}{\kappa} \left(\underbrace{\frac{R_t^\star}{R_t} \frac{F_t}{S_t} - 1}_{\text{CIP Deviation}_t} \right)^2. \tag{6}$$

[8] While we model frictions in forward supply as position limits, imperfect competition in financial intermediation can also result in an upward sloping supply of forwards (Wallen, 2022).

1.1.3 Equilibrium in Forward Exchange Market

Forward market clearing requires that short-dollar forward position of local intermediaries (supply of U.S. dollars, K_{t+1}) equals of long-dollar forward position of global investors (demand of U.S. dollars, $-H_{t+1}$):

$$K_{t+1} = -H_{t+1} \tag{7}$$

Equations (2), (4) and (7) 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 (4) represents the supply of dollar forward, with its slope determined by the tightness of local intermediaries' position limits, parameterized by κ. 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 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 (2) 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, global investors demand less dollar forwards when CIP deviations are larger.

Two factors shift the forward demand curve of global 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. Indeed, log expected returns from the forward-trade are the sum of UIP deviations and CIP deviations:

$$f_t - E_t(s_{t+1}) = \underbrace{r_t - (r_t^\star + (E_t(s_{t+1}) - s_t))}_{\text{UIP deviation}_t} + \underbrace{r_t^\star - (r_t - (f_t - s_t))}_{\text{CIP deviation}_t}. \tag{8}$$

Even when global investors are restricted from trading short-term bonds, they can still chase predictable excess currency returns (UIP deviations) through appropriate forward market trades. However, when CIP deviations are present, the expected return from forward trading diverges from that of a standard UIP trade conducted with direct bond positions. Hence, global forward demand is shaped by both UIP and CIP deviations. We note that equation (8) highlights that global investors may still take long home-currency forward positions even when CIP deviations are negative—implying an overly appreciated forward rate—if UIP deviations are sufficiently large.

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 equilibrium UIP deviations. If UIP deviations are positive, tighter risk-bearing capacity leads global 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, global investors demand less local-currency forward (more dollar forward).

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:*

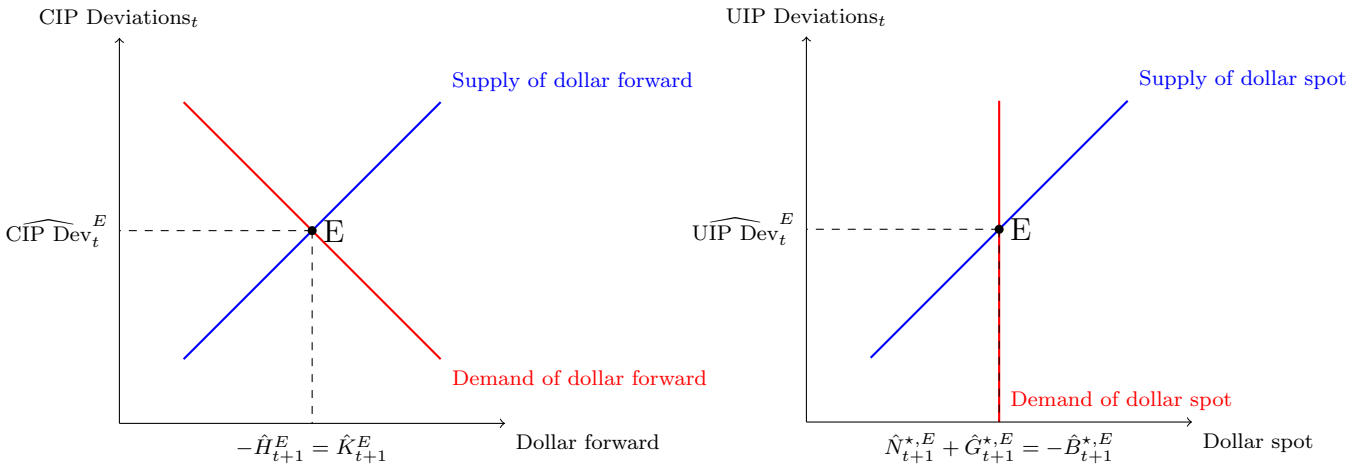
(a) is negatively correlated with the position of global investors in the forward market;

(b) is negatively correlated with the CIP deviation;

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

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 (7). In turn, because CIP deviations emerge as compensation for local intermediaries' costly forward supply, their forward dollar position is negatively correlated with CIP deviations (eq. (4)), and their forward position must deliver positive profits (eq. (6)). 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 Exchange 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.

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, similar to the "arbitrageurs" in Gabaix and Maggiori's (2015) model of foreign exchange spot market.

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

$$\max_{B_{t+1}^\star} \quad B_{t+1}^\star E_t\left(1 - \frac{R_t}{R_t^\star}\frac{S_t}{S_{t+1}}\right) - \frac{\lambda}{2}\left(B_{t+1}^\star\right)^2 \text{var}_t\left(1 - \frac{R_t}{R_t^\star}\frac{S_t}{S_{t+1}}\right),$$

where λ denotes their risk aversion. The first-order condition reads:

$$\frac{\overbrace{\left(E_t \frac{R_t}{R_t^\star} \frac{S_t}{S_{t+1}} - 1\right)}^{\text{UIP Deviation}_t}}{\lambda \operatorname{var}_t \left(\frac{R_t}{R_t^\star} \frac{S_t}{S_{t+1}}\right)} = -B_{t+1}^\star \tag{9}$$

Equation (9) states that domestic currency-spot traders' home-currency position is increasing in excess home-currency returns, in proportion to their risk bearing capacity.[9]

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

$$S_t \frac{N_{t+1}^\star}{R_t^\star} + \frac{N_{t+1}}{R_t} = 0. \tag{10}$$

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. It could also capture the central bank's currency demand.

1.2.1 Equilibrium in Spot Exchange Market

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

$$N_{t+1}^\star + G_{t+1}^\star = -B_{t+1}^\star. \tag{11}$$

Equations (5), (9), (10), and (11) 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. Thus, they require higher excess home currency returns (UIP deviations, eq. (9)).

[9] We note that equation (9) 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).

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):

$$\underbrace{(r_t^\star - r_t + f_t - s_t)}_{\text{CIP Deviation}_t} = \frac{\Lambda\kappa}{\Gamma_t + \kappa + \Lambda}(\xi_t); \qquad \underbrace{(r_t - r_t^\star - E_t s_{t+1} + s_t)}_{\text{UIP Deviation}_t} = -\frac{\Lambda(\Gamma_t + \kappa)}{\Gamma_t + \kappa + \Lambda}(\xi_t), \quad (12)$$

where lower-case letters denote the logarithm of the respective upper-case variables, $\Gamma_t \equiv \gamma_t \sigma_s^2$ and $\Lambda \equiv \lambda \sigma_s^2$ are global investors' and domestic currency-spot traders' risk-bearing capacity, respectively, while ξ_t denotes a shock to the demand for home currency bonds.[10] We assume that the exogenous processes, ξ_t, Γ_t, and s_{t+1} are independent.

We can then use eq. (12) to express the expected return in the forward market:

$$\underbrace{(f_t - E_t s_{t+1})}_{\text{forward-market returns}_t} = -\frac{\Lambda\Gamma_t}{\Gamma_t + \kappa + \Lambda}(\xi_t). \quad (13)$$

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, ξ^c. In equilibrium, the cross-currency correlation between average UIP deviations and average CIP deviations is negative.*

Proof. See Appendix A.4 ■

The proposed mechanism implies that countries with higher UIP deviations exhibit lower CIP deviations. In our model, a country with high average UIP deviations attracts global investors' demand for home-currency forward. To induce local intermediaries to supply home-currency forward, CIP deviations have to decline. We note that cross-currency differences in CIP deviations are sustained because only local intermediaries can conduct the CIP arbitrage in a given currency (Rime et al., 2022; Siriwardane et al., 2022).[11,12]

[10] The shock to home-currency bond demand is formally defined as $\xi_t = -\left(R_t/R_t^\star S_t/F_t\right)^2 N_{t+1}^\star$.
[11] Figure A.1 provides an illustration of the logic behind Proposition 2.
[12] Chen and Zhou (2025) obtain an inverse relationship between CIP and UIP deviations in a model in which risk-averse global investors are heterogeneous in their underlying bond positions.

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, along with 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, see, *e.g.*, 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 to home-currency risk). The ensuing movement along the forward supply curve result in increasing CIP deviations. In equilibrium, UIP deviations also increase as local intermediaries reduce their foreign-currency spot demand since they now have to supply less home-currency forward.[13]

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), for given interest rate differentials. In this sense, the U.S. dollar can be interpreted as a global risk factor, appreciating during periods of high 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.

[13] These dynamics are summarized in Figure A.2.

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 Empirical Validation Using Peru's Micro-Level Data

We begin by confronting the model's assumptions and predictions with granular data from Peru. Peru serves as a relevant case study due to its similarities with other emerging economies, allowing us to analyze a broadly applicable setting while grounding our discussion in concrete examples. The granularity of the data also allows us to test predictions that require detailed information on forward positions across participants, as well as intermediaries' positions in spot and money market.

Like many other emerging economies, Peru is partially dollarized, with local intermediaries, or "banks", acting as market makers in both spot and forward exchange markets. These banks play a central role in liquidity provision and operate under regulatory constraints similar to those in other emerging markets.

These local intermediaries, which we refer as "local banks" or "Peruvian banks", may be subsidiaries of global banks. However, to operate as a local bank in Peru, they must establish offices within the country and comply with Peruvian regulations, just as domestic banks do.[14] Crucially, they cannot bypass these regulations when trading with their foreign headquarters, which are treated as separate entities by the regulatory agencies.

Beyond their role in the FX market, Peruvian banks serve as key financial intermediaries in the broader economy. Most function as commercial lenders, accepting deposits and extending loans in both soles (PEN, the internationally recognized abbreviation for Peru's currency) and U.S. dollars. As noted in Keller (2024), these deposits—particularly term deposits—are

[14] Examples of local banks that have foreign headquarters include Scotiabank Peru, BBVA Continental, Citibank Peru.

an important funding source for CIP trading activities.

Section 2.1 describes the granular data from Peru, Section 2.2 examines how the model's setting and assumptions align with the structure of Peru's forward and spot markets, and Section 2.3 tests the model's predictions using Peruvian data.

2.1 Data

Our data consist 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.[15] The sample goes from 2005 to 2018.

Market Data We collect foreign-exchange data on spot and forward transactions from *Bloomberg*. We also retrieve Peru's official closing spot foreign-exchange data from Peru's banking regulator, *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 gather data on global investors' holdings of fixed income securities in Peru. The safest short-term sovereign-risk security in Peru are Central Bank's certificates of deposit, which typically have maturities of less than one year.[16] We manually collected the data for these holdings from various reports published by the Central Bank of Peru. For longer-term sovereign bonds issued by *Ministerio de Economia y Finanzas* (Peru's finance ministry), we manually extract the number of sovereign bonds held by global investors from PDFs from Ministerio de Economía y Finanzas (2023).

Forward Data To complement market data, we use confidential (and mandatory) foreign exchange trading reports submitted by local banks to the SBS. Our primary dataset consists of weekly snapshots of all forward contract holdings of local banks, including details such as the bank name, trade date, maturity, trade direction, notional amount, forward price and counterparty information. Additionally, banks must report the spot price at the time they

[15] Throughout the paper, we consider exclusively short-term CIP deviations on interbank money market instruments. Unlike CIP deviations on long-term government bonds (Du and Schreger, 2016), these short-term deviations are unlikely to capture local-currency sovereign risk.

[16] As we explain later, global investors used to hold some of these securities, until regulation made it prohibitively expensive for them to do so. Since October 2010, global investors have had a zero balance of certificates of deposits.

closed the forward contract—a key input to computing trade-level forward premia.

Investment and Borrowing Data. In addition to forward contract-level data, local banks report information on their money-market assets and liabilities to the SBS, allowing us to compute banks' CIP profits. Following Keller (2024), we focus on the assets and liabilities that are most probably used when arbitraging CIP deviations. For soles and dollar funding, we use rates and balances of new term deposits. For soles investments, we use a dataset containing monthly snapshots of banks' fixed-income holdings. While the snapshots are monthly, the dataset includes the transaction date, enabling us to approximate daily investments. From this dataset, the relevant asset in soles we use 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.

Exchange Rate Expectations. We also obtain exchange rate expectations for the PEN/USD exchange rate from *Consensus Economics*, spanning January 2002 to December 2022. It includes monthly observations on the exchange rate on the survey date, as well as forecasts for 3 months, 12 months, and 24 months ahead. These expectations provide insights into market participants' outlook on currency movements over different time horizons.

2.2 Market Structure

In this subsection, we discuss the evidence that motivates the key assumptions underlying the framework in Section 1. More specifically, we highlight the type of market segmentation in emerging economies, the presence of large offshore/integrated non-deliverable forward markets, and the regulatory framework governing local banks' exchange rate risk hedging.

2.2.1 Market Segmentation

Assumption 1 and Assumption 2 capture that global investors find it difficult to invest in *short-term* bonds. Consequently, in our model, if they want to engage in carry trade and hence want to borrow in one currency to invest in another, they do so through forward contracts rather than the short-term bond market.

