Managing Emerging Market Currency Risk*

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Abstract

We analyze U.S. bond funds' currency forward positions and document that the currency risk exposure of foreign investors in emerging markets (EM) is substantially greater than the estimates based on bond holdings alone, and varies by fund objectives. Unique to emerging markets, funds use forwards to overcome capital control and reduce portfolio deviations from benchmarks, effectively taking directional exposure in the forward market. These findings motivate an equilibrium model featuring investor heterogeneity, inelastic hedging demand, capital control and forward market segmentation. The model rationalizes key empirical regularities in EM currency forward premia and highlights the impact of policy barriers.

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1 Introduction

Local currency emerging market (EM) bonds have taken an increasingly important place in global investors' fixed-income portfolios. As of 2021, more than half of foreign investors' EM government debt portfolios are denominated in local currency (Onen, Shin, & von Peter, 2023). Accompanying this trend is a shift in currency risk exposure from borrowers to lenders (Bertaut, Bruno, & Shin, 2025), together with sizable growth in offshore derivatives trading in major EM currencies, which reached a turnover of more than USD 2.5 trillion in 2025 according to the BIS Triennial Survey.

Standard analyses based on advanced economy (AE) currencies conclude that fixed income investors should hedge a substantial portion of their portfolio exposed to currency risk (Glen & Jorion, 1993; Campbell, Medeiros, & Viceira, 2010, for instance). While the literature has shown that international investors deviate from the theoretical benchmark in their currency hedging patterns (Sialm & Zhu, 2024; Bräuer & Hau, 2025b), there remains limited work documenting the structure of offshore EM currency forward markets, global investors' EM currency risk management practices, and their ultimate currency risk exposure.

Understanding how global investors use FX derivatives for EM currencies is nevertheless important. Extant studies focus on measuring bond investors' exposure to EMs through direct debt holdings. A precise characterization of their overall exposure is incomplete without understanding the usage of currency derivatives, whose role may be especially relevant for EMs. Market segmentation due to the non-deliverability of currency forward contracts and binding capital account restrictions could elevate their significance in foreign investors' EM portfolio as alternative instruments to gain exposure and align with their investment objectives and benchmarks. These considerations could also be crucial for understanding the dynamics of forward exchange rates.

This paper takes a first step towards addressing these gaps. Using a novel dataset on U.S. investment funds' EM currency forward usage at the contract level from 2010 to 2023, we calculate funds' currency exposure through forward contracts, analyze important drivers of forward positions, and explore heterogeneity in funds' forward usage that could inform the understanding of the market structure. Based on our findings, we develop an equilibrium model of the offshore forward market to study the implications of foreign investors' forward usage and capital control on equilibrium forward premia.

Our first headline finding from the granular dataset is that the true currency risk exposure of major global fixed-income investors in emerging markets is much larger and more extensive than what their direct holdings of bonds indicate. An average mutual fund with a mandate to invest in EM fixed-income assets actively employs currency forward agreements to build risk exposure on top of their underlying bond positions, rather than hedging the currency risk away. One dollar of EM local currency bond investment is associated with an average long forward position of 15 cents in the same currency. This additional risk exposure still reflects a partial picture at best, as these mutual funds also use forwards to seek direct exposure to currencies. For every five currencies in an average mutual fund's EM investments, there are two associated with zero or tiny bond investment positions in the same currency.[1] Investment objectives play an important role in explaining the heterogeneity of net forward exposure across funds, as funds following local currency bond indices as benchmarks are 18 percent more likely to take on net long forward positions. Aggregated to the currency level, long forward exposure adds 25% to the overall exposure of U.S. EM-focused bond funds to major EM currencies. Consequently, data on direct holdings of debt securities largely understates the degree of currency risk that global investors with an EM mandate actually face.

We also explore important correlates that could explain the direction and degree of currency risk taking through derivatives. Unique to the context of EM, we find that in the cross section of major EM currencies, net forward purchases of local currencies are systematically increasing in measures of capital account restrictions that capture the

[1]Tiny bond investment positions refer to those smaller than 0.1% of the funds' total net assets.

difficulty of capital movement across borders. This finding remains robust after controlling for additional currency characteristics, such as local currency-USD yield differential, yield curve slopes, expected currency depreciation, and deviations from Covered Interest Parity (CIP). We provide corroborating event-study evidence, showing that after Brazil's repeal of its capital inflow tax, net forward purchases of funds in our sample substantially decline, while allocation toward Brazilian Real bonds increases.

Underpinning this close relationship between capital account restrictions and net forward positions is the incentive for local currency bond funds seeking currency exposure consistent with benchmark indices when facing costs to obtain such exposure directly through bonds. Zooming in on funds following local currency EM bond indices, we find that funds' net forward purchases in a currency is strongly associated with a wider gap of funds' bond allocation to the same currency short of the index weights, with a cross-currency correlation of 85%. Meanwhile, benchmark deviations are wider in countries that impose stronger restrictions on bond flows. An important implication of this triangular interaction is that such funds effectively become "speculators" in the offshore forward market, taking directional exposure through net long forward positions that bring the funds' overall currency exposure closer to index-implied levels.

Meanwhile, policy measures that affect the integration of offshore and onshore forward market also drive forward usage. We provide event study evidence on Malaysia's 2016 enforcement of onshore-offshore forward market segmentation to document that aggregate net forward purchases of Malaysian Ringgit (MYR) in our sample of funds reduce by 50% in response to the policy tightening that increases the difficulty to trade offshore currency forwards. Taken together, these findings highlight the important role played by various forms of policy barriers in shaping the foreign investors' participation in offshore EM derivatives markets.

To understand the structure of the market for EM forward contracts in more detail, we separate funds in our sample into "local currency investors" and "local currency hedgers" based on the overall direction of each fund's currency risk taking through forwards. This data-driven approach yields several insights. First, local currency investor and hedger funds differ in their investment objectives. Local currency investors, defined as those who persistently take net long forward positions, tend to follow local currency bond market indices as benchmarks, echoing our finding on the role of capital control in driving net forward purchases. Local currency hedgers, on the other hand, are more likely to follow hard currency indices. Second, relative to hedgers, local currency investors are exposed to a larger number of currencies on average, take larger gross forward positions, and generate returns that are more sensitive to currency fluctuations. Third, on the nature of forward demand, a series of predictive regressions demonstrate that while FX excess return, currency volatility, and hedging cost predict local currency investors' net forward usage, the strongest predictor of local currency hedgers' net forward sales in a currency is their bond portfolio weight denominated in the same currency. The latter finding indicates that local currency hedgers' demand for EM currency forwards tend to be inelastic, driven by the need to hedge bond investments. Within each of the two groups of funds, however, we do not find significant evidence that fund performance differs systematically along the dimension of net forward positions.

The strong influence of capital flow restrictions, derivative market segmentation and heterogeneity in investment objectives that we document in the data could have important implications on forward exchange rates. To delineate the economic mechanism, we write down a model of the offshore forward market featuring local currency hedgers, local currency investors, and a global intermediary. In the model, risk averse hedgers with a dollar return objective are endowed with predetermined local currency bond exposure. The associated hedging motive gives rise to inelastic demand for forward dollars. Local currency investors, on the other hand, make joint decision to allocate their wealth on EM currency bonds and forwards. Accommodating hedging demand by buying local currency forward can be profitable for local currency investors. The global intermediary absorbs the remaining imbalances and offload the risk to outside entities such as domestic investors in EMs, earning a portion of the expected returns as fees.

Capital flow restriction and forward market segmentation enter the model in meaningful ways. First, akin to conventional capital inflow restrictions, local currency investors pay a cost to purchase each unit of local currency bond (the "onshoring cost" channel). Second, the global intermediary has limited capacity due to a non-zero probability of failure to fully shed risk to outside investors and thus having to resort to its costly balance sheet space. This probability is conceptually related to the imperfect integration between onshore and offshore derivative markets due to policy measures that raise the "intermediation cost" facing global intermediaries in connecting the offshore and onshore forward markets.

We characterize the currency forward market equilibrium and demonstrate the model's ability to rationalize several salient empirical patterns related to EM currencies' forward premia. In the model, the willingness of local currency investors to absorb hedging demand is increasing in their expected profit from hedging service provision—measurable via the difference between deviations from Uncovered Interest Parity (UIP) and Covered Interest Parity (CIP). Using data on forward exchange rates and survey-based exchange rate expectation, we show in the data that this relative currency wedge is in general positive and is larger for currencies comprising a higher share in hedger funds' bond portfolio. We also use a portfolio approach to gauge the premium from taking directional currency exposure through forwards, by forming a long-short currency portfolio sorted on the share of long forward positions calculated using our sample funds. The portfolio returns 2.32% per annum. Finally, we study the onset of the COVID-19 crisis as an important "risk-off" episode, and find that currencies that experience a larger contraction of forward purchases in this period saw a stronger increase in hedging costs.

In our model, the relationship between equilibrium hedging cost and capital flow restriction measures in our model crucially depends on the types of restriction being considered. When the hedgers are sufficiently more risk averse than the local currency investors and EM currencies command a positive UIP deviation, a higher "onshoring cost" of capital flows into local currency bond market reduces hedging cost, but the opposite is true when the "intermediation cost" increases as stronger forward market segmentation increases the difficulty for the global intermediary to shed risk. We show that both predictions are consistent with the data. On the onshoring cost channel, we show that currency portfolios associated with more positive net fund forward positions also feature lower hedging cost and stronger capital account restrictions. Meanwhile, we show that after Malaysian authorities restricted onshore entities from trading in the MYR offshore forward market in late 2016, hedging cost measured by CIP deviations spiked by more than 300 basis points, validating the intermediation cost channel.

Taken together, our analysis implies that exchange rate movements could have a stronger impact on capital inflows into emerging markets and the borrowing cost of EM issuers than previously thought. The fact that the currency risk exposure of international investors is much larger and more extensive once we take into account the derivatives channel provides a potential rationale for the pervasive relationship between broad currency index and capital flows and portfolio allocation uncovered in the recent literature (Avdjiev, Du, Koch, & Shin, 2019; Jansen, Shin, & von Peter, 2024). Unique to emerging market currencies, we emphasize the importance of understanding policy- and benchmark-driven forward allocation in affecting exchange rate dynamics.

Related literature Our paper contributes to two strands of literature. A growing literature documents the use of derivatives for institutional investors allocating capital worldwide.[2] An important predecessor is Sialm and Zhu (2024), who show that international fixed income funds' currency hedge ratio is in general smaller than what is theorized by standard models. They also find evidence of funds using currency forwards to increase, rather than hedge, their currency exposure. Opie and Riddiough (2024) study international equity funds and underscore the heterogeneity in forward usage patterns across funds. Cheema-Fox and Greenwood (2024) use custodial records to show that currency hedgers maintain a target hedge ratio and rebalance accordingly. Bräuer and Hau (2025b) take a portfolio approach and find little evidence indicating that funds engage in optimal hedging using forwards. Most papers in this domain, however, are

[2]Beyond currency derivatives, the literature has also discussed mutual funds' usage of credit default swaps (Adam & Guettler, 2015; Jiang, Ou, & Zhu, 2021), interest rate derivatives (Choi, Kim, & Randall, 2024) and equity derivatives (Kaniel & Wang, 2025) using the same set of regulatory filings.

tilted towards advanced (G10) currencies partly due to the sheer size of G10 currency instruments. Exceptions are Du and Huber (2024) and Hacioglu Hoke et al. (2026), who document currency hedging and speculating practices more generally. Here, the contribution of our paper is to use granular data of forward usage at the contract level to understand the role of investor heterogeneity, and several distinct features of emerging markets, such as capital control, benchmark-driven investment and market segmentation in explaining foreign investors' currency derivative usage.

We also contribute to the nascent literature studying the hedging and speculative channel of exchange rate determination. Kubitza, Sigaux, and Vandeweyer (2024) study the interaction between forward usage, capital flows, and interest parity deviations for Euro Area investors. Kremens (2024) demonstrates that hedge fund positioning in the currency futures market is informative of currency-equity correlation. Bräuer and Hau (2025a) and Ben Zeev and Nathan (2024) establish a causal impact of time-varying hedging demand from international bond and equity investors on exchange rates.