These assumptions are consistent with the regulatory practices observed in emerging

economies. For example, in several Asian markets, global investors face restrictions on accessing onshore platforms, including investing in short-term government debt, spot exchange rate, and local currency borrowing, and therefore prompting the development of offshore non-deliverable forward markets as a key alternative for currency speculation and hedging (Heenan et al., 2011; Global Treasurer, 2013; Patnaik et al., 2013; Schmittmann and Teng, 2020). Similar restrictions exist across Latin America, with examples including Brazil, Chile and Colombia (BIS, 2015).

We provide evidence of market segmentation using both data and institutional details on the regulatory framework in Peru as well as examples from various sources on other emerging economies.[17] We describe how financial regulations impose significant costs—and sometimes outright barriers—on global investors accessing local short-term bond and spot exchange markets. These constraints, listed below and common across emerging economies, give local banks a clear advantage in the spot exchange and money markets, reinforcing their role as intermediaries while restricting global investors' pursuit of predictable excess returns primarily to forward markets.

A. Restrictions to trading money-market instruments. In Peru, global investors face two key restrictions when attempting to trade money-market instruments as a means of capturing predictable excess returns through short-term securities.

First, only local banks can participate in the Central Bank's primary auctions, which include essential money market instruments for arbitraging CIP deviations, both in terms of investing and funding.

Second, also accessing short-term government securities in the secondary market is costly for global investors. In early 2008—amid significant carry trade inflows—Peru's Central Bank further tightened access by imposing barriers on foreign investment in the secondary market for its certificates of deposit (CDs). As the safest short-term sol-denominated securities, CDs were ideal for carry trades and CIP arbitrage. However, with these new restrictions, global investors seeking such opportunities were forced into sovereign bonds, which have a longer maturity that CDs, exposing them to price risk. Figure B.1 shows that after the Central Bank imposed a 4% fee on the notional amount for global investors purchasing CDs, foreign

[17] See also Keller's (2024) Online Appendix on market segmentation in Peru's exchange rate market.

holdings of these instruments gradually declined to zero as existing certificates matured. This decline was not due to a lack of demand for sol-denominated assets. While global investors reduced their holdings of sovereign debt during the crisis, they increased their positions in sovereign bonds after capital inflows resumed in 2010. However, re-entering the CD market remained prohibitively expensive.[18]

These constraints are not unique to Peru. Many emerging markets restrict foreign investment in short-term bonds to curb speculation and carry trade, often pushing investors toward forward contracts instead (Heenan et al., 2011; Patnaik et al., 2013; BIS, 2015; Patel and Xia, 2019; Schmittmann and Teng, 2020). For instance, India imposes strict quotas on foreign holdings of Treasury bills (Patnaik et al., 2013), Indonesia bans direct foreign purchases of short-term central bank instruments and enforces minimum holding periods (Heenan et al., 2011), and Brazil applies a 6% tax to deter inflows (BIS, 2015). Similarly, Chile and Colombia restrict global investors' access, encouraging forward trading (BIS, 2015), while South Korea has intermittently imposed a withholding tax on interest income and capital gains from foreign holdings of Treasury and Monetary Stabilization Bonds (IMF, 2011).

B. Restrictions to participate in the spot currency market. In Peru, local banks are the only participants allowed to trade in the interbank USDPEN spot market, the primary reference for USDPEN spot rates. Global investors must rely on local intermediaries to buy and sell currency in the spot market.

This market structure is not unique to Peru. In Brazil and Colombia, dealers have exclusive access to interbank venues, requiring all FX transactions to go through them (Dodd and Griffith-Jones, 2007; Baker McKenzie, 2022). Similar restrictions exist across Asia. In India, despite efforts to integrate with global financial markets, foreign investors still face limits on onshore access (BIS, 2022). Malaysia enforces strict policies limiting global investors from trading its local currency onshore (Schmittmann and Teng, 2020; Euromoney, 2020) while in China, access is limited to approved domestic institutions, with quota programs and designated channels for foreign investors (BIS, 2022).

[18] In November 2010 and February 2012, global investors purchased newly issued 10-year sovereign bonds. These bonds were structured as Global Depository Notes (GDNs), allowing them to be traded, settled, and paid in dollars while maintaining the terms of the sol-denominated Peruvian sovereign debt.

C. Restrictions to borrowing local currency. In Peru, when global investors expect a depreciation of the sol that exceeds the interest rate differential (*i.e.* negative excess returns), they may want to profit by borrowing in soles and investing in dollars.[19]

However, global investors cannot easily access soles funding and if they do, it would involve transactions costs. First, soles can only be liquidated in Peru, requiring global investors to hold a soles-denominated account in Peru. Second, banking regulations prohibit any entity other than local banks from receiving deposits from households and firms, effectively preventing global investors from obtaining soles deposits. An alternative would be borrowing from local banks. However, Keller (2024) shows that soles are scarce when CIP deviations increase, and local banks use such soles funding to do the CIP arbitrage themselves. As a result, any lending to global investors is likely to come at higher interest rate, compensating local banks for the opportunity cost of not deploying these funds for arbitrage.

As with the previous restrictions, the limitations for global investors to borrow in local currency exist across emerging economies. After the Asian crisis, many Asian countries introduced restrictions on global investors' local currency borrowing. For example, limits and restrictions were set in Thailand, Indonesia, Malaysia, while in Philippines the supply of local currency was subject to its central bank authorization (Watanabe et al., 2002).

2.2.2 Large Non-deliverable Forward markets

The growth of foreign exchange non-deliverable forward (NDF) markets has been driven by restrictions on onshore markets, particularly for global investors (Patel and Xia, 2019; Schmittmann and Teng, 2020; Euromoney, 2020). These derivative contracts allow investors to hedge or speculate on currencies without physically exchanging them, settling only the net difference (*i.e.*, the profit) in U.S. dollar.

For global investors, NDFs offer several key advantages. Not only they bypass the restrictions outlined in Section 2.2.1, but also minimize counterparty risk, as only the profit is settled in U.S. dollars at maturity, without exchanging notional amounts. They also require less upfront capital.[20] To conduct carry trade with bonds, for example, an investor

[19] In case they were arbitraging CIP deviations, which they do not, they would also need soles funding to arbitrage positive CIP deviations.

[20] The low counterparty risk in the NDF market because of netting notionals, in addition to local intermediaries also facing very low risk in money market when unwinding their positions—banks use very short-term

typically borrows the full amount in currency A to invest in currency B. With an NDF, they can simply sell currency A forward and have the same exposure. Then, if the trade incurs in losses, they only need to cover the net difference rather than the full notional amount. Lastly, NDFs simplify transactions by providing the same exposure as a traditional carry trade in a single step, eliminating the need to borrow in currency A, convert to currency B and invest.

Given these benefits and the difficulty global investors face in accessing onshore spot markets, the NDF market has grown substantially across emerging economies, often surpassing onshore spot volumes. Since 2016, NDF volumes have more than doubled (Schmittmann and Teng, 2020). In December 2024, offshore trading of India's rupee NDFs reached $161 billion (Reuters, 2025). The NDF market is also highly liquid; for instance, Brazil's NDF market, one of the largest outside Asia, is the most liquid avenue for BRL FX trades, even exceeding spot transactions (BIS, 2015; Duo, 2025).

Peru follows similar trends as other emerging economies. Our dataset shows that in 2017 and 2018—the latest years in our sample—the average daily volume of forward contracts that local intermediaries supply was approximately $400 million, with nearly 90% consisting of NDFs, surpassing the average daily volume of FX spot transactions (The Trade, 2024).

2.2.3 Local Intermediaries' FX Hedging

Assumption 3 states that local intermediaries hedge their exchange rate risk. This is a general characteristic of emerging economies' financial intermediaries due to regulatory requirements. Canta et al. (2007) documents the exchange rate risk limits imposed on local banks across a broad panel of emerging economies. Recent evidence confirms this feature. Some examples include Peru (Keller, 2024, Online Appendix), Chile (Alfaro et al., 2023), Brazil (Bradesco, 2023), Colombia (Autorregulador del Mercado de Valores, 2019), Mexico (IMF, 2022). Asian countries also have similar policies, such as India (Reserve Bank of India, 2010; Lexsite.com, 2024), Indonesia (Bank of Indonesia, 2005) and Philippines (Business World, 2021).

Using data on local banks' forward, swap and spot positions, we extend the analysis from

investment instruments and fund themselves from large institutional investors, banks and Central Bank repos—makes it highly unlikely that CIP deviations in Peru are driven by counterparty risk. Moreover, it is hard to reconcile a pure counterparty risk on CIP deviations that turn sign often.

Keller (2024, Online Appendix). As expected from regulation that forces banks to hedge most of their exchange rate exposure, Figure B.2 shows that banks' FX spot positions are consistently offset by inverse forward and swap positions, ensuring that their net FX exposure remains minimal.[21]

2.3 Testing predictions on positions and returns

We now test the model's key predictions on positions and returns (Proposition 1 and Proposition 3). Since assessing positions requires granular data unavailable in cross-country datasets, we rely on our detailed data from Peru. To complement this analysis, Section 3 tests additional model predictions using cross-country data.

2.3.1 Counterparties' role in FX forwards and CIP deviations

Proposition 1 characterizes the model's relationship between global investors' forward demand, local banks' forward supply, CIP deviations, and arbitrage profits.

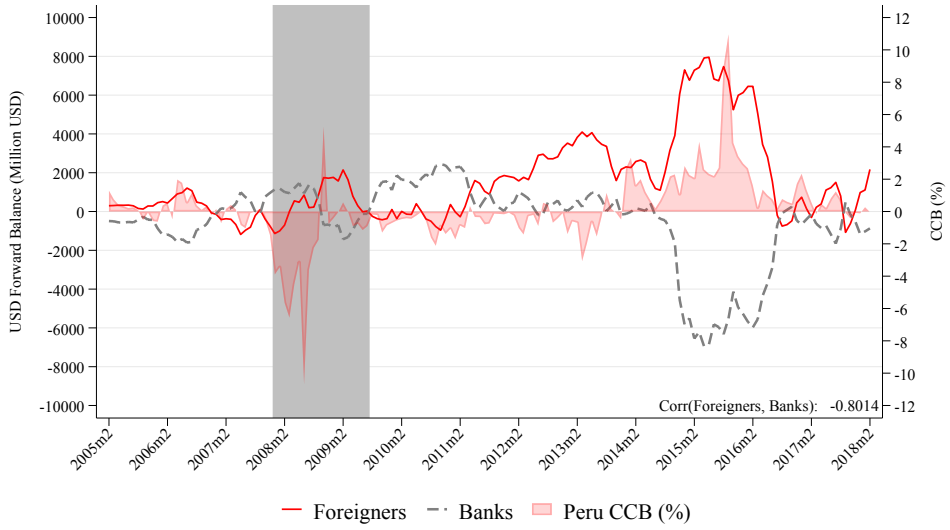
First, Proposition 1(a) states that local banks' positions should be negatively correlated with those of global investors, as global investors are the primary counterparties driving banks' positions. Using forward contract-level data from Peru, we document a correlation of -0.80 between the forward balances of global investors and banks (the correlation is -0.88 when computed with flows instead of balances). As illustrated in Figure 2, global investors' long dollar forward balances (red) and banks' long dollar forward balances (dotted gray) move in opposite directions. A regression of banks' forward positions on those of global investors shows that a 1 U.S. dollar increase in global investors' long forward dollar position is associated with a 0.8 U.S. dollar decrease in banks' long forward positions (not reported).[22] Hence, forward balances of local intermediaries are nearly the mirror image of those of global investors, even though local intermediaries also trade forwards with local corporates, pension funds, and occasionally the central bank, highlighting the key role of

[21] FX swaps were actively traded in 2015, primarily with the Central Bank of Peru, which intervened in the FX market using swaps rather than its usual spot interventions. This shift explains differences in the balance of banks' forward and swap positions compared to other periods. A detailed breakdown of FX forward and swap components is provided in Figure B.3.

[22] Before the Taper Tantrum in 2013, this relationship was even stronger, with a near one-to-one coefficient. However, after the Taper Tantrum, as the sol and other emerging-market currencies depreciated, local firms increasingly used forwards, weakening the correlation. Despite this, global investors remain the dominant counterparty for local banks in the forward market.

global investors in shaping forward demand.

Figure 2: Forward balances from foreigner investors and banks



Note: The solid red line shows global 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 global investors and local banks' net long dollar forward balances.

Second, Proposition 1(b) states that CIP deviations should be negatively correlated with banks' forward holdings. When local banks face position limits and, thus, an upward-sloping forward supply curve, they require positive CIP deviations as compensation for supplying (*i.e.* selling) more dollars forward and maintaining a negative net long dollar forward position. Figure 2 conforms to this prediction, depicting a correlation of -0.36 between local banks' net long dollar forward balance and CIP deviations in Peruvian data.[23]

Finally, Proposition 1(c) states that local banks should earn positive profits from their CIP trades. Below, we show that banks' profits from trading CIP deviations—whether positive or negative—increase as deviations grow in absolute value.

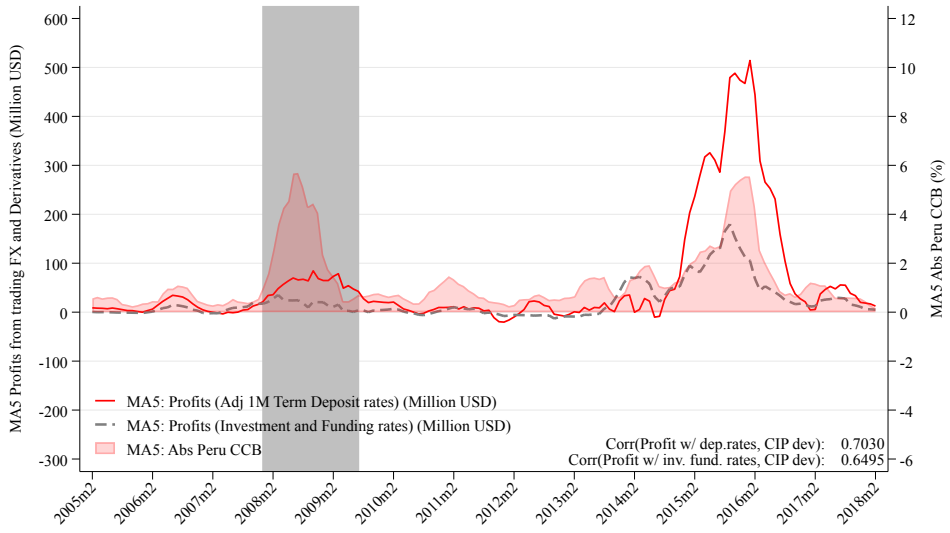
We measure local banks' profits from arbitraging CIP deviations by first computing for each bank the approximate CIP deviations they obtain for each trade, and multiplying this by the volume of the trade. This would give the CIP profit of the trade. We then aggregate these profits for the banking system.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

[23] Similar results hold when analyzing flows instead of balances.

used for CIP arbitrage are not directly observable, we compute profits using two approaches. The first assumes investment and funding rates are term deposit rates, adjusted for reserve requirement costs. The second follows Keller (2024), using the most likely investment and funding rates for each currency. Further details on the profit calculation, including trade direction and rate selection, are provided in Appendix B.1.

Figure 3 presents the results of these calculations. The shaded red area represents the de-trended six-month moving average of the absolute value of CIP deviations, overlaid with the two profit measures. The moving average incorporates the past five months plus the current one. The red line represents profits calculated using only deposit rates, while the gray line corresponds to the proxy adjusted for investment and funding rates.

Figure 3: CIP deviations and profits of local intermediaries



We compute six-month moving averages of trading profits (covering the past five months plus the current month) and Peru's absolute CIP deviations. The red line represents the de-trended six-month moving average of total FX spot and FX derivatives profits, while the gray line serves as a proxy adjusted for investment and funding rates. The shaded red area depicts the de-trended six-month moving average of the absolute value of CIP deviations.

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

2.3.2 Positions and Returns during Global Financial Disruptions

Proposition 3(a) states that during periods of heightened global risk aversion, CIP deviations increase and the U.S. dollar appreciates in the baseline model. It occurs because global investors reduce their open forward positions in emerging market currencies. As fewer global investors take on local currency exposure, the demand for local currency forwards declines. This drives CIP deviations higher (*i.e.*, less negative or even positive) since local intermediaries buy local currency (sell U.S. dollars) at a more depreciated rate than the cost of unwinding this position in the spot market. In this subsection, we provide empirical support for the relationship among CIP deviations, global investors' local currency (U.S. dollar) forward positions, and the U.S. dollar index.

To empirically assess Proposition 3(a), we first document in Figure 4a that during periods of U.S. dollar appreciation CIP deviations increase. This relationship is particularly strong during the Global Financial Crisis.

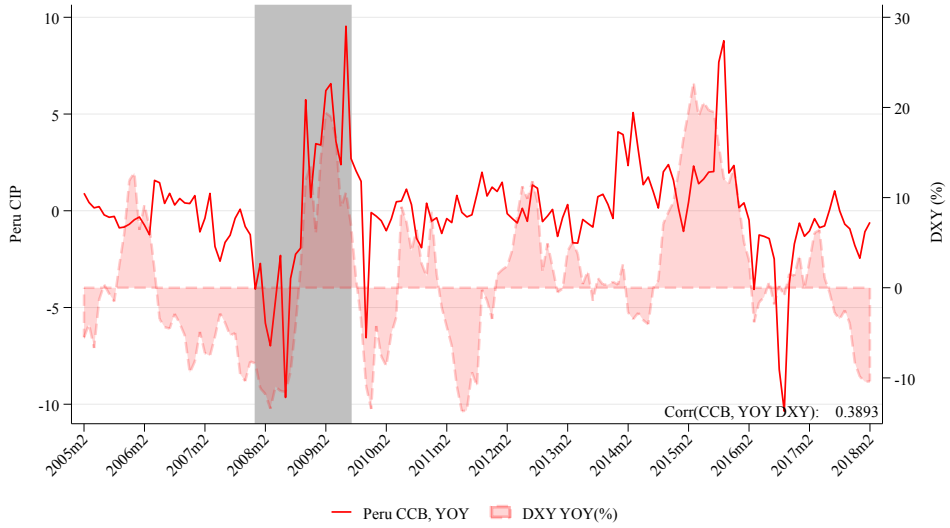
Second, we find that global investors demand more dollars forward and local banks supply dollars forward during periods of appreciated U.S. dollar, consistent with the model. Figure 4b displays the year-over-year (YoY) change of the dollar index (DXY), along with the net long dollar flows of global investors and local intermediaries. An increase in global investors' net long dollar forward flows corresponds to greater global demand of dollars forwards. Consistent with the model, these flows display a strong positive correlation (0.51) with the dollar index. Given that local intermediaries are dealers in the forward market, their flows represent 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 global investors), and therefore an increase in the net supply of dollars forward. The negative relationship between local banks' net long dollar forward flows and the dollar index aligns with our model's prediction: higher risk aversion, associated with stronger U.S. dollar, corresponds to a greater supply of dollars forward provided by local banks.

2.4 Forward Demand: Speculation vs. Hedging Motives

The literature on CIP deviations often assumes that forward demand primarily reflects hedging motives. In contrast, our framework models a distinct motive—"currency speculation"—

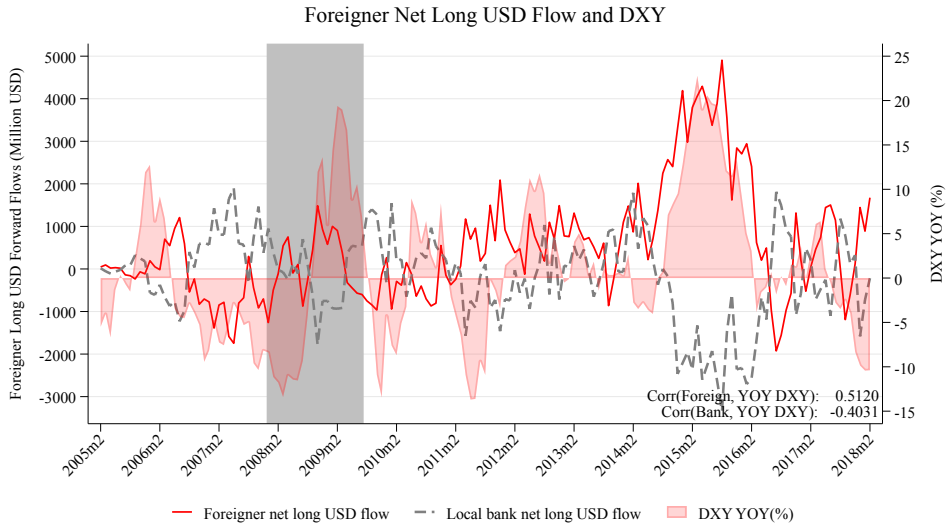
Figure 4: YOY DXY, YOY Peru cross-currency basis, net long dollar forward flows

(a) Panel A: Year-over-year (YOY) change of dollar index and Peru's cross-currency basis



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

(b) Panel B: Year-over-year (YOY) change of dollar index and net long dollar forward flows



Note: The light red area corresponds to the YOY change of USDPEN cross-currency basis, while the dotted gray line corresponds to the YOY change of the dollar index (DXY). 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.

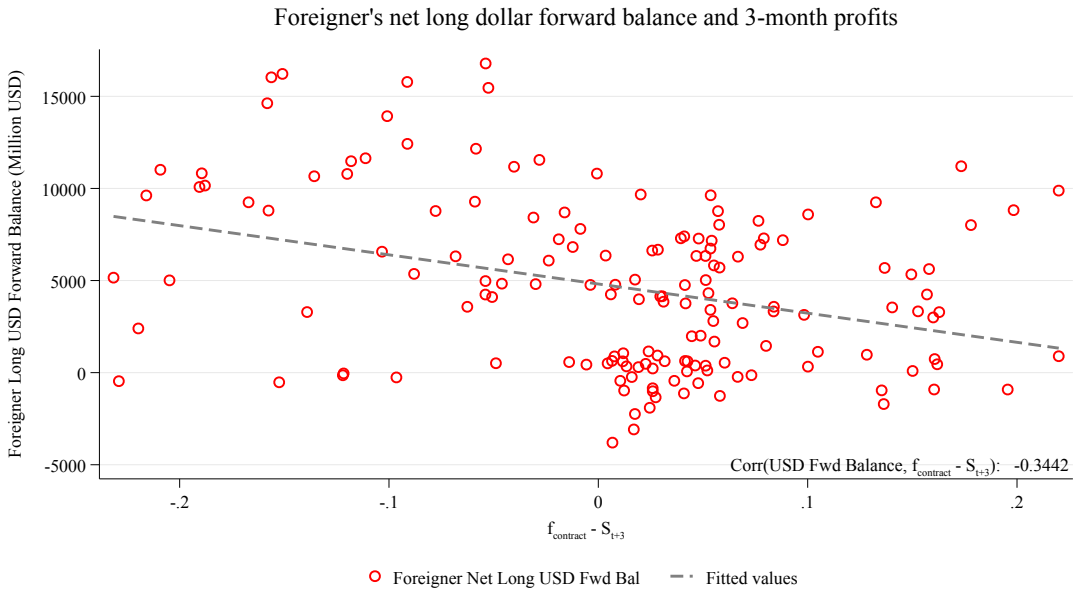
whereby global investors take forward positions to increase, rather than offset, currency risk exposure in pursuit of positive expected return. We argue that speculative motives are likely the dominant force behind forward demand in emerging markets, and next we provide several additional pieces of evidence using data from Peru to support this view.

First, if global investors were hedging, we would expect them to have long dollars forward positions to offset their exposure to Peruvian assets that are denominated in soles (since global investors can only hold long positions in soles-denominated assets). However, as shown in Figure 2, global investors' total long forward positions were mostly *negative* before February 2011, except during the Global Financial Crisis (2008-2009), when they turned positive. Rather than hedging, global investors' positions appear consistent with them speculating on sol appreciation by selling dollars forward. The shift in February 2011 likely stems from a regulatory change targeting carry trades involving forward contracts.[24] Since then, global investors have held long dollar forward positions, though it remains unclear whether this reflects speculation on sol depreciation or hedging Peruvian bonds and stocks holdings. For example, after 2013, the increase in global investors' 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 4a), and higher likelihood of future Sol depreciation.

Second, if forward positions were used for hedging, global investors should be buying dollars forward when they buy soles assets. Hence, the changes in their balances of their forward dollar holdings should be positively correlated with increases in their balances of soles assets. While we do not have comprehensive data on all positions in soles, we have data on their soles sovereign debt and forward holdings. Figure B.4 shows that the correlation between the changes in global investors' forward positions and the changes in their Peru sovereign bond holdings is weak (-0.03) and statistically insignificant. Moreover, this correlation is fairly unstable across subperiods, with rolling correlations sometimes reaching significantly

[24] At the end of January 2011, the Peruvian bank regulator (SBS) introduced a regulation imposing 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 speculated that additional restrictions, such as taxes, could follow if the sol continued to appreciate. (Bloomberg, 2011).

Figure 5: Global Investors' Forward Balance and Returns from Forward Trade



Note: This scatter plots the monthly averages of foreign net long dollar forward balance and the corresponding average of forward prices agreed minus the 3-month spot rate.

negative values.

Third, if global investors were speculating on predictable currency returns rather than hedging, their forward market positions would correlate with excess currency returns. Specifically, their long dollar forward holdings should be higher when the agreed forward price is below the expected spot price at maturity. In other words, their long dollar position should be negatively correlated with the forward minus future spot price difference. Figure 5 conforms to the expectations, displaying a correlation of -0.34 between net long dollar forward positions and the forward minus 3-month future spot price difference over a three-month horizon.[25] Moreover, 60% of the months in our sample yield positive profits for foreign investors.