Among various contributions in this strand of literature, our paper is most closely related to Liao and Zhang (2024), who study how hedging demand arising from dollar asset-liability gap of a country and imperfect financial intermediation could jointly shape the dynamics of exchange rates for G10 currencies, and to De Leo, Keller, and Zou (2024), who use Peruvian data to examine the exchange rate implication of the interaction between foreign speculative demand and constrained local intermediaries, who take the opposite position. Our paper differs in several major aspects. Empirically, our data covers a large cross-section of currencies and we focus on characterizing the role of capital account restrictions and benchmarking, taking into account both speculative and hedging demand from foreign investors. Consequently, our model focuses on the heterogeneous risk-return tradeoff facing the ultimate buyers and sellers of hedging services on both ends of the offshore forward intermediation chain. Unique to our model, it establishes the role of benchmark-driven investment in affecting funds' forward positioning, and the impact of policy barriers on currency hedging costs.[3]

The remaining part of the paper is structured as follows: Section 2 offers an overview of the EM currency market and introduces the data. Section 3 presents a set of stylized facts on EM-focused mutual funds' currency forward usage, with a focus on the role of capital control. Section 4 highlights the differences between local currency investors and hedgers in the market. Section 5 introduces a partial equilibrium model of the offshore currency forward market and discusses its empirical validation. Section 6 concludes.

2 Emerging market currency hedging: Data and context

2.1 Overview

The EM currency derivatives market is characterized by a number of unique features. For a large subset of EM currencies, the lack of full convertibility and capital control give rise to strong segmentation between offshore and onshore markets and an active offshore non-deliverable forward (NDF) market, where forward contracts involve no physical delivery of currencies and settle with net profits and losses. Informed by our data to be introduced in the next section and echoing De Leo et al. (2024), Figure 1 illustrates the market structure. Our focus is on characterizing forward usage and forward pricing in the offshore market, where offshore end investors, such as mutual funds and hedge funds, trade NDFs with global banks that have partial access to onshore derivatives markets. By trading with local counterparties, global banks shift the currency risk from the offshore to the onshore market. Shifts in the degree of market access, often policy driven, could have implications on the condition of the offshore forward market.

[3]From a broad perspective, the paper is also related to the literature on currency risk and optimal hedging (Solnik, 1974; Black, 1990; Campbell et al., 2010; Verdelhan, 2018; Opie & Riddiough, 2020, among others), and to the large literature on understanding deviations from interest rate parity (Du & Schreger, 2016; Du, Tepper, & Verdelhan, 2018; Borio, Iqbal, McCauley, McGuire, & Sushko, 2018; Kalemli-Özcan & Varela, 2022; Cerutti & Zhou, 2024; Kim & Kim, 2025, among others).

Currency derivatives can also be employed to gain direct exposure to currency risk without the need to hold any cash position. This feature could be particularly important for EM currencies, thanks to pervasive capital control on bond inflow and outflow (also see Figure 1), persistently positive interest rate spread over the U.S., high currency volatility, and the prevalence of benchmark-driven investment (Arslanalp, Drakopoulos, Goel, & Koepke, 2020).[4] An implication of the use of non-deliverable forward contracts in emerging markets is that data on local currency bond or equity positions may offer at best an incomplete picture to understand global investors' true currency exposure to emerging markets.

Forward pricing reflects these frictions unique to emerging markets. Cerutti and Zhou (2024) compute deviations from Covered Interest Parity (CIP) constructed using EM currency forward exchange rates and show that in most cases, CIP deviations are large and volatile compared to their G10 counterparts.[5] Consequently, international investors looking to hedge their currency risk arising from local currency bond or equity holding could face substantial hedging cost and rollover risk.

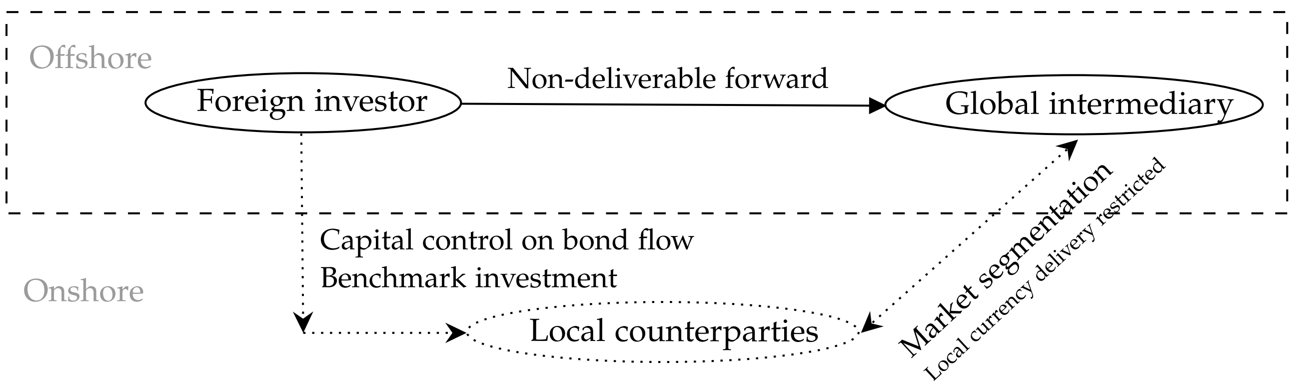


Figure 1: The structure of the EM currency forward market: a stylized representation

[4]An instance in which offshore market could feature strong speculative force is Indonesia. While the Indonesian authority restricts onshore trading of currency derivatives without underlying investment, the Indonesian Rupiah has the largest offshore NDF market among Southeast Asian economies (Schmittmann & Chua, 2020).

[5]Jung and Jung (2022) document strong law of one price deviations for onshore and offshore currency forwards during global crisis episodes and relate the gap to intermediary frictions and position limits.

2.2 Data

We focus on U.S.-domiciled fixed income mutual funds and ETFs with a mandate to direct most of their capital into emerging market debt securities. We obtain the sample of funds from Morningstar (within the "Emerging Markets Fixed Income" category) and cross check the sample with CRSP Survivor-Bias-Free Mutual Fund database. The data covers a total of 150 funds from 2010Q1 to 2023Q3 with total net assets of 64 billion USD by the end of 2021.[6]

Mutual fund FX forward usage Fund-level FX forward positions are collected from the SEC's EDGAR system. Mutual funds are required to disclose their complete portfolio holdings, including all derivatives, to the SEC every quarter (and later every month). Before 2019Q3, mutual funds report their complete holdings via Form N-CSR/CSRS and Form N-Q. Starting from 2019Q3, the SEC has standardized the filing format through the new Form N-PORT. We obtain data related to forward usage via scraping Form N-PORT and manually recording information in Form N-Q and N-CSR/CSRS with help from OCR software. We also manually cross-check our final data with the filings to ensure the accuracy of our processed data.

A fund filing contains detailed contract-level information on FX forwards, including currency to purchase, currency to sell, notional amount, market value of a contract, settlement date, counterparty, and unrealized valuation gains and losses. This provides us with a rich amount of information to study how mutual funds manage their currency risk unavailable in other data sources.[7] A total of 59 non-G10 currencies have forward contracts traded by mutual funds in our sample. While we calculate and report summary statistics including all currencies, our main analyses restrict attention to a subset of 19

[6]Due to fund entry and exit, the total number of funds each year varies from 34 to 100, and stabilizes after 2013. We exclude "global" fixed income funds allocating a small share to EM from our sample, to prevent any fund-level hedging mandates from complicating our analysis specific to EM currencies.

[7]Figure A1 in the Appendix provides a screenshot of the FX forward-related information from an SEC filing by JPMorgan Emerging Markets Debt Fund using Form N-Q.

major currencies for which we have high-quality data on hedging cost.[8]

Portfolio holding and fund characteristics Security-level holding data comes from CRSP, available at quarterly frequency. We also collect fund characteristics including fund size (total net assets), return, expense, prospectus benchmarks, and turnover ratio. We develop a crosswalk based on CRSP's SEC-CRSP fund matching file to merge information on FX forward usage with the CRSP data. We manually check fund-quarters missing in CRSP and fill in the data using records from Morningstar and SEC filings.

Security-level information such as currency denomination and issuer country comes from Refinitiv and Bloomberg based on matching with bond ISIN. Missing security identifiers in the CRSP portfolio holding data are prevalent, especially in the early part of our sample. We manually collect currency denomination from Bloomberg (using the OpenFIGI API) and Refinitiv based on CRSP-provided information on coupon, maturity date, and security name. For an average fund-quarter pair, we are able to assign currency denomination to 93% of the securities as a share of total net assets (excluding cash).

Currency wedges Two measures of currency wedges (deviations from interest parity) will be helpful for our analysis. We obtain average 3-month-ahead and 1-year-ahead median forecast on spot exchange rates from Bloomberg to compute an ex-ante measure of deviations from Uncovered Interest Parity (UIP, Kalemli-Özcan and Varela (2022)). In addition, we follow Cerutti and Zhou (2024) to construct forward premia and deviations from Covered Interest Parity (CIP) for emerging market currencies. In the convention of Du, Tepper, and Verdelhan (2018), the CIP deviations of tenor n against the USD are

$$x_{t,t+n} = i^{\$}_{t,t+n} - [i_{t,t+n} - (f_{t,t+n} - s_t)] \tag{1}$$

where $f_{t,t+n}, s_t$ are log forward and spot exchange rate, in units of local currency per USD. $i^{\$}_{t,t+n}$ and $i_{t,t+n}$ are money market interest rate in USD and local currency. We focus

[8]This set of currencies include BRL, CLP, CNY, COP, CZK, HUF, IDR, ILS, INR, KRW, MXN, MYR, PEN, PHP, PLN, RUB, THB, TRY and ZAR.

on short tenors such as 1-month and 3-month CIP deviations, as we will show later that these are the main tenors of the contracts in our granular data. (1) is a direct measure of the hedging cost facing EM local currency bond investors evaluating returns in dollars, with a smaller $x_{t,t+n}$ indicating a lower hedging cost. In particular, a negative $x_{t,t+n}$ corresponds to the situation where currency-hedged local currency return exceeding the return of dollar assets with a similar risk and maturity profile.

Overall, compared with the literature, our data has the advantage that it combines multiple reporting forms to achieve a much longer sample period, while preserving the granularity of the data.[9] Our focus on mutual funds and ETFs with EM investment mandates should capture a major share of activities in both the EM currency forward market and the local currency debt market, as other types of institutions are unlikely to maintain a substantial position on local currency assets, and if anything, these other types do not hedge their currency exposure.[10]

2.3 Currency risk management of investment funds: Measurement

Following standard practice in the literature (Sialm & Zhu, 2024; Opie & Riddiough, 2024), we define a number of terms that measure various dimensions of how investment funds manage currency risk via FX forwards.

Starting from the fund-currency level, the *net forward sale* is the present value of the total notional amount of forward currency sold, net of forward currency purchased. The

[9] Sialm and Zhu (2024) and Opie and Riddiough (2024) use N-Q and N-CSR/CSRS, while Kaniel and Wang (2025) focus on NPORT-P data. Liao and Zhang (2024) and Du and Huber (2024) use data on insurance companies' currency hedged investment aggregated at the company level.

[10] Zhou (2025) shows that Germany-based banks, insurance companies and pension funds hold tiny position on local currency EM sovereign bonds. Jansen et al. (2024) show that Dutch pension funds employ little hedge for investments that are not USD, GBP or JPY denominated. Bertaut et al. (2025) provide evidence that U.S. investment funds are the dominant holders of EM local currency government bonds among all types of U.S. institutions.

notional amount is converted to USD value. More formally, let

$$\text{NFS}_{ict} \equiv \frac{\$\text{NFS}_{ict}}{\text{TNA}_{it}} = \frac{\widetilde{\text{FS}}_{ict} - \widetilde{\text{FP}}_{ict}}{\text{TNA}_{it}}. \tag{2}$$

Both $\widetilde{\text{FS}}_{ict}$ (forward sales) and $\widetilde{\text{FP}}_{ict}$ (forward purchases) are aggregated across contracts of all tenors.[11] A positive NFS_{ict} indicates that fund i is on net selling currency c forward. To the extent that fund i has a long position in currency-c bonds, the exchange rate risk is partially or fully hedged if $\text{NFS}_{ict} > 0$.

Another measure characterizing currency forward usage at fund-currency level is the *hedge ratio*, defined as

$$\text{HR}_{ict} = \frac{\text{NFS}_{ict}}{\omega_{ict} \times \mathbb{1}\{\omega_{ict} > \underline{\omega}\}}, \tag{3}$$

where ω_{ict} is fund i's portfolio weight in currency c. A positive hedge ratio (i.e., $\text{HR}_{ict} > 0$) means that a fund reduces its exposure in currency c via FX forwards, and vice versa. An HR_{ict} equal to one indicates that fund i is fully hedged in currency c while a bigger number indicates overhedging.

In the data, mutual funds could report small positions in bonds denominated in a currency while holding a large notional position in forward contracts involving the same currency. To make sure the hedge ratio reflects economically meaningful currency hedges, the measure (3) is only defined for currencies whose portfolio weight exceeds a threshold $\underline{\omega}$. Our baseline measure sets $\underline{\omega}$ to 0, and we check for robustness of our findings varying the size of $\underline{\omega}$.

Subtracting net forward sales from portfolio weights, the *net currency exposure* of fund i in currency c is given by

$$\text{NCE}_{ict} = \omega_{ict} - \text{NFS}_{ict}, \tag{4}$$

[11] Following Sialm and Zhu (2024), we work with present values in our subsequent analysis. We use one-month U.S. treasury yield to discount the contract value. For instance, $\widetilde{\text{FS}}_{ict} = \sum_j \text{FS}^j_{ict}/(1+r_t)^{M_j/365}$, where r_t is the risk free rate and j groups all forward sale contracts with the same residual maturity M_j.

where a positive NCE_{ict} indicates residual currency risk arising from partial hedges.

To aggregate our measures (2), (3), and (4) to the fund level, we take the sum over all currencies for each fund:

$$\text{NFS}_{it} = \frac{\sum_{c \neq USD} (\widetilde{\text{FS}}_{ict} - \widetilde{\text{FP}}_{ict})}{\text{TNA}_{it}} \tag{5}$$

$$\text{HR}_{it} = \frac{\sum_{c \neq USD} \text{NFS}_{ict}}{\sum_{c \neq USD} \omega_{ict} \times \mathbb{1}\{\sum_{c \neq USD} \omega_{ict} > \underline{\omega}\}} \tag{6}$$

$$\text{NCE}_{it} = \sum_{c \neq USD} (\omega_{ict} - \text{NFS}_{ict}). \tag{7}$$

3 The currency exposure of foreign investors in EM

3.1 Currency risk amplification and exposure building

Table 1 reports a number of basic summary statistics on the forward-contract-level data. On average, EM-focused funds in our sample employ short-term currency forwards to manage currency risk. The average residual maturity of the contracts is 50 days. This finding suggests that there is a substantial maturity mismatch between the underlying bond investment and the currency derivatives. To the extent that the hedging cost is generally high for EM currencies (Cerutti & Zhou, 2024), these factors could deter investors from substantially hedging their currency exposure.

Table 2 reports relevant summary statistics at the fund level.[12] The average hedge ratio is −15%. For one dollar invested in an EM currency, investors on average *add* 15 cents to the currency risk exposure. Average net forward sales are −9% of total net assets. In addition, an average fund has a long or short position in 8-9 currencies but sources the contracts from 5 counterparties, indicating a generally concentrated market for EM currency forwards. The counterparty banks are predominantly global banks in

[12]Table A2 presents additional fund-level summary statistics and robustness checks.

	Obs	Mean	STD	P25	P50	P75
Purchase EM currency against USD	248439	0.47	0.50	0.00	0.00	1.00
Sell EM currency against USD	248439	0.38	0.49	0.00	0.00	1.00
Purchase G9 currency against USD	248439	0.05	0.21	0.00	0.00	0.00
Sell G9 currency against USD	248439	0.07	0.26	0.00	0.00	0.00
Contracts with two Non-USD currencies	248439	0.04	0.19	0.00	0.00	0.00
Notional Amount ($ Million)	248439	6.14	24.71	0.23	0.90	3.54
Remaining Days to Maturity	248432	50.29	63.17	16.00	39.00	66.00
Observations	248439					

Table 1: Summary statistics: Forward contract-level

Notes: Table 1 presents summary statistics of the forward-contract level data. Sample currencies include 59 non-G10 and G9 (excluding USD) currencies. The sample runs from 2010Q1 to 2023Q3.

the offshore forward markets (for example, JP Morgan).[13] The distribution of net forward positions and hedge ratios are highly spread out (Figure 2(a), 2(b)), but ultimately an average fund has a stronger net currency exposure compared to their bond-level portfolio weight, according to Figure 2(c). Furthermore, using offshore forwards to increase currency exposure is a pervasive phenomenon across funds, and it is not driven by a few extreme outliers. We show this precisely in Figure A3 in the Appendix, by documenting a significant share of fund-currency-quarters that involve tiny to zero bond position but net long forward position. In comparison, Sialm and Zhu (2024, Figure 3) show that for a larger sample of mutual funds investing in both G10 and non-G10 currencies, while some funds use forwards to increase their currency exposure, a substantial portion of fund-level net foreign currency exposure is below its portfolio weight, indicating a stronger propensity to hedge G10 currency exposure.[14]

By projecting fund-level net forward sales (or an indicator variable of positive net forward sales) on a series of fund-level characteristics, we show in Table 3 that a fund's

[13] Appendix Table A1 lists all counterparty banks appearing in the sample.

[14] Our results are also robust after excluding ETFs, index funds, and liquidated or merged share classes from the calculation (see Appendix Table A3).

investment objective reflected in its benchmark indices drives heterogeneity of forward exposure across funds. A fund following local-currency bond indices, such as JPMorgan GBI-EM, is 18 percent more likely than a fund following indices denominated in other currencies to take on net long forward exposure (columns (1) and (2)). The average size of local currency index-following funds' net forward purchases would be larger by 11 percent of TNA. Similar to Sialm and Zhu (2024), we also find that funds with more assets in institutional share classes purchase more forwards on net, consistent with institutional investors seeking specific types of risk exposures through investing in specialized funds.

Liquidity management has been shown as a major driver of derivatives usage in other context (Kaniel & Wang, 2025). We analyze two related channels that could influence currency forward usage for our sample funds. A precautionary channel could be in force, where funds sell EM currency forwards (i.e., buy U.S. dollar forward) to hedge future redemption risk and dollar liquidity need. Another channel speaks to the flexibility of forward contracts in handling flows and overcome market illiquidity. Facing inflows, a long position in currency forward contract can serve as a synthetic instrument when the bond denominated in the same currency is difficult to source. Similarly, the long forward position can be flexibly unwound after investor redemption to rebalance portfolio risk.

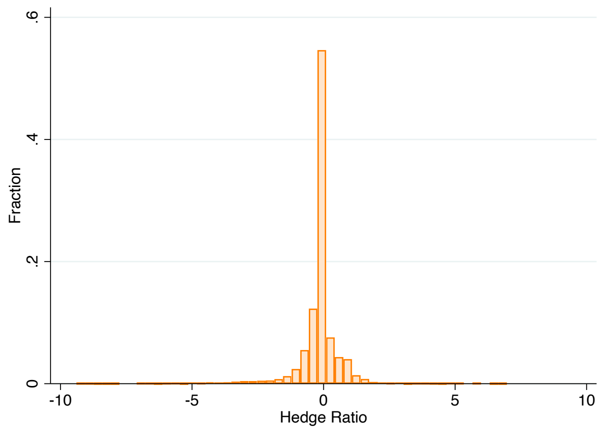
To analyze the precautionary motive, we include flow volatility and cash holdings in the same regressions (Table 3), and find that funds sell more EM currencies forward when they face a more volatile investor base and hold less cash. In the Appendix, we estimate the flow-forward trading relationship. Table A4 show that on average, 1 dollar of fund inflow is associated with 2.8 cents additional net forward purchases. The flow-forward trading relationship strengthens when the fund experiences an outflow. Taken together, the evidence provides support to both channels of currency forward usage for liquidity management.

The prevalence of forward purchases with tiny or zero corresponding bond investments suggests that aggregate local currency bond positions paint a severely incomplete

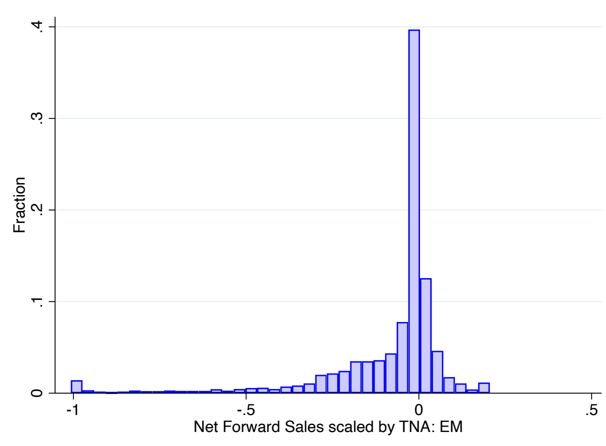
	Obs	Mean	STD	P25	P50	P75
Fraction of Fund-Quarter with FX Forward	4387	0.76	0.43	1.00	1.00	1.00
Total Net Assets ($ Million)	4387	759.41	1497.52	39.80	169.70	699.90
Portfolio Weight of EM Currencies	4387	0.37	0.36	0.03	0.27	0.71
Hedge Ratio: EM	4100	-0.15	0.98	-0.25	0.00	0.00
Net Forward Sales scaled by TNA: EM	4387	-0.09	0.20	-0.11	0.00	0.00
Net Currency Exposure	4387	0.46	0.43	0.04	0.37	0.91
Forward Purchases scaled by TNA: EM	4387	0.24	0.34	0.00	0.07	0.33
Forward Sales scaled by TNA: EM	4387	0.15	0.22	0.00	0.05	0.21
Gross Forward scaled by TNA: EM	4387	0.38	0.53	0.00	0.13	0.57
Number of Unique FX Counterparties	4387	4.72	4.78	1.00	3.00	8.00
Number of Unique Purchase Currencies	4387	8.80	8.35	1.00	6.00	16.00
Number of Unique Sale Currencies	4387	7.88	7.70	1.00	6.00	14.00
Number of Currencies with No Bond Investment	4387	3.85	4.62	0.00	2.00	6.00
Number of Currencies with Bond Investment	4387	9.52	7.13	3.00	9.00	16.00
Number of Contracts	4387	49.57	77.04	1.00	16.00	67.00
Observations	4387					

Table 2: U.S. fixed-income EM mutual funds: Fund-by-quarter level summary

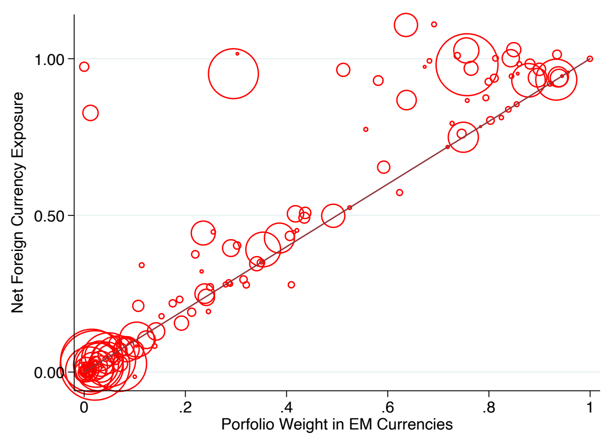
Notes: Table 2 presents summary statistics of the fund-quarter level data. In the calculation of hedge ratio, net forward sales, forward purchases, and forward sales, we restrict to non-G10 EM currencies. For hedge ratio, we remove extreme observations of which the absolute value of hedge ratio exceeds 10. We winsorize net forward sales, forward purchases, and forward sales at 1%. The hedge ratio is based on fund-quarters with non-zero portfolio weights. The sample runs from 2010Q1 to 2023Q3.