Fourth, a growing literature studies the use of FX derivatives by U.S. fixed-income and equity mutual funds investing outside of the U.S.. Across U.S. mutual funds, FX derivatives usage is often limited, related to expected currency returns, and even used to amplify, rather than dampen, market exposure. Sialm and Zhu (2024) document that the average hedge

[25] In this exercise we have used 3-month future spot rate. We find similar results when using the survey-expected 3-month future spot rate, as reported in Figure B.5.

ratio of U.S. fixed-income 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 U.S. fixed-income mutual funds often hold negative hedge ratios for emerging-market currencies, amplifying rather than hedging risk through net long positions in short-term currency forwards. They also find that such positions are larger in countries with stricter capital controls, suggesting that offshore-traded derivatives allow fund managers to gain direct exposure and adjust positions flexibly while bypassing capital restrictions. Opie and Riddiough (2024) find that most U.S. international equity mutual funds maintain near-zero hedge ratios, using long and short currency forwards to construct separate currency portfolios. These portfolios often include currencies outside their equity holdings, targeting excess returns from strategies like 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. 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

Using financial-market data from a large panel of emerging economies, this section tests the model predictions on the behavior of CIP deviations *vis a vis* UIP deviations as well during periods of global distress (Proposition 2 and Proposition 3).

3.1 Data: Spot and Forward Market Returns

We collect data on spot and forward exchange rates, interbank rates, and U.S. LIBOR rates from *Bloomberg*. To complement missing values in *Bloomberg* data we resort to *Datastream* (see Table B.1). Our baseline sample focuses on 19 emerging economies, and we report results for advanced economies (G10) in Appendix B.3. The sample ranges from January 2002 to December 2022, chosen to maximize coverage of emerging market currencies. We follow Du et al. (2018a) and Cerutti and Zhou (2024) to construct the main variables of interest.

We construct annualized 3-month CIP deviations using spot and forward exchange rates,

and 3-month interbank rates:

$$\text{CIP deviation}_{c,t} = \frac{360}{ACT}\left(\frac{\text{Forward Premium}_{c,t}}{\text{Interest Differential}_{ct}} - 1\right);$$

$$\text{Forward Premium}_{c,t} = \frac{F_{c,t}^{(3\text{M})}}{S_{c,t}}; \quad \text{Interest Differential}_{c,t} = \frac{1 + r_{c,t}^{(3M)} \times \frac{ACT}{360}}{1 + r_{\$,t}^{(3M)} \times \frac{ACT}{360}},$$

where ACT is the number of days in the 3-month period. The forward premium is the 3-month forward rate divided by the spot rate, quoted in domestic currency per U.S. dollar. The interest rate differential is computed as the gross 3-month domestic interbank rate divided by the gross 3-month U.S. LIBOR rate. Both forward premium and interest differentials are annualized.

Excess domestic currency returns (relative to the U.S. dollar), and the returns from the "forward trade" are, respectively:

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

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

Here, s, f, and r are the logarithm of the spot and forward exchange rate, and interbank rate, respectively, while Δs_{t+3M} is the 3-month difference in the logged exchange rate.[26]

3.2 UIP and CIP Deviations across Currencies

Consistent with Proposition 2, we find a significant negative correlation between CIP deviations and excess currency returns. Figure 6 depicts the cross-sectional means of 3-month excess home-currency returns versus the corresponding mean 3-month CIP deviations. Among emerging market currencies, currency returns and CIP deviations exhibit a negative rela-

[26] To construct the 3-month excess return at *daily* frequency, we first, for each date t with available spot rate, search the date that is 3 months ahead according to ACT, as $t + 3M$. If $t + 3M$ is Saturday or Sunday, we use the values on the nearest Friday. We then compute the 3-month change Δs_{t+3M} as the difference of logged spot rates between the two dates. We then add the daily 3-M interest rate differential to compute the 3-month excess currency returns. Table B.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.

tionship.[27]

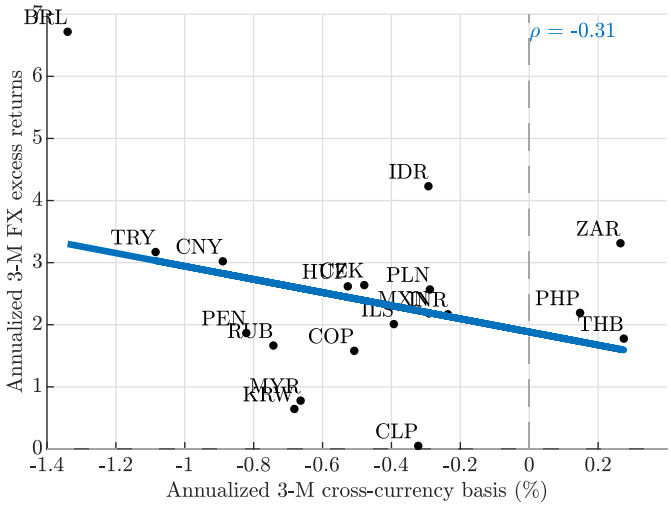


Figure 6: UIP and CIP deviations across emerging currencies

Note: The figure depicts scatter plots of mean cross-currency basis with 3-month excess home-currency returns across emerging economies, based on 3-month interbank rates, annualized, and quoted in percentage points. For illustration, variables are winsorized at the 5% level.

Moreover, Figure B.2 report the cross-sectional relationship between the mean 3-month CIP deviation and the mean 3-month interest rate differentials as well as the net international investment positions (Net IIP) excluding FX reserves, scaled by GDP. In line with Cerutti and Zhou's (2024) findings, 3-month CIP deviations of emerging economies exhibit a negative correlation with interest differentials and a positive correlation with net international investment positions. Speculative forward demand offers a clear interpretation of these findings. Since interest differentials and net international investment positions 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 interest differentials and lower net international investment positions—both indicating higher expected excess currency returns—tend to have lower CIP deviations.

[27] We adopt the prevailing approach in empirical finance and macroeconomics of using realized excess currency returns rather than proxies for expected excess returns.

We substantiate these relationships through formal panel regressions:

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

where α_c is the currency FE and δ_t is the time FE. The time period is a day, and we use Driscoll and Kraay (1998) standard errors to account for the overlapping observational periods. Table 1 reveals that CIP deviations are negatively associated with subsequent excess currency returns both across countries on average and within a given country over time.

Table 1: UIP deviations and CIP deviations

	Excess domestic currency returns $rx_{i,t+3M}$		
	OLS	FE	FE
CIP deviation	-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

We examine the comovement properties of CIP deviations of emerging economies. We isolate the common variation in CIP deviations through a principal component (PC) analysis of the monthly changes in 3-month cross-currency bases of emerging economies. Then, we document the properties of the first principal component of emerging-market CIP deviations, in relationship to variables that proxy for global financial risk-bearing capacity ($\hat{\Gamma}_t$), and to the U.S. dollar. Table 2 reports the correlations between the first principal component of the monthly changes in 3-month CIP deviations and selected global risk factors. The first principal component is highly correlated (91%) with the changes in the mean CIP deviations in emerging markets. This indicates that the latent factor that captures the most common variations in CIP deviations across emerging markets resembles a level factor.

Table 2: 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.

Consistent with Proposition 3(b), emerging economies' CIP deviations comove positively with the U.S. dollar and proxies of tight global financial conditions such as implied market volatility (VIX and VXEEM). In addition, CIP deviations are negatively correlated with variables that signal positive global market conditions such as Fama and French (1993) and He et al. (2017) factors. The results suggest that the tightening of global financial conditions is associated with and increase in emerging-market CIP deviations, consistent with Proposition 3. When UIP deviations are positive, as in emerging economies, higher risk aversion reduces global investors' incentive to take open forward positions in emerging market currencies, putting downward pressure on forward prices and upward pressure on CIP deviations.[28]

[28] In a complementary empirical analysis, Cerutti and Zhou (2024) 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 comovement patterns of CIP deviations with global risk factors in emerging economies.

4 CIP Deviations in Emerging vs. Advanced Economies

Deviations from covered interest parity (CIP) in emerging and advanced economies display different unconditional and conditional properties. We emphasize two main differences:

#1 CIP deviations are significantly larger in emerging economies (100 basis points on average in absolute value) than in advanced ones (20 basis points).

#2 During periods of heightened global risk aversion, CIP deviations increase in emerging economies while they decline in advanced economies.[29]

What factors might be behind these differences? We discuss specific extensions of the baseline framework of Section 1 to answer this question.

Market segmentation Regarding Fact #1, we emphasize that the constraints that global investors face in adjusting their short-term bond positions in emerging economies (Assumption 1) are *essential* for sustaining non-zero CIP deviations. If global investors had unrestricted access to bond and spot markets, they could engage in the "UIP trade" not only through forward contracts, as in the baseline model (the "forward trade"), but also via bonds. In this scenario, arbitrage would equalize the returns on these two strategies, necessarily driving CIP deviations to zero. The following Proposition formalizes this argument.

Proposition 4 *Relax Assumption 1, and consider the problem of an otherwise identical global investor that actively trades in home/foreign bond and spot/forward market. Under these conditions, CIP deviations are zero.*

Proof. See Appendix A.4 ■

Frictional access to short-term borrowing/lending in emerging-market currency by global investors is prevalent in emerging economies, as argued in Section 2.2, and can rationalize why CIP deviations in emerging economies are significantly larger than in advanced economies.

Regarding Fact #2, we propose two complementary explanations: (i) time-varying convenience yields; (ii) time-varying U.S. dollar hedging by local investors.

[29] The relationship between CIP deviations and the U.S. dollar in advanced economies is documented in Avdjiev et al. (2019). Relatedly, the first PC of emerging economies CIP deviations is negatively correlated with the mean CIP deviations in advanced economies (see Table 2). Additionally, we note that G10 economies exhibit a positive relationship between CIP deviations and excess home-currency returns (see Figure B.3).

Convenience yields Fluctuations in convenience yields derived from U.S. bonds can be source of CIP deviations (Engel and Wu, 2018; Jiang et al., 2021), whether or not Assumption 1 holds. If investors have a preference for holding assets issued by U.S. entities, 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.[30] Following Jiang et al. (2021), we highlight that convenience yield can explain why CIP deviations in advanced economies decline when the U.S. dollar appreciates.

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 from holding a U.S. bond. Under these conditions, CIP deviations negatively comove with the U.S. dollar, that is* $\text{cov}(\textit{CIP Deviation}_t, \textit{USD}_t) \leq 0$.

Proof. See Appendix A.4 ■

When investors place a higher convenience premium on U.S. bonds, the U.S. dollar appreciates, and CIP deviations decline. In emerging economies, average CIP deviation is positively correlated with the value of the U.S. dollar (Section 3.3). We interpret this as evidence that fluctuations in CIP deviations in emerging markets primarily reflect the dynamics of global investors' currency speculation rather than fluctuations in convenience yields.

Dollar hedging If local investors' demand for hedging their U.S. dollar foreign assets plays a key role in shaping forward market dynamics, and if this hedging demand rises during periods of heightened risk aversion, then global risk aversion could increase the overall demand for home-currency forwards, leading to a decline in CIP deviations.[31] The following proposition formalizes this mechanism.

Proposition 6 *Extend the baseline model of the forward market of Section 1.1 to include a set of local investors that hold predetermined long U.S. dollar position and are partially hedged. Assume that these local investors have mean-variance preferences with the same risk aversion of global investors. If the unhedged dollar position of local investors is sufficiently large, global financial disruptions* ($\hat{\Gamma}_t \uparrow$) *cause a decline in CIP deviations.*

[30] Log CIP deviations can also be expressed as dollar cash rate minus the dollar synthetic rate.
[31] The authors thank Wenxin Du for suggesting this explanation.

Proof. See Appendix A.4 ■

In a setting with both local and global investors, total forward demand during periods of heightened global risk aversion reflects two opposing forces: global investors' desire to sell home-currency forwards and local investors' demand to buy them as a hedge against U.S. dollar exposure. The net effect of these forces determines the direction of forward pressure and the movement in CIP deviations.

In advanced economies, local investors are often significant players in the forward market (on the demand side), and their trading behavior may be driven by a need to hedge U.S. dollar exposure, particularly during episodes of global risk aversion. Abbassi and Bräuning (2020), Liao and Zhang (2021) and Du and Huber (2023) provide empirical evidence supporting this mechanism for advanced economies.[32] In line with this conjecture, hedging appears to be more prevalent among non-U.S. investors, compared to U.S. mutual funds' evidence reviewed in Section 2.4. Du and Huber (2023) document that U.S. dollar hedging ratios among global investors in 2020 are around 44%, 35%, and 21%, for insurance companies, pension funds, and mutual funds, respectively. 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%.[33]

In Section 2, we show that forward demand in Peru is predominantly driven by global investors, whose trading is largely motivated by currency speculation, including carry trades. In contrast, the local investor sector is relatively small and less inclined to hedge, possibly due to the desirable characteristics of the dollar exchange rate relative to emerging-market currencies and the widespread presence of dollar-denominated liabilities.

[32] Liao and Zhang (2021) document a negative relationship between NFAs and CIP deviations in advanced economies (see Figure B.3). Their interpretation is based on a hedging model of forward demand, in which countries with higher NFAs have greater U.S. dollar exposure and thus hold a shorter U.S. dollar position. In Section 3, we argued that in emerging economies, the opposite relationship between NFAs and CIP deviations arises due to carry-trade motives.

[33] Du and Huber (2023) 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) 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).