(a) Histogram of hedge ratio



(b) Histogram of net forward sales



(c) Net currency exposure and portfolio weight

Figure 2: U.S. fixed income mutual funds' FX forward position and portfolio weight to EM

Notes: Figure 2 presents histograms of two key measures that capture FX forward usage at fund-quarter level, and illustrates the extent to which each fund's underlying portfolio weight in EM currencies differs from its true currency exposure. Upper left panel is hedge ratio defined in Equation (6), and upper right panel is net forward sales scaled by total net assets defined in Equation (5). The figure in the bottom panel plots fund-level time-series average of underlying portfolio weight in EM currencies (x-axis) against time-series average of net foreign currency exposure defined in Equation (7) (y-axis). Circles above the 45-degree line are funds that hold net long forward positions (i.e., increase currency exposure), and those below are funds that hold net short forward position (i.e., decrease currency exposure). Each circle is weighted by the size of a fund's total net assets. Net forward sales are winsorized at 1%, and for hedge ratio, we remove extreme observations of which the absolute value of hedge ratio exceeds 10.

	$\mathbb{1}(NFS > 0)$		NFS (% TNA)	
	(1)	(2)	(3)	(4)
Portfolio Share of EM Currencies (%)	-0.003***	-0.003***	0.077	0.043
	(0.001)	(0.001)	(0.094)	(0.073)
LC Benchmark	-0.209***	-0.180***	-13.150**	-11.633**
	(0.062)	(0.061)	(6.288)	(5.758)
Portfolio Currency Concentration	-0.001	-0.001	0.075*	0.046
	(0.001)	(0.001)	(0.042)	(0.035)
Log TNA	-0.011	-0.017	-0.307	0.020
	(0.011)	(0.013)	(0.905)	(0.985)
Portfolio Weight of Cash (%)		-0.002**		-0.337**
		(0.001)		(0.166)
Expense Ratio (%)		-0.132		-4.683
		(0.079)		(4.944)
Turnover Ratio (%)		0.000**		0.010
		(0.000)		(0.013)
Institutional Share (%)		-0.001		-0.053*
		(0.001)		(0.026)
Flow-Performance Sensitivity (%)		-0.002		0.241
		(0.003)		(0.159)
Flow Volatility (%)		0.000		0.169**
		(0.001)		(0.068)
Fund Age		0.005		-0.025
		(0.006)		(0.292)
Time FE	✓	✓	✓	✓
R-squared	0.174	0.193	0.113	0.161
N	4387	3853	4387	3853

Table 3: Fund-level determinant of net forward sales

Notes: Table 3 examines the fund-level determinants of net forward sales. The dependent variable in column (1) and (2) is an indicator variable taking the value of one if a fund's net forward sale position is positive, and the dependent variable in column (3) and (4) is net forward sales (% of total net assets). Negative coefficients imply larger net forward purchases/long exposure. LC benchmark is an indicator variable taking the value of one if a fund tracks a local currency benchmark (e.g., JPMorgan GBI-EM index). Portfolio currency concentration is computed by taking the sum of squares for a fund's portfolio weight in a local currency as a fraction of all EM currency assets, which is constructed in the same spirit of the Herfindahl-Hirschman Index (HHI). A higher index score implies a more concentrated portfolio. Net forward sales are winsorized at 1%. Standard errors in parentheses are two-way clustered by fund and time. The estimation is based on the sample period from 2010Q1 to 2023Q3.

picture of funds' overall EM currency risk exposure. To illustrate this point, we aggregate net forward sales of each fund to the currency level and report the aggregate currency exposure of bond funds in our sample to EM currencies in Figure 3 separated by exposure due to bond holdings and due to forward usage. We find that across most major EM currencies, net long forward positions add substantially to the overall currency exposure. For currencies such as Indian Rupee (INR), Chinese Renminbi (CNY), and Polish Zloty (PLN), a large fraction of forward exposure comes from mutual funds with no corresponding bond holdings denominated in the same currency. Overall, averaged across 2010Q1 to 2023Q3, currency forwards add 25% to the bond funds' long exposure, of which more than 55% is attributed to forward-only exposure without holding bonds denominated in the same currencies. Such "naked" positions are dominated by forward purchases rather than sales across all currencies we consider. This finding constitutes the first set of evidence that forwards are primarily used to seek exposure consistent with the investment objective.

3.2 Capital control, derivative market segmentation, and the net long positions in currency forwards

Offshore-traded derivatives (such as non-deliverable forwards) offer fund managers the option to gain long currency exposure and flexibly adjust positions to manage liquidity and partly overcome barriers to capital movement across borders. We thus expect a stronger propensity of EM funds to purchase currency forwards when the currency issuer imposes stronger capital account restrictions that add to the cost of purchasing local currency bonds. The incentive to follow benchmark indices would further lead to a strong relationship between forward usage and the gap to desired currency exposure according to benchmark weights. Meanwhile, direct policy measures that affect the degree of integration between onshore and offshore forward markets may also play a role by affecting the availability of forward counterparties (see Figure 1). We use data on capital account restrictions and regulatory events to highlight the relationship. Section 5

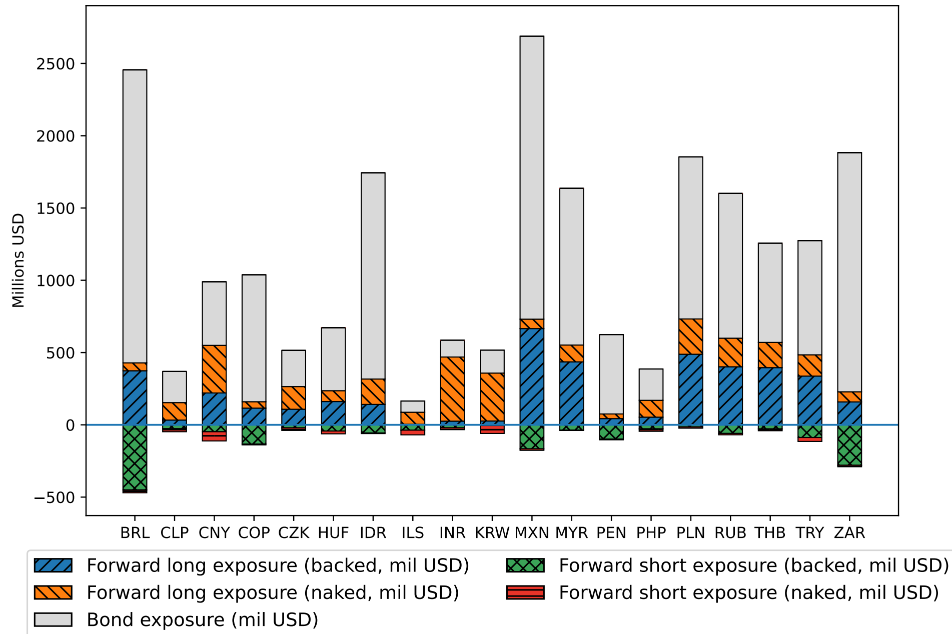
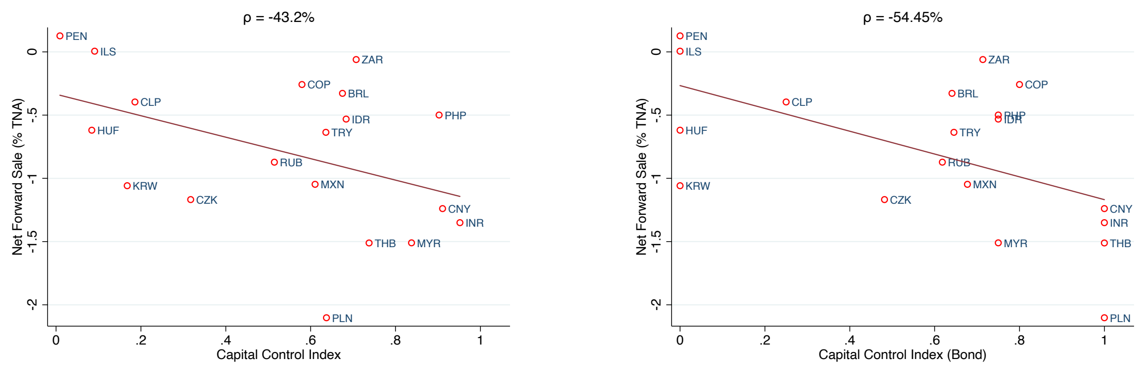


Figure 3: Bond versus forward exposure: Major EM currencies

Notes: Figure 3 reports the aggregate currency exposure of U.S. EM-focused bond funds in our sample across major EM currencies through both bond positions and forward positions, averaged across our sample period starting from 2010Q1 to 2023Q3. Naked exposure refers to forward positions of funds with zero or tiny underlying bond positions ($<$ 0.1% TNA bond positions denominated in the same currency). Backed positions refer to forward positions of funds with corresponding bond positions $\geq$ 0.1% TNA.

discusses the implication on offshore forward pricing through an equilibrium model.

Capital account restrictions We focus on the cross-section of currencies, drawing on official reports on capital control compiled by Bergant, Fernández, Teoh, and Uribe (2026). The data consists of standardized indices (ranging from 0 to 1) measuring the overall degree of policy barriers to capital inflows and outflows across different asset classes based on reports filed by country authorities to the IMF. Figure 4, Panel (a) shows that there is a strong negative relationship between a country's capital account restrictiveness and net forward sale positions of the currency of that country. We also use subindices of the Bergant et al. (2026) dataset and show in Panel (b) that consistent with our intuition, there is a stronger negative correlation between net forward sales and capital control related to the bond market, indicating that currency forwards are particularly useful instruments for fixed-income fund managers to gain exposure while alleviating explicit constraints for capital movements. In the Appendix, we further show in Figure A4 that the negative relationship between capital control and net forward sales strengthens when we consider the "naked" position reported in Figure 3.



(a) Overall capital account restrictions **(b)** Capital account restrictions for bonds

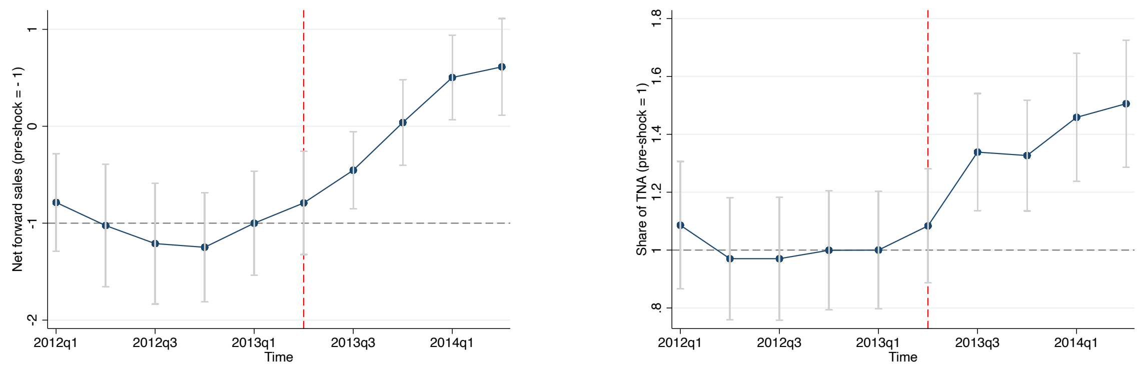
Figure 4: FX forward usage and capital control

Notes: Figure 4 presents the cross-currency correlation between net FX forward position and capital control. The left panel focuses on the capital control index that captures all asset categories. The right panel focuses on the index that captures restrictions on bond transactions. The index ranges from 0 to 1. Sample averages are taken based on winsorized net forward sales at 1% over 2010Q1 to 2023Q3. A higher capital control index indicates more stringent capital control. Data for capital control index is in annual frequency and comes from Bergant, Fernández, Teoh, and Uribe (2026).