5 Conclusions

Currency derivatives markets are well recognized as a channel for currency speculation, serving as an alternative to the textbook approach of executing carry trades through bond markets (Burnside et al., 2008). In this paper, we argue that these markets provide a particularly advantageous—if not the only—avenue for global investors operating on emerging-market currencies, given restrictions in access to short-term bond markets. We show that this perspective helps explain key properties of CIP deviations in emerging economies, including their comovement with UIP deviations, the U.S. dollar, and, notably, the forward market positions of different investors. These empirical patterns would be difficult to reconcile with theories that primarily attribute currency derivatives usage to hedging motives.

We emphasize how specific financial market regulations influence these relationships by shaping access and risk-bearing capacity differently for local and global market participants. Building on this, we extend the baseline analysis to formally account for key differences in CIP deviations between emerging and advanced economies, linking them to different structural and institutional characteristics of financial markets and the composition of investors.

We highlight how global investors' speculative forward exchange demand influences the pricing of instruments originally designed for currency risk hedging, with important implications for macroeconomic and financial policies. For example, we show that the dynamics of global demand for forwards increases CIP deviations during global recessions. As a result, the cost of synthetic domestic-currency borrowing—the dominant form of external financing for many emerging economies— increases during downturns, weakening the effectiveness of countercyclical monetary policy (De Leo et al., 2024) and potentially justifying policy interventions aimed at "basis control" (Gourinchas, 2021).

References

Abbassi, P. and F. Bräuning (2020): "Demand Effects in the FX Forward Market: Micro Evidence from Banks' Dollar Hedging," *The Review of Financial Studies*, 34, 4177–4215.

Aldunate, F., Z. Da, B. Larrain, and C. Sialm (2023): "Pension Fund Flows, Exchange Rates, and Covered Interest Rate Parity," *Exchange Rates, and Covered Interest Rate Parity (April 21, 2023)*.

Alfaro, L., M. Calani, and L. Varela (2023): "Granular Corporate Hedging Under Dominant Currency," *CEPR Discussion Paper 16232*.

Alvarez, F., A. Atkeson, and P. J. Kehoe (2009): "Time-varying risk, interest rates, and exchange rates in general equilibrium," *The Review of Economic Studies*, 76, 851–878.

Autorregulador del Mercado de Valores (2019): "Guía de Regulación Cambiaria," .

Avdjiev, S., W. Du, C. Koch, and H. S. Shin (2019): "The Dollar, Bank Leverage, and Deviations from Covered Interest Parity," *American Economic Review: Insights*, 1, 193–208.

Bacchetta, P., J. S. Davis, and E. Van Wincoop (2024): "Exchange Rate Determination under Limits to CIP Arbitrage," Tech. rep., National Bureau of Economic Research.

Baker McKenzie (2022): "Global Public MA Guide: Colombia," https://resourcehub.bakermckenzie.com/en/resources/global-public-ma-guide/latin-america/colombia/topics/general-legal-framework.

Banco Central de Reserva del Perú, . (2023a): "Data on: Interbancaria S/," Last updated Sep 12 2023.

——— (2023b): "Data on: Interbancaria US$," Last updated Sep 12 2023.

Bank of Indonesia (2005): "Cirlation Letter: Minimum Capital Adequacy Requirements for Commercial Banks Conducting Business Based on Sharia Principle," https://ojk.go.id/Files/201402/sebi075305_1392881724.pdf.

Barbiero, O., F. Bräuning, G. Joaquim, and H. Stein (2024): "Dealer Risk Limits and Currency Returns," *Available at SSRN*.

Ben Zeev, N. and D. Nathan (2024a): "Shorting the Dollar When Global Stock Markets Roar: The Equity Hedging Channel of Exchange Rate Determination," *The Review of Asset Pricing Studies*, 14, 640–666.

——— (2024b): "The widening of cross-currency basis: When increased FX swap demand meets limits of arbitrage," *Journal of International Economics*, 152, 103984.

BIS (2015): *Currency carry trades in Latin America*, no. 81 in BIS Papers, Bank for International Settlements.

——— (2022): "Foreign exchange markets in Asia-Pacific," .

Bloomberg, . (2011): "Peru Sol Has First Weekly Fall this Month on Currency Measures," .

Bloomberg (2023): "Data on: Currencies and Money Markets." .

Borio, C. E., M. Iqbal, R. N. McCauley, P. McGuire, and V. Sushko (2018): "The failure of covered interest parity: FX hedging demand and costly balance sheets," .

Bradesco (2023): "Bradesco Reference Form: Resolution CVM N80/22," https://www.latibex.com/docs/Documentos/esp/hechosrelev/2024/FR_Bradesco_EN_2023.pdf.

Bräuer, L. and H. Hau (2024): "Fund-Level FX Hedging Redux," .

Bruno, V. and H. S. Shin (2017): "Global Dollar Credit and Carry Trades: A Firm-Level Analysis," *The Review of Financial Studies*, 30, 703–749.

Burnside, C., S. Rebelo, and M. Eichenbaum (2008): "Carry Trade: The Gains of Diversification," *Journal of the European Economic Association*, 6, 581–588.

Bush, G. (2019): "Bank FX hedging needs and the impact on covered interest parity, an emerging market perspective," Tech. rep., Working paper, Bank of Mexico.

Business World (2021): "Foreign exchange rules liberalized further," https://www.bworldonline.com/banking-finance/2021/06/04/373154/foreign-exchange-rules-liberalized-further/.

Canta, M., P. Collazos, and M. Shiva (2007): "Límites a las posiciones de cambio como mecanismo de mitigación del riesgo cambiario ." *SBS, Revista de Temas Financieros*, 119–136.

Cenedese, G., P. Della Corte, and T. Wang (2021): "Currency mispricing and dealer balance sheets," *The Journal of Finance*, 76, 2763–2803.

Cerutti, E. and H. Zhou (2024): "Uncovering CIP deviations in emerging markets: Distinctions, determinants, and disconnect," *IMF Economic Review*, 72, 196–252.

Cerutti, E. M., M. Obstfeld, and H. Zhou (2021): "Covered interest parity deviations: Macrofinancial determinants," *Journal of International Economics*, 130, 103447, nBER International Seminar on Macroeconomics 2020.

Chen, N. and H. Zhou (2025): "Managing Emerging Market Currency Risk," Tech. rep.

Coeurdacier, N., H. Rey, and P. Winant (2011): "The Risky Steady State," *American Economic Review*, 101, 398–401.

De Leo, P., G. Gopinath, and S. Kalemli-Ozcan (2024): "Monetary Policy and the Short-Rate Disconnect in Emerging Economies," .

De Leo, P., L. Keller, G. Simoncelli, M. V. Villegas, and T. Williams (2025): "Global Investors in Local-Currency Bond Markets: Implications for Bond Yields and Exchange Rates," .

Della Corte, P., S. J. Riddiough, and L. Sarno (2016): "Currency Premia and Global Imbalances," *The Review of Financial Studies*, 29, 2161–2193.

di Giovanni, J., Şebnem Kalemli-Özcan, M. F. Ulu, and Y. S. Baskaya (2022): "International Spillovers and Local Credit Cycles," *Review of Economic Studies*, 89, 733–773.

Dodd, R. and S. Griffith-Jones (2007): "Brazil's Derivatives Markets: Hedging, Central Bank Intervention and Regulation," *CEPAL*.

Driscoll, J. C. and A. C. Kraay (1998): "Consistent Covariance Matrix Estimation With Spatially Dependent Panel Data," *The Review of Economics and Statistics*, 80, 549–560.

Du, W. and A. Huber (2023): "Dollar Asset Holding and Hedging Around the Globe," .

Du, W., J. Im, and J. Schreger (2018a): "The us treasury premium," *Journal of International Economics*, 112, 167–181.

Du, W. and J. Schreger (2016): "Local currency sovereign risk," *The Journal of Finance*, 71, 1027–1070.

——— (2022): "CIP deviations, the dollar, and frictions in international capital markets," in *Handbook of International Economics*, Elsevier, vol. 6, 147–197.

Du, W., A. Tepper, and A. Verdelhan (2018b): "Deviations from covered interest rate parity," *The Journal of Finance*, 73, 915–957.

Duo, L. (2025): "Uncovering the Rising Demand for NDF Trading: A Closer Look at Emerging Markets and Future Developments," https://www.alpfin.com/post/uncovering-the-rising-demand-for-ndf-trading-a-closer-look-at-emerging-market.

Engel, C. and S. P. Y. Wu (2018): "Liquidity and Exchange Rates: An Empirical Investigation," NBER Working Papers 25397, National Bureau of Economic Research, Inc.

Euromoney (2020): "Can FX NDFs still deliver?" https://www.euromoney.com/article/27mm7etau498o7ijtqadc/foreign-exchange/can-fx-ndfs-still-deliver.

Fama, E. F. and K. R. French (1993): "Common risk factors in the returns on stocks and bonds," *Journal of financial economics*, 33, 3–56.

Fanelli, S. and L. Straub (2021): "A Theory of Foreign Exchange Interventions," *Review of Economic Studies*.

Gabaix, X. and M. Maggiori (2015): "International Liquidity and Exchange Rate Dynamics," *The Quarterly Journal of Economics*, 130, 1369–1420.

Global Treasurer (2013): "India Tightens Limits on Foreign Investment in Treasury Bills," https://www.theglobaltreasurer.com/2013/04/02/india-tightens-limits-on-foreign-investment-in-treasury-bills/.

Gourinchas, P.-O. (2021): "International Macroeconomics: From the Global Financial Crisis to COVID-19, and Beyond," *Mundell-Fleming Lecture, XXII Jacques Polak Annual Research Conference, International Monetary Fund*, https://youtu.be/8Go8fUgdhgE?t=2.

Gutierrez, B., V. Ivashina, and J. Salomao (2023): "Why is dollar debt Cheaper? Evidence from Peru," *Journal of Financial Economics*, 148, 245–272.

Hacioğlu-Hoke, S., D. Ostry, H. Rey, A. R. Planat, V. Stavrakeva, and J. Tang (2024): "Topography of the FX derivatives market: a view from London," .

He, Z., B. Kelly, and A. Manela (2017): "Intermediary asset pricing: New evidence from many asset classes," *Journal of Financial Economics*, 126, 1–35.

Heenan, G., S. Zhou, D. Benedek, and M. Chivali (2011): "Indonesia: Selected Issues," *International Monetary Fund*.

IMF (2011): "Republic of Korea: Staff Report for the 2011 Article IV Consultation," *International Monetary Fund*.

IMF (2022): "IMF Country Report N22/338: Mexico - Financial Sector Assessment Program," https://www.imf.org/-/media/Files/Publications/CR/2022/English/1MEXEA2022003.ashx#:~:text=43,element%20of%20Mexican%20banks%20liquidity.

Jiang, Z., A. Krishnamurthy, and H. Lustig (2021): "Foreign Safe Asset Demand and the Dollar Exchange Rate," *Journal of Finance*, 76, 1049–1089.

Kalemli-Ozcan, S. and L. Varela (2024): "Five Facts about the UIP Premium," .

Kaniel, R. and P. Wang (2025): "Unmasking Mutual Fund Derivative Use," *The Review of Financial Studies*, hhaf001.

Kekre, R. and M. Lenel (2023): "The high frequency effects of dollar swap lines," Tech. rep., National Bureau of Economic Research.

Keller, L. (2024): "Arbitraging covered interest rate parity deviations and bank lending," *American Economic Review*, 114, 2633–2667.

Kubitza, C., J.-D. Sigaux, and Q. Vandeweyer (2024): "Cross-Currency Basis Risk and International Capital Flows," *Fama-Miller Working Paper, Chicago Booth Research Paper*, 24–18.

Lane, M. P. R. and M. G. M. Milesi-Ferretti (2017): *International financial integration in the aftermath of the global financial crisis*, International Monetary Fund.

Lexsite.com (2024): "Master Direction - Risk Management and Inter-Bank Dealings: Amendments," https://www.lexsite.co.in/eDocs/RBI-32.pdf.

Liao, G. and T. Zhang (2021): "The hedging channel of exchange rate determination," *Working Paper*.

Lustig, H., N. Roussanov, and A. Verdelhan (2011): "Common Risk Factors in Currency Markets," *The Review of Financial Studies*, 24, 3731–3777.

Ministerio de Economía y Finanzas, . (2023): "Reporte de Tenencias de Bonos Soberanos," .

Opie, W. and S. Riddiough (2024): "On the use of currency forwards: Evidence from international equity mutual funds," *Available at SSRN 4432796*.

Patel, N. and P. Cavallino (2019): "FX intervention: goals, strategies and tactics," in *Reserve management and FX intervention*, ed. by B. f. I. Settlements, Bank for International Settlements, vol. 104, 25–44.

Patel, N. and F. D. Xia (2019): "Offshore markets drive trading of emerging market currencies," *BIS Quarterly Review, December*.

Patnaik, I., S. Malik, R. Pandey, and Prateek (2013): "Foreign investment in the Indian Government bond market," *Securities and Exchange Board of India (SEBI)*.

Reserve Bank of India (2010): https://www.rbi.org.in/commonman/english/scripts/Notification.aspx?Id=729#.

Reuters (2025): "India rupee NDF volume hits record high on arbitrage activity," https://www.reuters.com/markets/currencies/india-rupee-ndf-volume-hits-record-high-arbitrage-activity-2025-01-09/.

Rime, D., A. Schrimpf, and O. Syrstad (2022): "Covered interest parity arbitrage," *The Review of Financial Studies*, 35, 5185–5227.

Schmittmann, J. M. and C. H. Teng (2020): "Offshore Currency Markets: Non-Deliverable Forwards (NDF) in Asia," *IMF Working Paper*.

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

Siriwardane, E., A. Sunderam, and J. L. Wallen (2022): "Segmented arbitrage," Tech. rep., National Bureau of Economic Research.

Superintendencia de Banca y Seguros, . (2011): "Resolucion S.B.S, N 923-2011," .

Superintendencia de Banca y Seguros (SBS), . (2018): "Data on: Anexos y Reportes," SBS provided access to the confidential data in February 2018.

——— (2024): "Data on: Tipo de Cambio Contable," Appended data accessed December 4 2018 with an update downloaded February 2 2024.

The Trade (2024): "Despite the dominance of voice trading, electronification is the natural path for Peru," https://www.thetradenews.com/despite-the-dominance-of-voice-trading-electronification-is-the-natural-path-for-peru

Wallen, J. L. (2022): "Markups to Financial Intermediation in Foreign Exchange Markets," .

Watanabe, K., H. Akama, and J. Mifune (2002): "The Effectiveness of Capital Controls and Monitoring: The Case of Non-Internationalization of Emerging Market Currencies," *EMEAP Discussion Paper*.

Appendix

A Model Derivations and Proofs

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:

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

As a result, the overall return on the intermediary's portfolio, eq. (3), 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

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

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 (4). In addition, local intermediaries' demand for U.S. dollar spot, eq. (5), is obtained by combining equation (A.3) with the aggregate version of equation (A.1).

A.2 Derivations of 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. (4):

$$\underbrace{\left(\hat{r}_t^\star - \hat{r}_t + \hat{f}_t - \hat{s}_t \right)}_{\widehat{\text{CIP Deviation}}_t} = \kappa \hat{K}_{t+1}; \tag{A.4}$$

The demand of U.S. dollar forward is the first-order approximation of eq. (2):

$$\underbrace{\left(\hat{r}_t^\star - \hat{r}_t + \hat{f}_t - \hat{s}_t \right)}_{\widehat{\text{CIP Deviation}}_t} = - \underbrace{\left(\hat{r}_t - \hat{r}_t^\star - E_t \hat{s}_{t+1} + \hat{s}_t \right)}_{\widehat{\text{UIP Deviation}}_t} + \Gamma(\hat{H}_{t+1}) + H(\hat{\Gamma}_t). \tag{A.5}$$

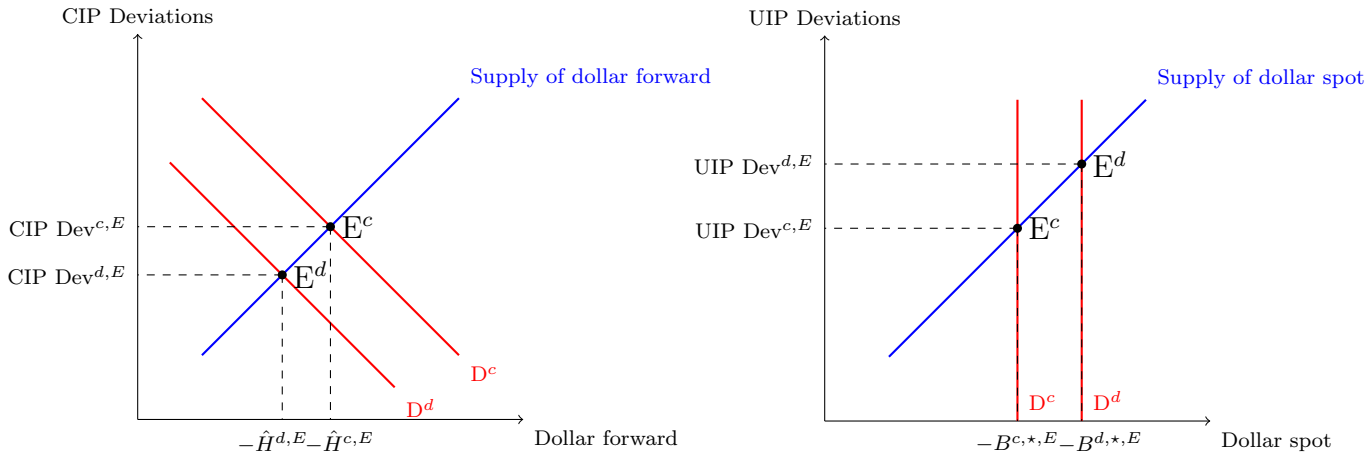
Equilibrium in spot market (Figure 1b) The supply of dollar spot represents the first-order approximation of eq. (9):

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

The demand of dollar spot is the first-order approximation of eq. (5):

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

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.

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 this is the case.

Equilibrium in the forward market (eqs. (2), (4), and (7)) implies:

$$-\frac{1}{\kappa}\left(\frac{R_t^\star}{R_t}\frac{F_t}{S_t} - 1\right) = \frac{\left(E_t \frac{F_t}{S_{t+1}} - 1\right)}{\gamma_t \,\text{var}_t\left(\frac{F_t}{S_{t+1}}\right)} \tag{A.6}$$

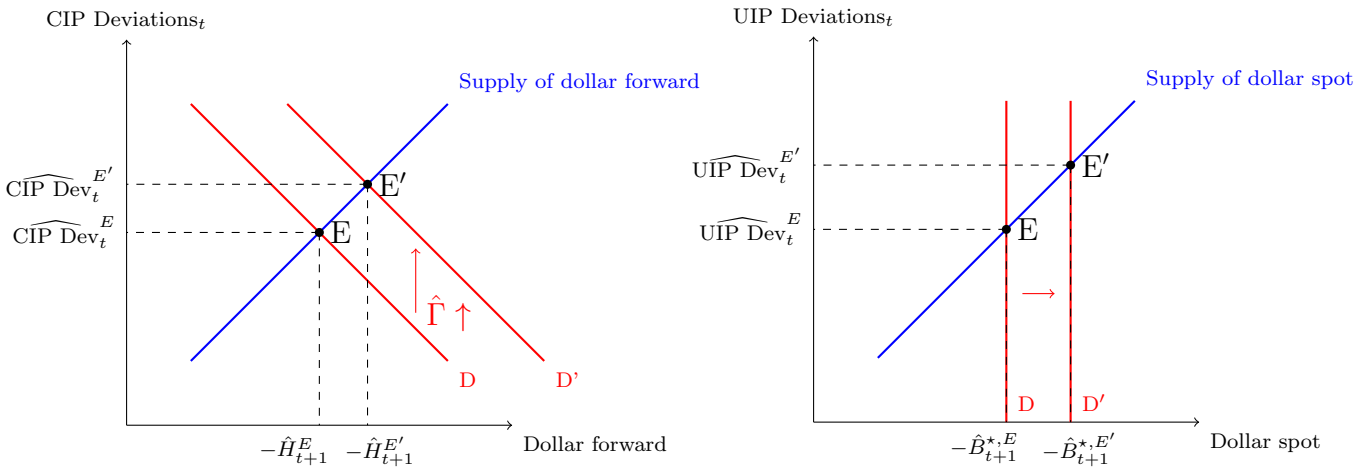
Equilibrium in the spot market (eqs. (9), (5), and (11)) implies:

$$-\xi_t + \frac{1}{\kappa}\left(1 - \frac{R_t}{R_t^\star}\frac{S_t}{F_t}\right) = \frac{\left(E_t \frac{R_t}{R_t^\star}\frac{S_t}{S_{t+1}} - 1\right)}{\lambda \,\text{var}_t\left(\frac{F_t}{S_{t+1}}\right)}. \tag{A.7}$$

Use Approximation 1 to rewrite eqs. (A.6)-(A.7) as:

$$-\frac{1}{\kappa}\left(r_t^\star - r_t + f_t - s_t\right) = \frac{(r_t - r_t^\star - E_t s_{t+1} + s_t) + (r_t^\star - r_t + f_t - s_t)}{\gamma_t \sigma_s^2} \tag{A.8}$$

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.

$$-\xi_t + \frac{1}{\kappa}\left(r_t^\star - r_t + f_t - s_t\right) = \frac{\left(r_t - r_t^\star - E_t s_{t+1} + s_t\right)}{\lambda\sigma_s^2}, \tag{A.9}$$

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 global investors and local spot traders risk-bearing capacity, respectively.

Using (A.8) and (A.9) we reach closed-form expressions for CIP and UIP deviations (eq. (12)):

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

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

A.4 Proofs

Proof of Proposition 1. Proposition 1(a) directly follows from the forward market clearing condition (7); Proposition 1(b) directly follows from the forward supply equation (4);

Proposition 1(c) derives from equation (6). The prediction on global investors' forward position and returns from the forward trade follows directly from the forward demand equation (2). 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, ξ^c. The steady-state version of closed form expressions of CIP and UIP deviations (see eq. (12)) for country c read:

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

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, ξ^c. The first-order approximation of the closed-form solutions of currency-c CIP and UIP deviations (see eq. (12)) are, respectively:

$$\underbrace{\left(\hat{r}_t^\star - \hat{r}_t^c + \hat{f}_t^c - \hat{s}_t^c\right)}_{\widehat{\text{CIP Deviation}}_t^c} = \frac{\Lambda\kappa}{\Gamma+\kappa+\Lambda}\hat{\xi}_t^c - (\xi^c)\frac{\kappa}{(\Gamma+\kappa+\Lambda)^2}\Lambda\hat{\Gamma}_t \tag{A.10}$$

$$\underbrace{\left(\hat{r}_t^c - \hat{r}_t^\star - E_t\Delta\hat{s}_{t+1}^c\right)}_{\widehat{\text{UIP Deviation}}_t^c} = -\frac{\Lambda(\Gamma+\kappa)}{\Gamma+\kappa+\Lambda}\hat{\xi}_t^c - (\xi^c)\frac{1}{(\Gamma+\kappa+\Lambda)^2}\Lambda^2\hat{\Gamma}_t \tag{A.11}$$

Proof of Part (a) of Proposition 3. Using (A.10) and (A.11), one can derive the response of currency-c UIP and CIP deviations to an increase in global risk aversion, $\hat{\Gamma}_t$:

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

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

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. (4), $\hat{K}_{t+1}^c = \frac{1}{\kappa}\left(\hat{r}_t^\star - \hat{r}_t^c + \hat{f}_t^c - \hat{s}_t^c\right)$, as well as

the the forward market clearing condition (7), one can also derive the responses of forward-market positions to an increase in global risk aversion, $\hat{\Gamma}_t$:

$$\frac{\partial \hat{K}^c_{t+1}}{\partial \hat{\Gamma}_t} = \frac{1}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation}^c \tag{A.14}$$

$$\frac{\partial \hat{H}^c_{t+1}}{\partial \hat{\Gamma}_t} = -\frac{1}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation}^c \tag{A.15}$$

Equations (A.12)-(A.15) 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:

$$\text{CIP } \widehat{\text{Deviation}}_t \equiv \int_0^1 \text{CIP } \widehat{\text{Deviation}}^c_t \, \mathrm{d}c = \frac{\Lambda\kappa}{\Gamma+\kappa+\Lambda}\hat{\xi}_t - (\xi)\frac{\kappa}{(\Gamma+\kappa+\Lambda)^2}\Lambda\hat{\Gamma}_t \tag{A.16}$$

$$\text{UIP } \widehat{\text{Deviation}}_t \equiv \int_0^1 \text{UIP } \widehat{\text{Deviation}}^c_t = -\frac{\Lambda(\Gamma+\kappa)}{\Gamma+\kappa+\Lambda}\hat{\xi}_t - (\xi)\frac{1}{(\Gamma+\kappa+\Lambda)^2}\Lambda^2\hat{\Gamma}_t \tag{A.17}$$

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.16) and (A.17):

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

$$\frac{\partial \text{UIP } \widehat{\text{Deviation}}_t}{\partial \hat{\Gamma}_t} = \frac{\Lambda}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation} \tag{A.19}$$

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:

$$\frac{\partial \widehat{\text{USD}}_t}{\partial \hat{\Gamma}_t} = \frac{\Lambda}{(\Gamma+\kappa+\Lambda)(\Gamma+\kappa)}\text{UIP Deviation.} \tag{A.20}$$

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.18)-(A.20) 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. ■