Bond-forward substitution: Time-series evidence from Brazil We supplement cross-currency comparison with event-based evidence on the role of capital control, focusing on Brazil's repeal of its tax on financial transactions in June 2013. The tax (Imposto sobre Operações Financieras, IOF) ranges from 2% and 6% on foreign portfolio debt inflows (Du & Schreger, 2016), and has been in place since October 2009 as part of its capital flow management measures. Figure 5 traces the evolution of net forward sales and the share of bond portfolio weights denominated in Brazilian Real (BRL), and shows that forwards and bonds could be imperfect substitutes in the face of capital inflow control.[15]

[15]The repeal of the IOF is largely intended to stem capital outflow and depreciation pressure after the "Taper Tantrum" (Du & Schreger, 2016). To the extent that the policy relaxation is expected to arrest

The repeal of capital inflow tax is associated with a significant decline in net forward purchases, and a significant increase in BRL bond investments by funds in our sample, with no significant pre-trend.



(a) Net forward sales

(b) BRL-denominated bond weights

Figure 5: FX net forward sale and bond position around 2013Q2 for BRL

Notes: Figure 5 presents time-series of fund-level FX net forward sale and bond position in BRL around the regulatory event in June 2013 that removed the capital inflow tax (IOF) on foreign investment. Gray intervals represent asymptotically normal 90% confidence intervals. Net forward sales are winsorized at 1%. Appendix Figure A5 further shows that the responses are driven by both funds that sell and buy BRL forward prior to the policy shock.

Capital control, local currency benchmark, and forward usage: A triangular relationship An implication of capital control on bond inflows and outflows is that foreign funds following local currency bond indices face difficulty in fully obtaining the desired exposure in line with the indices through bond investments. Funds may use long positions in offshore forward contracts as a substitute, and we would thus observe an important triangular relationship between net forward purchases, deviation of bond positions from benchmarks, and capital control. The stronger is capital control imposed by a particular currency issuer, the more negative the gap between funds' local currency bond allocation and the corresponding weight prescribed by the index, and the stronger the incentive to bridge the gap in currency exposure through offshore forwards.

currency depreciation, it should be more difficult to discover the negative relationship between bond holdings and forward purchases. In addition, there was also little change in major local currency bond indices tracked by global investors allocating to BRL (e.g., JPM GBI-EM index).

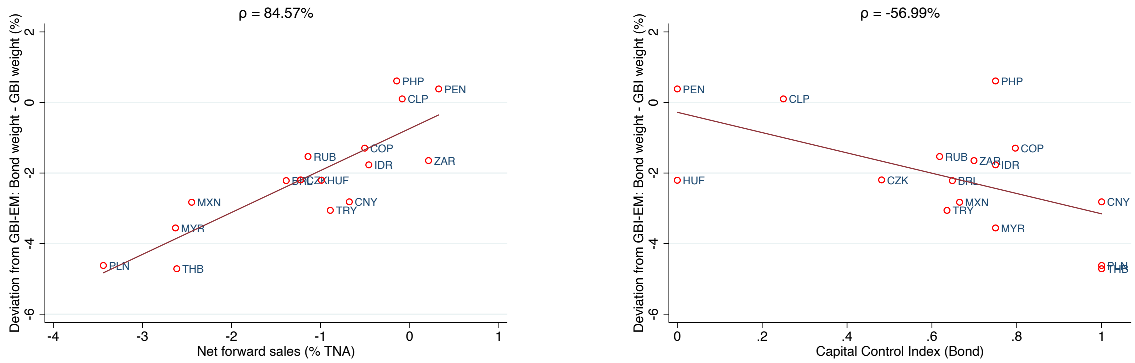
To examine this relationship, we zoom in on funds following the most popular local currency EM bond index family, the GBI-EM.[16] We calculate the time-series average of funds' allocation to bonds denominated in each currency and its deviations from the corresponding weight for an index-tracking ETF (iShares JP Morgan EM Local Currency Bond ETF), and relate the resulting gap measure to both the average net forward sales and capital control measures on bond inflows and outflows. Figure 6 demonstrates that the triangular relationship is strong. The cross-currency correlation between net forward sales and benchmark deviations is 85% (Panel (a)).[17] Meanwhile, Panel (b) shows that countries with stronger bond inflow and outflow restrictions indeed see stronger deviations of observed local currency bond allocation from benchmark prescriptions. An important takeaway from this analysis is that by substituting bonds into forwards to replicate benchmark currency exposure, benchmark-following local currency bond funds effectively place consistent bets on currency appreciation in the forward market, and thus could serve as an important source of liquidity for investors who seek to sell currencies forward to hedge currency risk. Our model in Section 5 formalizes this logic and studies its implication on currency hedging cost.

Derivative market segmentation: Event study evidence from Malaysia In addition to capital control measures that target the difficulty of capital movement across borders, we find that forward usage of our sample funds also responds to policies that directly affect the integration of offshore and onshore derivatives markets. In November 2016, the Malaysian central bank issued a notice to enforce the prohibition on domestic entities' participation in offshore, non-deliverable Ringgit forward market, partly aiming to deter speculative capital flows following shifts in the U.S. political landscape.[18] Figure 7 traces the evolution of funds' net forward sales of MYR around the regulatory shock. This enforcement action effectively severed the link between onshore and offshore forward market and increased the difficulty to trade MYR forwards offshore. Accordingly,

[16]We focus on funds not purely passive in this analysis by removing ETFs and index funds.

[17]Table A5 in the Appendix shows that a similar strong relationship can also be observed using within-fund time-series variations in benchmark deviations and net forward sales.

[18]See Schmittmann and Teng (2020) for more institutional background of Malaysia's policy tightening.



(a) Benchmark deviations and net FX forward sales

(b) Benchmark deviations and bond flow restrictions

Figure 6: Forward usage, deviations from benchmarks, and capital control: A triangular relationship

Notes: Figure 6 presents the cross-sectional correlation between deviation from a local currency benchmark (JPMorgan GBI-EM index), net forward sales, and capital control on bond transactions. The left panel plots deviation from the benchmark (bond weight − benchmark weight) against net forward sales. The right panel plots deviation from the benchmark against the bond flow restrictions index, which is based on Bergant, Fernández, Teoh, and Uribe (2026). A higher capital control index indicates more stringent capital control. Weights for the GBI-EM index are proxied by weights from the index-tracking iShares JP Morgan EM Local Currency Bond ETF. Currency-quarters not included in the GBI-EM index are excluded from the calculation. We restrict to funds only tracking GBI-EM indices, and exclude index funds and ETFs. Sample averages are taken based on winsorized net forward sales and benchmark deviations at 1% tail over 2010Q1 to 2023Q3.

aggregate outstanding net long positions of funds in our sample shrank by nearly 50% relative to the pre-shock level in 2016Q3.

3.3 Additional consideration: the role of currency fundamentals

For completeness, we consider fundamental currency characteristics that could also drive net forward positions across currencies for funds in our sample. Table 4 reports panel regressions relating aggregate net forward sales at the currency level to a series of currency fundamental indicators. The indicators include measures of the attractiveness of local currency bond investment (return differential relative to benchmark U.S. Trea-

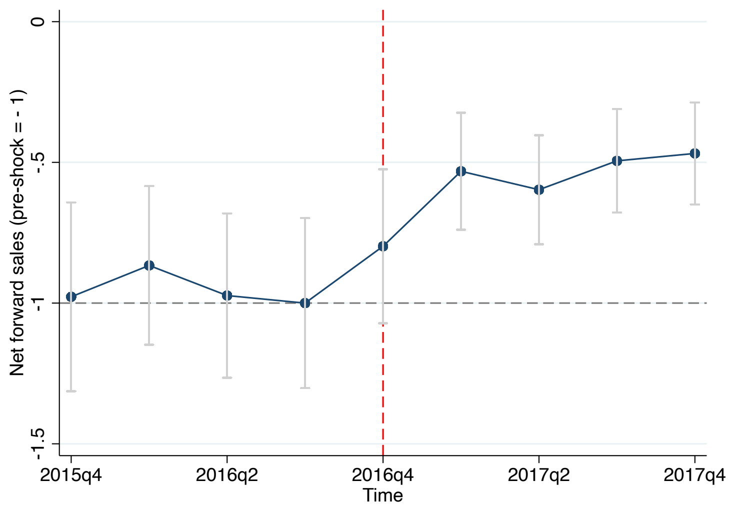


Figure 7: Fund-level net forward sales around the MYR's regulatory shock in 2016Q4

Notes: Figure 7 presents the average of net forward sale position across funds (normalized to -1 in 2016Q3) around the regulatory event in November 2016 that banned Malaysian residents from trading in FX NDF markets. Net forward sales are winsorized at 1%. Gray intervals represent asymptotically normal 90% intervals.

sury yields, as well as the slope of the yield curve proxied by 5-year minus 3-month local currency bond yield). On the currency side, we include median exchange rate forecast sourced from Bloomberg, implied volatility and deviations from CIP as the indicator for hedging cost. In our cross-sectional regressions using time fixed effect, we also examine the role of the hedging property of EM currencies, by including currency-specific β against the EM bond market (proxied by the JPMorgan GBI-EM total index return) and the US stock market (proxied by the SP500 return). We add the slow-moving capital control index examined in the previous section to cross-currency regressions to examine the robustness of its relationship with net forward purchases.

Table 4 shows that a stronger depreciation expectation is consistently associated with stronger net forward sales in the time series and the cross-section dimension. Using time-series variations (columns (1) and (2)), we find that holding all else unchanged, aggregate net forward sales rise with higher CIP deviations, suggesting a role for a rising hedging demand to materially affect hedging cost. A steeper yield curve slope is associated with lower net forward sales. Two likely explanations include global investors' rebalancing acts to exploit the positive time-series comovement between term premia and currency returns in emerging markets (De Leo, Keller, Simoncelli, Villamizar-Villegas, & Williams, 2025), as well as global investors responding to positive news in emerging markets, as yield curves tend to steepen when economic condition improves.

The attractiveness of long-term bond relative to currency forwards and outside assets can also explain the cross-currency variation of net forward sales (columns (3) and (4)). Higher return differentials relative to the U.S. and steeper yield curves are associated with stronger net forward sales. The sign of the coefficients for the yield curve slope are opposite to those obtained from the regressions with currency fixed effect. A possible explanation is that cross-sectional variation more saliently reflects the ability of currency forward contracts to mimic bond exposure to synthetically replicate benchmarks. This ability is lower when term premia is higher, given the low duration of forward contracts, leading to the observed positive correlation between yields and net forward sales. Finally, the strong negative relationship between net forward sales and capital flow restrictions remains robust in the cross section of currencies.

VARIABLES	(1) NFS (% TNA)	(2) NFS (% TNA)	(3) NFS (% TNA)	(4) NFS (% TNA)
5-Year LC-USD Govt Yield Spread (%)	-0.025	-0.020	0.144***	0.145***
	(0.030)	(0.036)	(0.030)	(0.031)
5-Year-3M LC Govt Yield Spread (%)	-0.109**	-0.107**	0.208***	0.208***
	(0.049)	(0.047)	(0.045)	(0.045)
3-Month FX Excess Return (%)	-0.019*	-0.026**	0.012	0.004
	(0.011)	(0.011)	(0.011)	(0.010)
3-Month CIP Deviations (%)	0.056**	0.054**	0.008	0.009
	(0.021)	(0.023)	(0.011)	(0.013)
Bid-Ask Spread: 3M FX Forward	0.028***	0.031***	0.035***	0.038***
	(0.010)	(0.011)	(0.012)	(0.014)
3-Month Depreciation Forecast (%)	0.015		0.019	
	(0.010)		(0.017)	
3-Month ATM Implied Volatility	-0.000		-0.027*	
	(0.017)		(0.015)	
1-Year Depreciation Forecast (%)		0.026**		0.033**
		(0.010)		(0.013)
1-Year ATM Implied Volatility		-0.012		-0.042*
		(0.024)		(0.022)
Capital Control Index			-1.345***	-1.344***
			(0.107)	(0.109)
$\beta(FX, GBI)$			0.111	0.038
			(0.190)	(0.205)
$\beta(FX, SP500)$			-0.035	-0.191
			(0.692)	(0.635)
Observations	1,025	1,025	1,025	1,025
R-squared	0.502	0.510	0.307	0.315
Number of groups	19	19	19	19
Currency FE	✓	✓	-	-
Time FE	-	-	✓	✓

Table 4: Currency-level correlates with net forward sales across major EM currencies

Notes: Table 4 reports regression results relating U.S. mutual funds' net forward sales aggregated to the currency level and a series of currency fundamental indicators associated with 19 EM currencies. Net forward sales are winsorized at 1%. Driskoll-Kraay standard errors are reported in parentheses. The sample runs from 2010Q1 to 2023Q3.