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 global 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:

$$\max_{X_{t+1}^{c,\star},\, H_{t+1}^c} \quad E_t W_{t+1}^c-\frac{\gamma_t}{2}\operatorname{var}_t W_{t+1}^c, \tag{A.21}$$

where γ_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:

$$\frac{\left(E_t\frac{S_t^c}{S_{t+1}^c}\frac{R_t^c}{R_t^\star}-1\right)}{\gamma_t\operatorname{var}_t\left(\frac{R_t^c}{R_t^\star}\frac{S_t^c}{S_{t+1}^c}\right)}=-X_{t+1}^{c,\star}+H_{t+1}^c\frac{R_t^\star}{R_t^c}\frac{F_t^c}{S_t^c} \tag{A.22}$$

$$\frac{\left(E_t\frac{S_t^c}{S_{t+1}^c}\frac{R_t^c}{R_t^\star}-\frac{R_t^c}{R_t^\star}\frac{S_t^c}{F_t^c}\right)}{\gamma_t\operatorname{var}_t\left(\frac{R_t^c}{R_t^\star}\frac{S_t^c}{S_{t+1}^c}\right)}=-X_{t+1}^{c,\star}+H_{t+1}^c\frac{R_t^\star}{R_t^c}\frac{F_t^c}{S_t^c} \tag{A.23}$$

Equations (A.22)-(A.23) 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:

$$\max_{X^\star_{t+1},\, H_{t+1}} \quad X^\star_{t+1}\left(1 - E_t \frac{S_t}{S_{t+1}} \frac{R_t}{(1+\eta_t)R^\star_t}\right) + H_{t+1}\left(E_t \frac{F_t}{S_{t+1}} - 1\right) \tag{A.24}$$

where η_t is the convenience yield. The first order condition of this problem imply:

$$\frac{R_t}{R^\star_t}\frac{S_t}{F_t} - 1 = \eta_t \qquad E_t \frac{S_t}{S_{t+1}}\frac{R_t}{R^\star_t} - 1 = \eta_t \tag{A.25}$$

or, using Approximation 1:

$$\underbrace{r^\star_t - r_t + f_t - s_t}_{\text{CIP Deviation}_t} = -\eta_t \qquad \underbrace{r_t - r^\star_t - E_t \Delta s_{t+1}}_{\text{UIP Deviation}_t} = \eta_t \tag{A.26}$$

As a result:

$$\text{cov}(\text{CIP Deviation}_t, \text{USD}_t) < 0 \tag{A.27}$$

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 interest differentials are constant following a change in convenience yields. ■

Proof of Proposition 6. Introduce a set of *local* investors, such as a local pension funds in a setting that is otherwise identical to the baseline forward market of Section 1.1.

In the bond market, local investors hold a zero-capital portfolio $\frac{1}{S_t}\frac{D_{t+1}}{R_t} + \frac{D^\star_{t+1}}{R^\star_t} = 0$, which delivers a return of $\frac{1}{S_{t+1}}D_{t+1} + D^\star_{t+1}$ U.S. dollars. The realized excess return from a $\frac{D^\star_{t+1}}{R^\star_t}$ U.S. dollar position is $D^\star_{t+1}\left(1 - \frac{S_t}{S_{t+1}}\frac{R_t}{R^\star_t}\right)$ U.S. dollars. Assume that local investors' bond allocation is predetermined at time t. This assumption embodies the notion that local investors' bond allocation is sticky, and determined by slow-moving factors, such as the amount of deposits in local pension funds.

In the forward market, local investors choose a U.S. dollar short forward position (H^l_{t+1}), subject to a transaction cost ψ for each U.S. dollar short forward position.

The realized return on the global investor's overall portfolio is, in U.S. dollars:

$$W_{t+1} \equiv D^\star_{t+1}\left(1 - \frac{S_t}{S_{t+1}}\frac{R_t}{R^\star_t}\right) + H^l_{t+1}\left(\frac{F_t}{S_{t+1}} - 1 - \psi\right).$$

Given the bond position $D^{\star}_{t+1}$, local investors choose H^{l}_{t+1} to solve:

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

where local investors' aversion to risk is the same as global investors, that is γ_t.

Local investors' demand for home-currency forward (H^{l}_{t+1}) reads:

$$\frac{\left(E_t\frac{F_t}{S_{t+1}} - 1 - \psi\right)}{\gamma_t \operatorname{var}_t\left(\frac{F_t}{S_{t+1}}\right)} = H^{l}_{t+1} - \frac{R_t}{R^{\star}_t}\frac{S_t}{F_t}D^{\star}_{t+1}, \tag{A.28}$$

which resembles the optimal hedging demand equations of non-U.S. investors in Liao and Zhang (2021) and Du and Huber (2023).

Assume that $D^{\star}_{t+1} = \frac{F_t}{S_t}\frac{R^{\star}_t}{R_t}D^{\star}$, and use Approximation 1, to rewrite equation (A.28) as:

$$\frac{\left(f_t - E_t s_{t+1} - \psi\right)}{\gamma_t \operatorname{var}_t\left(\frac{F_t}{S_{t+1}}\right)} = H^{l}_{t+1} - D^{\star}. \tag{A.29}$$

Equilibrium in the forward market now consists in aggregate forward demand (by local investors (A.29) and global investors (2)), i.e.,

$$\frac{\left(f_t - E_t s_{t+1} - \frac{1}{2}\psi\right)}{\gamma_t \operatorname{var}_t\left(\frac{F_t}{S_{t+1}}\right)} = \frac{H_{t+1} + H^{l}_{t+1} - D^{\star}}{2}, \tag{A.30}$$

as well as forward supply by local intermediaries (4), and forward market-clearing condition:

$$-K_{t+1} = H_{t+1} + H^{l}_{t+1}. \tag{A.31}$$

We consider a steady-state equilibrium in which returns on the forward trade are positive ($f_t - E_t s_{t+1} > 0$), and thus global investors are short dollars forward ($H > 0$) as in the baseline model. In addition, local investors hold dollar assets ($D^{\star} > 0$), sell dollars forward ($H^{l} > 0$), but are only partially hedged ($H^{l} - D^{\star} < 0$). By market clearing, local intermediaries are long dollar forward $K < 0$ and CIP deviations are negative ($r^{\star} - r + f_t - s < 0$), as in the baseline model. This steady state equilibrium can be achieved by appropriate choice of forward transaction costs, ψ, dollar bond position, $D^{\star}$, and UIP deviations $r - r^{\star} - s' + s$.

To a first-order approximation, aggregate forward demand (A.30), keeping UIP deviations

constant in this partial equilibrium model of the forward market, is:

$$\underbrace{\left(\hat{r}_t^\star - \hat{r}_t + \hat{f}_t - \hat{s}_t\right)}_{\text{CIP } \widehat{\text{Deviation}}_t} = \frac{\Gamma}{2}(\hat{H}_{t+1} + \hat{H}^l_{t+1}) - \frac{(D^\star - H^l) - H}{2}(\hat{\Gamma}_t). \tag{A.32}$$

Combining equations (A.32), (A.4), and market clearing $-\hat{K}_{t+1} = \hat{H}_{t+1} + \hat{H}^l_{t+1}$, one obtains:

$$\frac{\partial \text{CIP } \widehat{\text{Deviation}}_t}{\partial \hat{\Gamma}_t} = -\frac{\kappa}{2\kappa + \Gamma}\left[(D^\star - H^l) - H\right] \tag{A.33}$$

If unhedged dollar exposure of local investors outweigh the short-dollar forward position of global investors ($D^\star - H^l > H$), an increase in global risk aversion lowers CIP deviations. Higher global risk aversion has opposing effects on forward demand of local and global investors. While global investors keep wanting to buy dollar forward (sell home-currency forward), local investors sell dollar forward. If the latter effect dominates, then the aggregate demand of forward dollars declines, rather than increases, and CIP deviations (further) decline, as a result, to compensate local intermediaries. ■

B Additional Empirical Analyses

B.1 Calculation of local banks' profits from arbitraging CIP deviations

Several important factors must be taken into account to compute local banks' profits from arbitraging CIP deviations. 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 (soles) term deposit rate—adjusted for reserve requirements—as the funding rate for dollars (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.

B.2 Additional Figures and Tables to Section 2

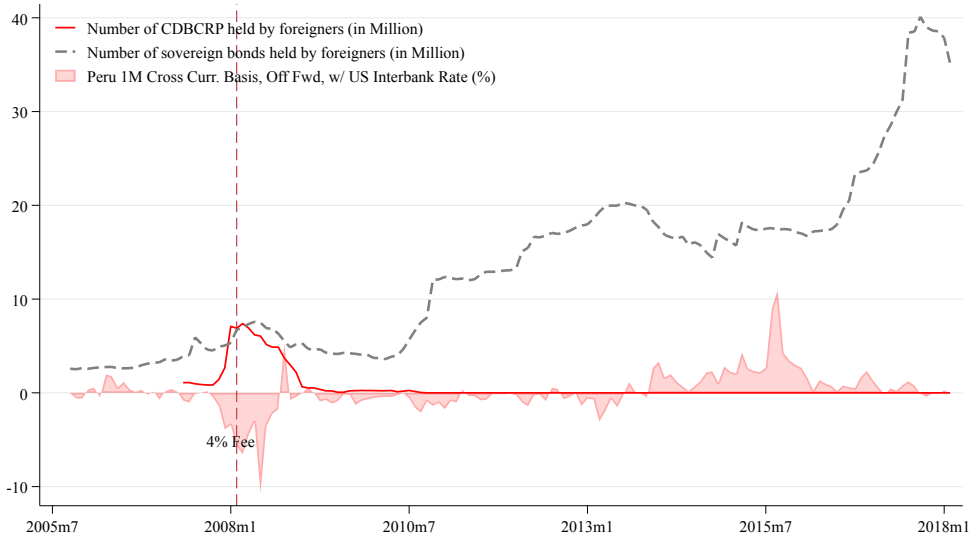
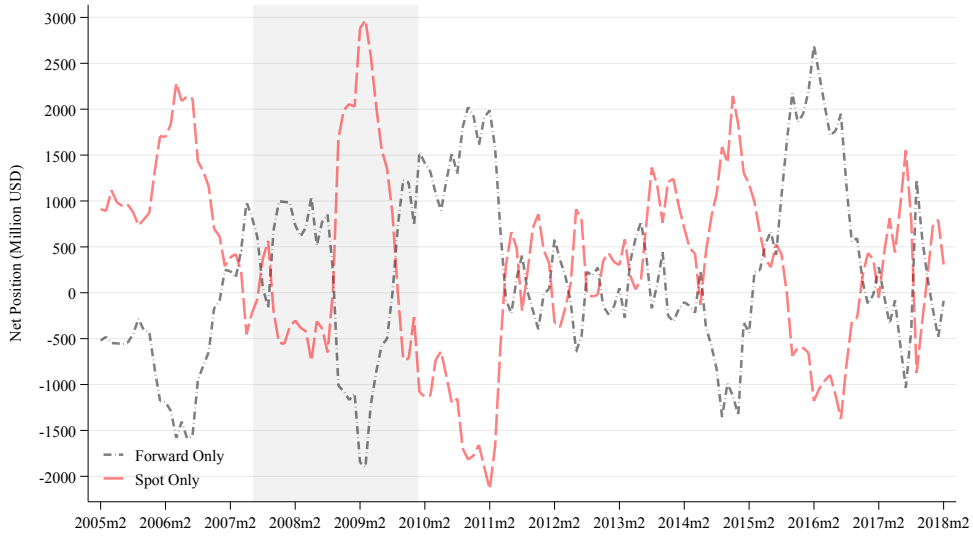


Figure B.1: Global Investor (Foreign) Holdings of Bond and Certificates of Deposit of the Central Bank

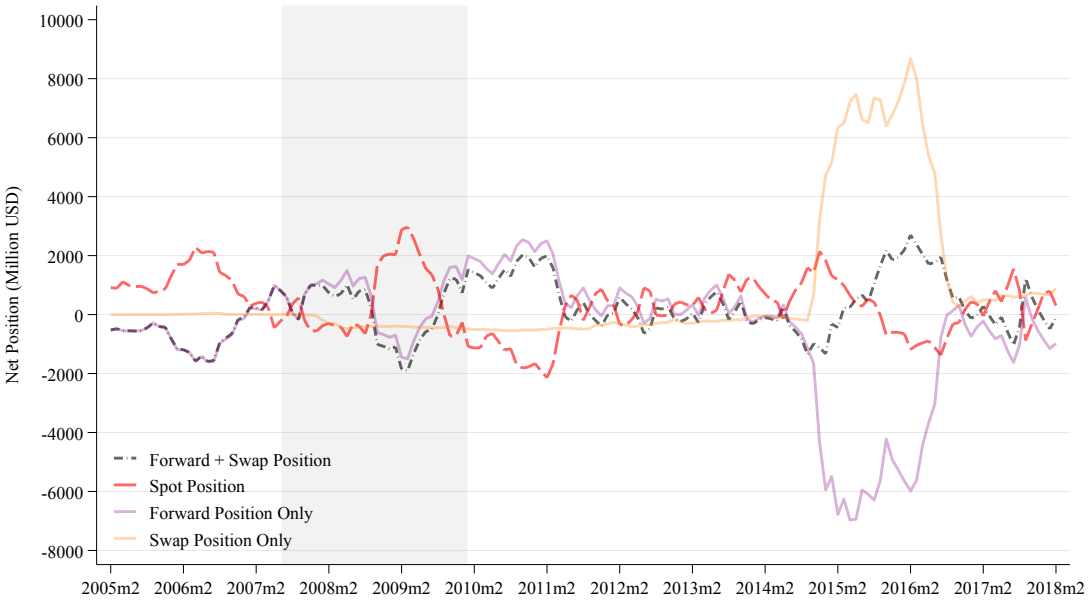
Note: The solid red line shows the number of CDs of the Central Bank that global investors hold (in millions). The dotted gray line shows the number of sovereign bonds global investors hold (in millions). The shaded red area shows the cross-currency basis. The dotted red line in January 2008 indicates the time when the Central Bank imposed the 4% fee on purchases of soles CDs charged to global 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 global investors.

Figure B.2: Bank hedging: Forward and Spot Positions



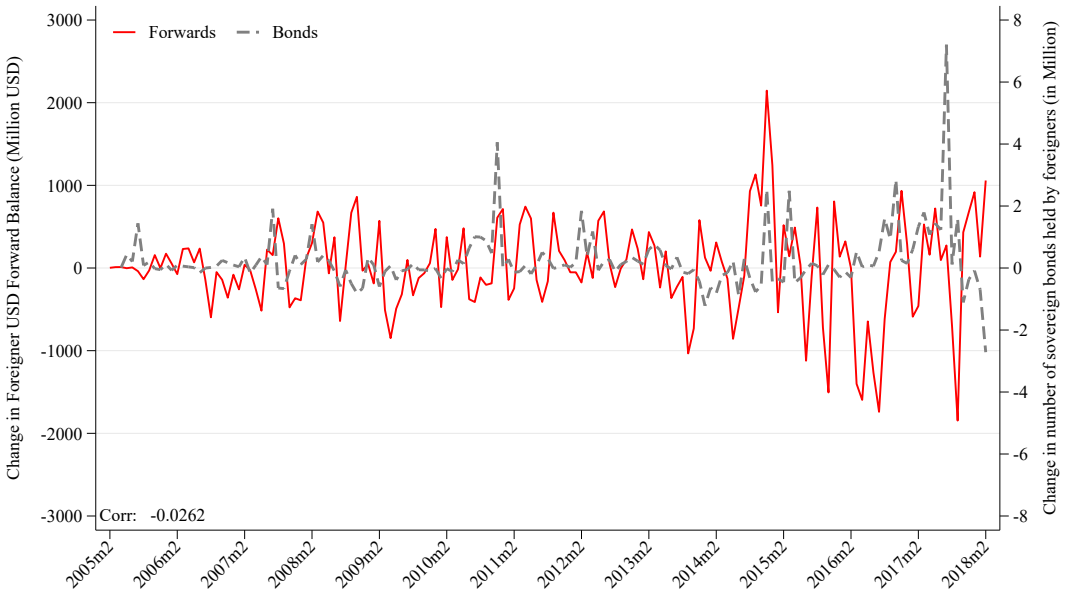
We compute Peru's banking system's long dollar spot and forward and swap FX positions. As expected when they hedge most of their currency foreign exchange position of forwards with spot, the spot position is inversely related to the forward position.

Figure B.3: Banks' Forward Position, Swap Position and Spot Position



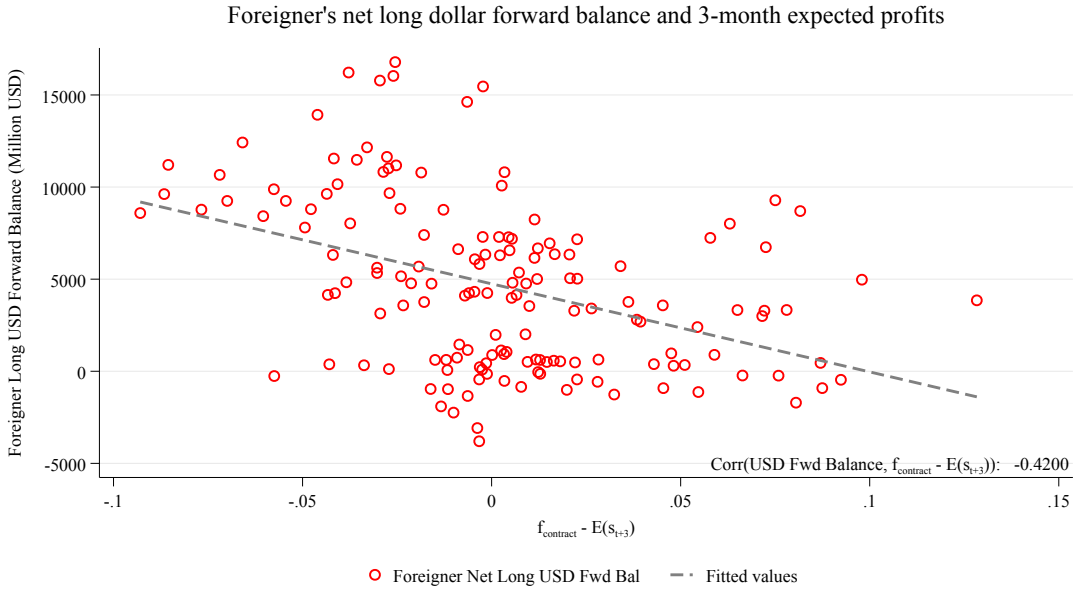
Note: This figure decomposes the forward plus swap position shown in Figure B.2, into its swap and forward components. These are shown in light purple and light orange. As shown, swaps was barely existent before 2015. In 2015 and through a portion of 2016, banks' FX swap balances were a crucial component 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.

Figure B.4: Change in Global Investors' Forward Balance and Their Change in Bond Holdings



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

Figure B.5: Global Investors' Forward Balance and Returns from Forward Trade Using Expectations



Note: This scatter plots the monthly averages of foreign net long dollar forward balance and the corresponding average of forward prices agreed minus the 3-month expected spot rate.

Table B.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

B.3 Additional Figures and Tables of Section 3

Table B.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 B.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 B.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 B.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 $\Delta s_{i,t+3M}$

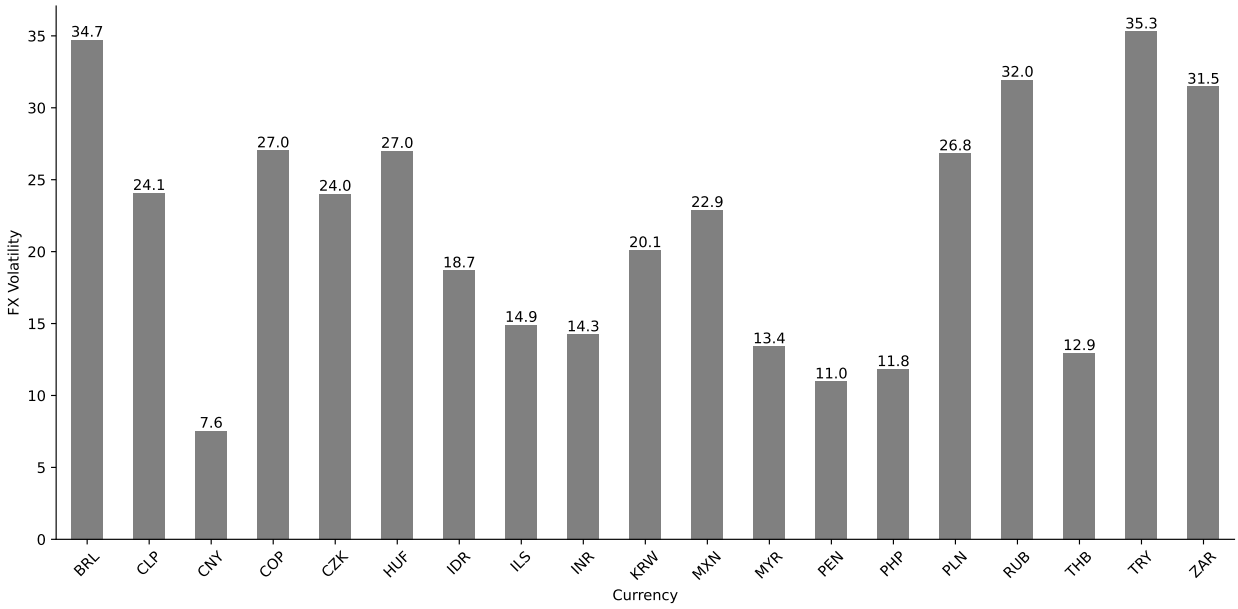
	OLS	FE	FE
CIP basis	-7.047***	-8.535**	-2.997
	(2.65)	(3.38)	(1.89)
Currency FE	No	Yes	No
Month FE	No	No	Yes
N	52111	52111	52111
R^2	0.007	0.010	0.654

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

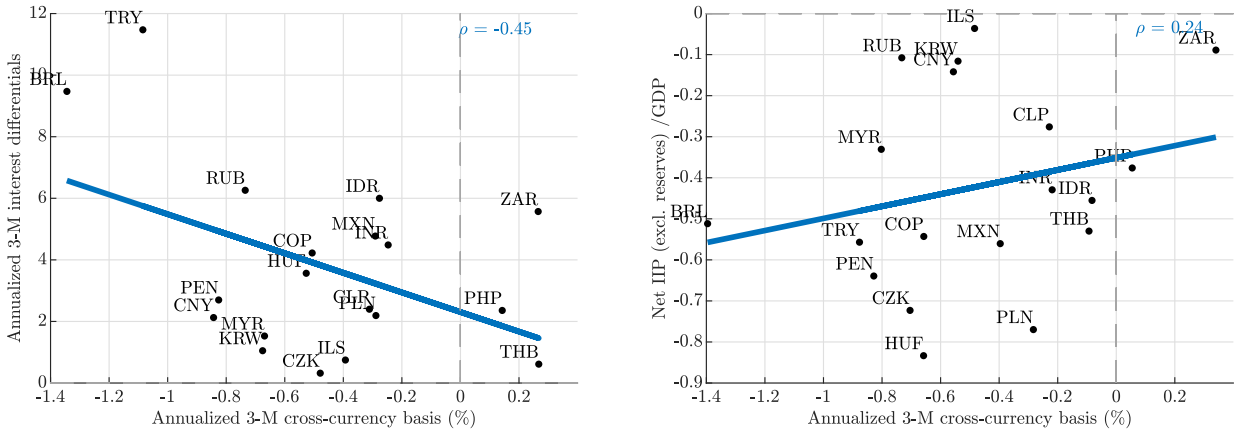
	OLS	FE	FE
CIP basis	0.278	-1.518***	1.127***
	(0.29)	(0.25)	(0.26)
Currency FE	No	Yes	No
Month FE	No	No	Yes
N	52111	52111	52111
R^2	0.001	0.412	0.432

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 B.1: Annualized FX volatility across emerging market currencies



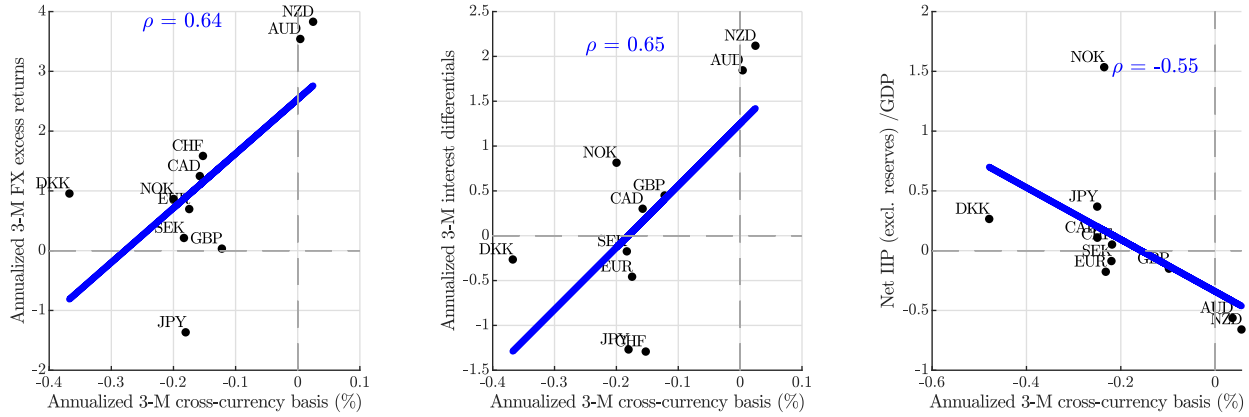
Note: The figure shows the annualized FX volatility across the emerging economies. The FX volatility is of similar magnitude across currencies, ranging from 7.6% for Chinese Yuan, to 35% for Turkish Lira. Though there exists heteroskedasticity among the currencies, there is little evidence of an outlier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



(a) Interest Rate Differentials **(b)** NFA positions

Figure B.2: UIP and CIP deviations across emerging currencies

Note: The figure depicts scatter plots of mean cross-currency basis withinterest rate differentials and net international investment (net IIP) positions across emerging economies. The cross-currency bases and interest rate differentials 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 interest rate differentials is 2002-2022, for net IIP 2010-2022.



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

Figure B.3: UIP and CIP deviations across G10 currencies

Note: The figure depicts scatter plots of mean cross-currency basis with excess home-currency returns, interest rate differentials, and net international investment (net IIP) positions across advanced economies. The cross-currency bases, excess currency returns, and interest rate differentials 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 excess currency returns and interest rate differentials is 2002-2022, for net IIP 2010-2022.