4 EM currency forwards: Investor heterogeneity

To get a deeper understanding of the market structure and heterogeneity, in this section we split funds in our sample into "local currency (LC) hedgers"—who sells EM currencies forward on average—and "local currency investors", who on average buys EM currencies forward.[19] The precise definition of these two fund types is based on their

[19]Figure A2 in the Appendix plots the time-series of FX forward usage and shows that there is a large cross-sectional dispersion.

observed forward usage patterns. A fund is classified as a local currency investor if the time-series average of its net forward position across all currencies is strictly negative (i.e., $\overline{\text{NFS}_i} < 0$), and a hedger if the mean of its net forward position is positive (i.e., $\overline{\text{NFS}_i} \geq 0$). We further require that a fund needs to use FX forward frequently for classification, such that the fund shall maintain a non-zero gross forward position (that is, the sum of forward purchase and forward sale) for at least 10 percent of the period that the fund appears in the data. This restriction filters out funds that only sporadically use currency forwards.[20]

We use a "revealed preference", data-driven approach as opposed to directly sourcing information from stated objectives for derivatives usage in fund prospectus, as such ex-ante measures do not offer much information content for classification. We read the prospectus of all funds in our sample, and show in Table A8 that more than 80 percent of funds state that they use derivatives for the dual purpose of hedging and creating synthetic exposure. Accordingly, there is no significant difference in the fraction of funds mentioning using derivatives for hedging, creating synthetic exposure, or return enhancement purposes across the local currency investor and hedger groups that we identify. While the local currency investor and hedger designation is based on the funds' overall net forward positions, Figure A7 provide further validation, that for most currencies, local currency investors' net forward sales are negative while the opposite is true for hedger funds.

Our samples funds are persistent in their currency management styles over time, as the sign of their net forward positions do not shift very often from quarter to quarter. The probability of switching the direction of its net forward exposure quarter-to-quarter is 0.11 for both types of funds. The transition probability reduces further when we

[20]Our definition of local currency investors and hedgers at the fund level reflects the currency risk borne by a fund across all forward positions. A fund may hold a short forward position in one currency while being classified as a local currency investor. Table A7 in the Appendix presents two examples of local currency investor and hedger funds, and Figure A6 plots the time-series of their net forward sales position. Table A6 in the Appendix reports the total number of fund in our sample with breakdown into local currency investor and hedger funds.

exclude funds with near-zero net forward sales. Figure 8 shows that the net forward sale position of local currency hedgers and investors mostly stay in the positive and negative territories, respectively. Net forward sale positions of local currency investors are on average more volatile.

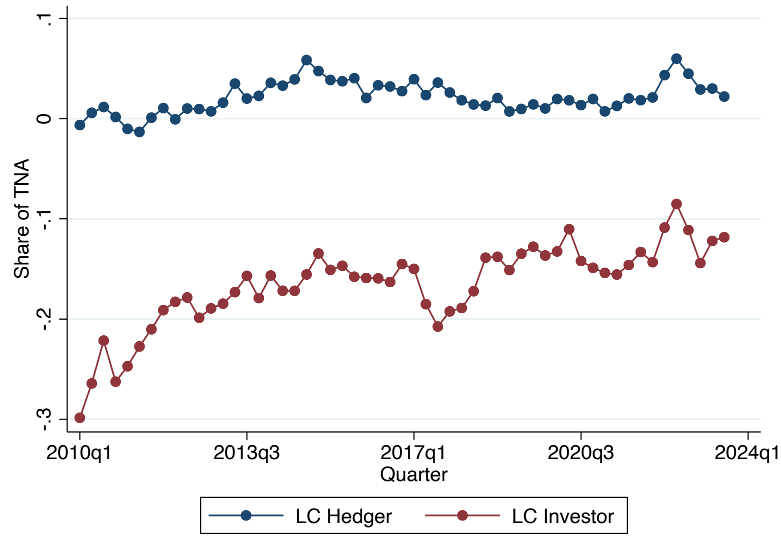


Figure 8: Time-series of net FX forward sales: LC hedger and investor funds

Notes: Figure 8 presents the time-series average of fund-level net forward sales position (scaled by total net assets) for LC hedger and LC investor funds. A fund is classified as a LC investor if the time-series average of its net forward sale position across all currencies is strictly negative, and a LC hedger if the mean of its net forward sale position is positive. Net forward sales are winsorized at 1%. The sample runs from 2010Q1 to 2023Q3.

Table 5 reports basic characteristics of local currency investor and hedger funds. Several dimensions are worth highlighting. Local currency investors predominantly follow local-currency bond indices as benchmarks, and thus their long forward positions could partially reflect the motive to substitute bonds with forwards to construct currency exposure similar to the benchmark index, documented in Figure 6. Local currency hedger funds, on the other hand, follow dollar-based indices and thus would have strong incentive to hedge local currency risk. The stark contrast in forward exposure across these two types of funds can thus be well explained by differences in investment objectives.

The average hedge ratio of hedger funds is 29%, similar to the average level reported by Sialm and Zhu (2024), while the corresponding number for local currency investors is a negative 46%. In addition, local currency investors hold substantially larger gross forward positions (56%) than local currency hedger funds do (17%), and are simultaneously exposed to more currencies (14) than hedger funds are (7). Local currency investor funds' return is also more sensitive to the movement of local currency exchange rates compared to the return on the underlying bonds.[21] These findings, taken together, supports the notion that local currency investor funds take on a role that resembles currency traders more than bond investors.

Within each group of funds, we do not find significant evidence that differences in the size of net forward positions are systematically related to different funds performance relative to their benchmarks. We further sort funds in each group into three subgroups based on the magnitudes of average net forward positions and compare their returns in excess of the returns of the funds' benchmark indices.[22] Local currency investor funds are deemed to be in the low (medium / high) forward usage group if their aggregate net forward purchases across currencies are in the first (second / third) tertile. Similar definition applies to hedger funds but for their aggregate net forward sales. Figure 9 shows that there is little evidence that local currency investor funds' average excess return is related to net forward purchases. Hedger funds' returns are the highest when funds sell the least local currency forwards. While not statistically significant, the differences may nevertheless reflect the important role of large hedging costs in affecting the synthetic dollar returns through hedged local currency bond investments.

[21] Appendix Figure A8 visualizes the distribution of local currency hedger and local currency investor funds' return beta to bond and currency returns.

[22] To compute the excess return, we use index ETFs tracking JPMorgan GBI-EM to measure benchmark returns in local currency (iShares JP Morgan EM Local Currency Bond ETF), and for dollar benchmark returns, we use index ETFs tracking the JPMorgan EMBI index (iShares JP Morgan USD Emerging Markets Bond ETF). For funds tracking blended benchmarks, we take the average of two benchmark returns.

	LC Hedger		LC Investor		Mean Diff.
	mean	sd	mean	sd	t
Total Net Assets ($ Million)	846.75	(1497.49)	690.45	(1506.54)	3.06
Hedge Ratio	0.29	(0.92)	-0.46	(1.08)	20.52
Net Forward Sales scaled by TNA	0.02	(0.06)	-0.16	(0.22)	29.80
Forward Purchases scaled by TNA	0.07	(0.16)	0.36	(0.35)	-28.61
Forward Sales scaled by TNA	0.10	(0.20)	0.20	(0.22)	-13.96
Gross Forward scaled by TNA	0.17	(0.36)	0.56	(0.54)	-23.78
Portfolio Weight of USD	0.76	(0.25)	0.42	(0.34)	31.54
Portfolio Weight of EM Currencies	0.12	(0.17)	0.42	(0.31)	-33.33
Portfolio Weight of Cash	0.03	(0.08)	0.06	(0.13)	-8.42
Maturity (Years)	10.25	(3.70)	8.55	(2.94)	15.17
Number of Portfolio Currencies	7.25	(4.57)	13.90	(5.12)	-39.63
Number of Currencies with No Bond Investment	2.76	(3.38)	4.11	(4.27)	-9.98
Portfolio Turnover Ratio	1.01	(1.14)	0.96	(0.76)	1.53
Fund Return	3.25	(1.78)	1.20	(1.74)	33.97
Return Volatility	9.91	(2.06)	10.76	(1.94)	-12.42
Flow Volatility	22.89	(16.65)	27.24	(16.65)	-7.58
Flow-Performance Sensitivity	-0.52	(6.88)	1.41	(8.39)	-7.09
LC Benchmark	0.20	(0.40)	0.77	(0.42)	-40.94
USD Benchmark	0.97	(0.18)	0.53	(0.50)	30.76
Return-Bond Sensitivity	0.65	(0.20)	0.46	(0.20)	26.98
Return-Currency Sensitivity	0.19	(0.19)	0.48	(0.27)	-35.57
Observations	1348		2404		3752

Table 5: Fund characteristics by fund classification

Note: Table 5 presents fund-quarter level characteristics for LC investors and hedgers. A fund is classified as a LC investor if the time-series average of its net forward sale position across all currencies is strictly negative, and a LC hedger if the mean of its net forward sale position is positive. Fund return is computed as the annualized quarterly return in percentage terms. Return volatility is the annualized standard deviation of quarterly return in percentage terms. Flow volatility is the standard deviation of quarterly flow in percentage terms. Flow-performance sensitivity is the flow beta to fund alpha, which is computed based on a two-factor (JPM GBI-EM and EMBI index returns) model. Flow is winsorized at 1%. Return-bond sensitivity and return-currency sensitivity refer to fund return beta to its benchmark index return and a simple average of FX spot return across 19 major EM currencies. Return betas are estimated by the following model: $Ret_{i,t} = \alpha + \beta_1 \text{GBI-EM}_t + \beta_2 \text{EMBI}_t + \beta_3 \text{FX Ret}_t + \gamma \Delta \text{VIX}_t + \epsilon_t$. We use iShares JP Morgan EM Local Currency Bond ETF to measure benchmark returns in local currency, and for dollar benchmark returns, we use iShares JP Morgan USD Emerging Markets Bond ETF. For funds with blended benchmarks, we take the average of two return betas. Net forward sales are winsorized at 1%, and for hedge ratio, we remove extreme observations of which the absolute value of hedge ratio exceeds 10. The sample runs from 2010Q1 to 2023Q3.

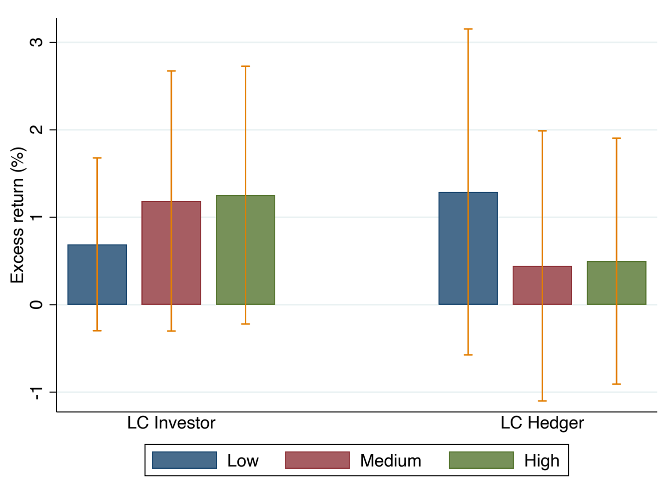


Figure 9: Benchmark-adjusted fund returns by fund type and net forward position

Notes: Figure 9 presents the average fund-level excess return relative to benchmarks. We sort both LC investor and hedger funds by their net forward positions. For LC investors, "Low" refers to funds whose average net forward purchase positions are lower in magnitude than the 33th percentile; "Medium" refers to funds whose average net forward purchase positions fall between 33th and 66th percentile; "High" refers to funds whose average net forward purchase positions are above 66th percentile. For LC hedgers, similar definition applies, but based on their aggregate net forward sales. Excess return is computed by subtracting a fund's quarterly benchmark return from its quarterly raw return, and expressed in annualized percentage terms. We use index ETFs tracking JPMorgan GBI-EM to measure benchmark returns in local currency (iShares JP Morgan EM Local Currency Bond ETF), and for dollar benchmark returns, we use index ETFs tracking the JPMorgan EMBI index (iShares JP Morgan USD Emerging Markets Bond ETF). For funds tracking blended benchmarks, we take the average of two benchmark returns. The vertical yellow line of each bar represents the 90% confidence interval of each group's excess return using Newey-West standard errors.

4.1 Correlates of forward usage vary across local currency investors and hedgers

To further understand the nature of forward demand from different types of funds, we run the following predictive regressions:

$$\text{NFS}_{ict} = \gamma' \boldsymbol{X}_{c,t-1} + \delta'(\boldsymbol{X}_{c,t-1} \times \omega_{ic,t-1}) + \chi \omega_{ic,t-1} + \alpha_{it} + \epsilon_{ict}, \tag{8}$$

where NFS_{ict} refers to net forward sales (short) position of fund i in currency c, and $\boldsymbol{X}_{c,t-1}$ includes a set of time-varying factors that capture currency-specific characteristics introduced in Table 4, such as FX return, CIP deviation, and volatility. $\omega_{ic,t-1}$ is fund

i's bond portfolio weight of currency c during the previous quarter. α_{it} denotes fund-time fixed effect. We include the interaction between currency characteristics and bond portfolio weights to capture how the exposure to local currency bond changes the responsiveness of forward usage. The base coefficient γ for local currency investor funds, for instance, can be interpreted as the sensitivity to changes in currency characteristics for funds with no underlying bond position corresponding to the same currency.

We report the results in Table 6. In Column (3), we find that the next-period forward positions of hedger funds are not responsive to current levels of currency returns, hedging cost, or volatility. In addition to the degree of capital control, the strongest predictor of hedger funds' net forward sales in a currency is their pre-existing portfolio weight of bond denominated in that currency, with the estimated coefficients exceeding hedger funds' average hedge ratio (29%). This finding is consistent with a generally inelastic demand for currency hedges, possibly due to mandates or the need to maintain a targeted hedge ratio (Cheema-Fox & Greenwood, 2024). For local currency investor funds, bond weights enter significantly (column (1)), but lose significance after interacted with currency fundamentals. For these funds, FX excess return, currency volatility, hedging cost and yield spread are among the significant predictors.[23] In addition, the sensitivity of local currency investor funds' net forward purchase to FX excess return and currency volatility fluctuations declines with bond portfolio weight, highlighting the increasing importance of hedging motive when the underlying bond position becomes more significant.[24]

[23]In Appendix D, we show that a uni-currency, mean-variance framework of optimal portfolio choice among unhedged and hedged local currency investments delivers a mixed performance in predicting optimal hedging decisions. In particular, a very low risk aversion coefficient to the order of 0.1 is needed to generate a negative hedge ratio or net forward sales. Bräuer and Hau (2025b) find that many European funds' observed forward usage does not reflect an optimal portfolio approach to hedging.

[24]Table A9 in the Appendix shows that our finding stands when we exclude a small number of fund-quarter observations with no bond investment denominated in EM currencies.

	LC Investor		LC Hedger	
	NFS (% TNA)	NFS (% TNA)	NFS (% TNA)	NFS (% TNA)
Portfolio Weight$_{t-1}$ (%)	0.172***	-0.029	0.408***	0.475***
	(0.024)	(0.054)	(0.062)	(0.094)
3M FX Excess Return$_{t-1}$ (%)	-0.010	-0.033**	0.006	0.004
	(0.010)	(0.013)	(0.008)	(0.009)
3M CIP Deviation$_{t-1}$ (%)	0.076***	0.083***	0.017	0.025*
	(0.016)	(0.018)	(0.012)	(0.012)
3M ATM Implied Volatility$_{t-1}$	-0.090***	-0.115***	-0.007	-0.012
	(0.016)	(0.023)	(0.010)	(0.013)
5Y LC-USD Govt Yield Spread$_{t-1}$ (%)	0.155***	0.120***	0.030	0.014
	(0.021)	(0.027)	(0.026)	(0.025)
5Y-3M LC Govt Yield Spread$_{t-1}$ (%)	0.102***	0.065	0.054**	0.103***
	(0.037)	(0.051)	(0.023)	(0.026)
3M Forward BA Spread$_{t-1}$	0.039***	0.044	-0.008	0.061**
	(0.012)	(0.028)	(0.015)	(0.023)
Capital Control Index$_{t-1}$	-1.870***	-1.967***	-0.612**	-0.335
	(0.214)	(0.235)	(0.234)	(0.253)
3M FX Excess Return $\times$ Weight$_{t-1}$		0.005**		0.001
		(0.002)		(0.003)
3M CIP $\times$ Weight$_{t-1}$		0.006		-0.003
		(0.004)		(0.012)
3M Vol $\times$ Weight$_{t-1}$		0.008***		0.006
		(0.003)		(0.006)
5Y LC-USD Govt Spread $\times$ Weight$_{t-1}$		0.013**		0.009
		(0.005)		(0.006)
5Y-3M Govt Spread $\times$ Weight$_{t-1}$		0.008		-0.032***
		(0.010)		(0.010)
3M BA Spread $\times$ Weight$_{t-1}$		0.000		-0.053***
		(0.006)		(0.017)
CC Index $\times$ Weight$_{t-1}$		0.062		-0.252**
		(0.066)		(0.099)
Fund*Time FE	✓	✓	✓	✓
R-squared	0.381	0.388	0.359	0.369
N	30875	30875	7976	7976

Table 6: Predicting net forward sale using currency characteristics: By fund type

Notes: Table 6 reports regression results based on Equation (8) in understanding the currency-level determinants of currency forward positions by different types of U.S. EM-focused bond funds. A fund is classified as a LC investor fund if the time-series average of its net forward sale position across all currencies is strictly negative, and a LC hedger if the mean of its net forward sale position is positive. The dependent variable is the net forward sale position of fund i in currency c at time t. Net forward sales are winsorized at 1%. Standard errors in parentheses are two-way clustered by fund and time. The sample period is 2010Q1–2023Q3.

5 Connection to exchange rate dynamics

Informed by empirical findings in Section 3 and 4, we build on Tsiang (1959) and introduce a partial equilibrium model of the offshore forward market with investor heterogeneity and various forms of market access restriction or intermediation friction. The model provides an economic mechanism with testable predictions on how these frictions shape offshore speculative and hedging forces, and further affect forward exchange rate dynamics. Focusing on the currency forward market equilibrium, we characterize the dependence of currency hedging cost on the cost of accessing the bond market or intermediating offshore forward trades.

5.1 Model setup

Local currency hedger A fixed income investor in EM local currency debt enters period 0 with wealth $W_0^{\$}$ in US dollar. She can invest in the local currency bond ("peso"), which yields a risk-free, exogenous return $(1+r)$ in period 1. The rest of the hedger's wealth is invested in risk-free USD cash. The peso-dollar exchange rate in period 1 is the only source of uncertainty in the market. To focus on the determination of equilibrium forward exchange rate, we assume that spot exchange rate process $\{S_0, S_1\}$ in units of peso per USD is exogenously given. In the data, emerging market currencies command a positive UIP premium, $\mathbb{E}\left[\frac{S_0(1+r)}{S_1} - 1\right] > 0$ (Kalemli-Özcan & Varela, 2022). In what follows, we assume that the first moment of S_1 is such that this condition holds.

Similar to Liao and Zhang (2024) and Du and Huber (2024), we assume that the hedger holds a pre-determined amount of peso bonds equal to ωW_0, where W_0 is the wealth of the hedger converted to pesos. She can enter into a forward agreement that sells (or buys) peso in period 1 at the forward exchange rate F (also in units of peso per USD). Similar to the market structure in a large number of emerging market currencies, the forward contract is non-deliverable, involving no currency exchange at inception. In period 1, counterparties settle the profit and loss in USD. A contract worth one peso of notional value sold at time 0 is expected to generate a profit of $F^{-1} - \mathbb{E}[S_1^{-1}]$ in USD terms, where S_1 is the peso-dollar exchange rate in period 1. The larger the peso is expected to depreciate (a higher $\mathbb{E}[S_1]$), the higher is the expected profit from selling peso forward and locking in the exchange rate at F.

The hedger has mean-variance preference over wealth at period 1. Given a predetermined local currency bond weight ω, she chooses the notional amount of forward contracts to sell, h, takes period 0 forward exchange rate F and period 1 spot exchange rate expectation given, and solves the following problem:

$$\max_h \mathbb{E}\Big[\frac{\omega W_0(1+r)}{S_1} + \frac{h}{F} - \frac{h}{S_1}\Big] - \frac{\gamma_h}{2} Var\Big(\frac{\omega W_0(1+r)}{S_1} + \frac{h}{F} - \frac{h}{S_1}\Big)$$

where γ_h is the risk aversion coefficient of the hedger. As will be seen later, the fundamental hedging demand of the hedger is increasing in γ_h.

The optimal amount of forward selling as a share of total wealth (the counterpart to NFS in our empirical analysis) is implied from the first-order condition:

$$\tilde{h} \equiv \frac{h}{W_0} = \omega(1+r) + \frac{\mathbb{E}[F^{-1} - S_1^{-1}]}{\gamma_h Var(S_1^{-1}) W_0} \tag{9}$$

Using the definition of dollar wealth $W_0^{\$} S_0 = W_0$ and normalizing the period 0 dollar wealth $W_0^{\$}$ to 1, the optimal demand for hedging services is intuitively given by

$$\tilde{h} = \omega(1+r) + \frac{\frac{S_0}{F} - \mathbb{E}\left[\frac{S_0}{S_1}\right]}{\gamma_h Var\left(\frac{S_0}{S_1}\right)} \tag{10}$$

(10) implies that the optimal hedging decision of the investor depends on the return of the investment, since she needs to hedge a larger cash flow when the return goes up; the (inverse of) hedging cost S_0/F relative to expected appreciation of the peso; and the

variance of appreciation, scaled by the hedger's risk aversion. The first component in (10) captures the inelastic hedging demand that is insensitive to exchange rate expectation or hedging cost, due to the predetermined bond holding. The second component corresponds to an elastic component that reacts to changes in the hedging cost and exchange rate expectations. The optimal hedging demand will be increasing when the local currency is expected to depreciate by more, when the local currency depreciation becomes more volatile, or when the hedging cost decreases.

Local currency investor The local currency investor also has initial wealth $W_0^{\$} = 1$. Unlike the hedger, she can choose to tap both the onshore local currency bond market and the offshore forward market for direct and synthetic exposure to pesos. The rest of her wealth is also allocated to US at risk-free rate r_f normalized to be zero. Due to capital control, however, buying one dollar worth of local-currency bonds would incur an additional quadratic cost that scales with parameter κ_b. We label this parameter "onshoring cost" as it best captures direct restrictions on capital inflows.

The local currency investor solves the following problem:

$$\max_{\omega_s, h_s} \quad \mathbb{E}\Big[\frac{\omega_s W_0(1+r)}{S_1}\Big] + (1-\omega_s)\frac{W_0}{S_0} - \frac{\kappa_b}{2}\Big(\frac{\omega_s W_0}{S_0}\Big)^2 + h_s \mathbb{E}[S_1^{-1} - F^{-1}]$$
$$- \frac{\gamma_s}{2} Var\Big(\frac{\omega_s W_0(1+r)}{S_1} + h_s(S_1^{-1} - F^{-1})\Big)$$

The first-order conditions are given by

$$\omega_s = \kappa_b^{-1} \cdot \underbrace{\Big[\frac{S_0}{F}(1+r) - 1\Big]}_{\text{CIP deviation}} \tag{11}$$

$$\tilde{h}_s \equiv \frac{h_s}{W_0} = \frac{\mathbb{E}\Big[\frac{S_0}{S_1}\Big] - \frac{S_0}{F}}{\gamma_s Var(S_0/S_1)} - (1+r)\omega_s \tag{12}$$

The optimality conditions of local currency investors imply that in the presence of onshoring costs, local currency investors use offshore forward contracts to obtain currency risk exposure, while the optimal bond holding would depend on the effective "risk-free" excess return in dollar terms, captured via CIP deviations.[25] The first term of (12), usually labeled "speculative demand" in the literature, increases in the expected appreciation of the currency.[26] The onshoring cost parameter scales the optimal bond holding. When hedging cost (forward discount) changes, the local currency investor substitutes between onshore bond holding and offshore forward contracts.[27] We will provide mild parameter restrictions in Proposition 2 that ensures local currency investor takes a long position in both bonds and forwards in equilibrium.

Our model can be extended to incorporate benchmarking demand of local currency investors to echo our empirical findings on the role of long currency forward positions in reducing portfolio deviations from benchmarks. In Appendix C, we show that similar to prior literature (Kashyap, Kovrijnykh, Li, & Pavlova, 2021; Pavlova & Sikorskaya, 2023; Li, Pavlova, & Sikorskaya, 2026), benchmarking in our model adds an inelastic long forward demand to local currency investors. This additional force nevertheless leaves the key model predictions unchanged.

Global intermediary A global intermediary can serve as the residual absorber of demand imbalances in the offshore forward market. It has limited risk-bearing capacity: holding the forward contract on its balance sheet incurs a quadratic cost per dollar of exposure that scales with parameter c. The intermediary is nevertheless able to trade with a group of outside investors, such as investors in the onshore currency market, to offload the currency risk. With probability $\lambda(\kappa_f)$, the intermediary finds a local counterparty to offload the position. With probability $1 - \lambda(\kappa_f)$, it holds the risk into period 1 and pays the balance sheet cost. We assume that $\lambda(\kappa_f)$ satisfies $\lambda'(\kappa_f) < 0$, $\lambda(0) = 1$, and $\lim_{\kappa_f \to \infty} \lambda(\kappa_f) = 0$, so that the parameter κ_f can capture the degree of segmenta-

[25]CIP deviations in the model is inverse to the empirical counterpart defined in Section 2.

[26]See, for instance, Hirshleifer (1990) and Hacioglu Hoke et al. (2026).

[27]We use CIP deviations and forward discount interchangeably for the concept of hedging cost in the model as we assume exogenous interest rates.

tion between onshore and offshore derivative markets, or the intermediation friction: the weaker is the onshore-offshore linkage, the more difficult the intermediary could offload currency risk. Modeling global intermediaries in this way is consistent with the practice of major global banks, who are not the natural holder of currency risk but can nevertheless access EM local markets, transferring the risk from their own balance sheets to local banks and end investors (also see Jung and Jung (2022) and De Leo et al. (2024)).

Finally, for analytical tractability, we make the simplifying assumption that upon meeting outside investors, the global intermediary keeps θ fraction of expected returns from the non-deliverable contract as fees for facilitating the risk sharing.[28]

The global intermediary solves the following problem:[29]

$$\max_{h_I} \lambda(\kappa_f)\theta \cdot \mathbb{E}[S_1^{-1} - F^{-1}] \cdot h_I + (1 - \lambda(\kappa_f))\Big[\mathbb{E}[S_1^{-1} - F^{-1}]h_I - c\Big(\frac{h_I}{S_0}\Big)^2\Big]. \tag{13}$$

The intermediary's optimal supply of hedging services, normalized by the wealth of local currency hedger or investor, is given by

$$\tilde{h}_I \equiv \frac{h_I}{W_0} = \alpha(\kappa_f) \cdot \Big(\mathbb{E}\Big[\frac{S_0}{S_1}\Big] - \frac{S_0}{F}\Big), \tag{14}$$

where $\alpha(\kappa_f) \equiv \frac{1-(1-\theta)\lambda(\kappa_f)}{2(1-\lambda(\kappa_f))c}$. The price elasticity of forward supply decreases when the derivative market becomes more segmented.

[28]This can be motivated by considering a generalized Nash bargaining problem between buyers and sellers in an OTC setup, where θ represents the bargaining power of the global intermediary.

[29]We write (13) without carrying an absolute value sign for the expected difference between S_1 and F. As will be clear in Proposition 2, we focus on conditions consistent with emerging markets that generate net long offshore forward positions for global intermediaries in equilibrium. This equilibrium is relevant for EM, as shown by De Leo et al.'s (2024) Peruvian data. While our empirical analysis focuses on funds with an EM investment mandate that on average buy EM currencies forward, other investors, such as large global bond funds allocating to EMs, could have fund-level hedging mandates consistent with the pattern documented in Cheema-Fox and Greenwood (2024).

Market clearing We focus on the offshore forward market equilibrium and impose market clearing: $\tilde{h}_s + \tilde{h}_I = \tilde{h}$. The equilibrium forward premium is given by

$$\frac{S_0}{F} = \frac{\frac{1+r}{\kappa_b} + \mathbb{E}[\frac{S_0}{S_1}]C(\kappa_f) - \omega(1+r)}{C(\kappa_f) + \frac{(1+r)^2}{\kappa_b}}, \tag{15}$$

where $C(\kappa_f) \equiv \alpha(\kappa_f) + (\gamma_s^{-1} + \gamma_h^{-1}) \cdot [Var(S_0/S_1)]^{-1}$. A higher expected appreciation of the peso enlarges the profit of hedging service provision and thus strengthens the incentives of the local currency investor and intermediary to supply hedging services, leading to a lower equilibrium hedging cost. Meanwhile, a higher ω increases the inelastic hedging demand of the hedger, pushing up the equilibrium hedging cost, as the local currency investor and the intermediary would require a higher risk premium to compensate for bearing a higher quantity of currency risk. To sharpen the intuition, Proposition 1 focuses on the limiting case in which the global intermediary plays no role, and the local currency investor specializes in providing hedging services:

Proposition 1. *When $\kappa_b \to \infty$, $\kappa_f \to \infty$, and $c \to \infty$, the intermediary-less equilibrium features*

$$\frac{S_0}{F} = -\omega(1+r)\left(\frac{1}{\gamma_h} + \frac{1}{\gamma_s}\right)^{-1} Var\left(\frac{S_0}{S_1}\right) + \mathbb{E}\left[\frac{S_0}{S_1}\right] \tag{16}$$

Proof. Plug in the parameter restriction into (15) and rearrange. □

When κ_f, κ_b and $c \to \infty$, we obtain simple equation that characterizes an endogenous positive gap between the expected appreciation of the peso and forward premium, S_0/F. This gap corresponds to the local currency investor's expected profit from hedging service provision. (16) also uncovers an inverse relationship between equilibrium hedging cost and expected peso appreciation: when the peso is expected to appreciate more, local currency investors settle for a lower hedging cost, trading off the benefit of absorbing hedgers' inelastic forward demand against the expected gain from bearing currency risk.[30]

[30]The model in De Leo et al. (2024) also generates an inverse relationship between CIP and UIP devia-

In the general case with finite κ_b, κ_f, c, we can put mild restriction on the relative strength of risk aversion between the local currency hedger and the local currency investor to characterize the comparative statics connecting currency hedging cost with onshoring cost and intermediation friction:

Proposition 2. *Suppose the risk aversion of local currency investor is sufficiently small and the risk aversion of hedger is sufficiently large, and the deviation from uncovered interest parity (UIP),* $\mathbb{E}[\frac{S_0}{S_1}](1+r)-1$*, is positive. Then, there exists an equilibrium where the hedger partially hedges her currency risk and the following results hold:*

- $\frac{S_0}{F} - \mathbb{E}\left[\frac{S_0}{S_1}\right] < 0$*: the gap between forward premium and expected appreciation of the peso is negative.*
- $\frac{S_0}{F}(1+r) - 1 > 0$*: the CIP deviation is positive.*
- $\frac{\partial S_0/F}{\partial \kappa_f} < 0$*: the equilibrium hedging cost is increasing in the degree of segmentation in the forward market.*
- $\frac{\partial S_0/F}{\partial \kappa_b} > 0$*: the equilibrium hedging cost is decreasing in the onshoring cost of purchasing local currency bonds.*

Proof. See Appendix B.1. □

Proposition 2 shows that it is possible to construct an equilibrium where the local currency investor and intermediary earn positive profit from hedging service provision, while ensuring that the hedger's hedge ratio remains positive. When the local currency investor's risk aversion is low enough, the market for hedging service would be

tions, through an intermediary-based mechanism different from ours. In their model, local intermediaries cannot take currency risk. They require profits to overcome portfolio frictions so as to accommodate a higher speculative forward demand driven by UIP violations.

sufficiently deep to accommodate the hedger's hedging demand, ensuring that an equilibrium with positive forward exchange rate exists. Any γ_s below the threshold

$$\frac{1}{\omega(1+r)^2} \cdot \frac{UIP}{Var(S_0/S_1)} \tag{17}$$

would also imply that the local currency investor holds a long position on bonds, which requires CIP deviations—the effective risk-free excess return on the local bond in dollar term—to be positive. This threshold tightens with the degree of inelastic hedging demand and the volatility of spot exchange rate, but loosens when the excess return from currency risk exposure enlarges.

Meanwhile, the proof shows that if CIP deviations are positive (i.e., γ_s is below the threshold given by (17)), a necessary and sufficient condition of the hedger's forward sales being positive is given by

$$\gamma_h \omega > \frac{1}{\alpha(\kappa_f)\ Var(S_0/S_1) + \gamma_s^{-1}} \cdot \omega_s, \tag{18}$$

where the left hand side captures hedger's desire to hedge, driven by her risk aversion and the quantity of currency risk, and the right hand side reflects the intermediary and local currency investor's capacity to absorb the hedging demand. In practice, a higher γ_h could reflect the USD-based investment objective of the hedger funds in our sample. With a positive UIP premium, a higher γ_h pushes up profit from hedging service provision, so that ω_s would decrease as the local currency investor shifts from holding bonds to buying forwards, relaxing the inequality. Hence, partial hedge is guaranteed when γ_h is sufficiently large.

Proposition 2 highlights that different types of policy barriers could have starkly different implications on the equilibrium hedging cost. Higher onshoring costs in the local bond market prompts the local currency investor to shift towards building long positions in forward contracts to get exposure to EM currency risk, resulting in higher supply of hedging services and lower hedging cost. On the other hand, measures that decrease the degree of market integration between onshore and offshore forward markets—connected via the global intermediary—would increase the hedging cost, as the intermediary faces a higher possibility that its limited balance sheet space would be occupied. Subsequent sections take these predictions to the data.

5.2 Model verification: currency wedges, portfolio returns, and global financial tightening

Our model prediction is largely verified in the data by a number of empirical regularities. First, we focus on the relative deviations from interest parity ("currency wedges") across currencies and show that the data supports the tight relationship between the wedges, hedging demand, and volatility posited in Equation (16).[31] We then show that a long-short portfolio sorted on the share of long forward positions calculated using the sample funds generates an excess return, capturing the risk premium from hedging service provision. Finally, we study global financial tightening episodes, such as COVID-19, to illustrate the dynamics of hedging cost in risk-off events, driven by the unwinding of long forward positions.

Relative currency wedges Guided by (16), for each currency, we report the time-series average distance between log expected appreciation and log forward premium (both at 3-month horizon) in Figure 10. This distance is a measure of the relative deviations from interest parities, and represents the empirical counterpart to local currency investors' profit from hedging service provision. Consistent with (16), we find that this wedge is on average positive for most currencies except CZK and ILS. For Czech Koruna, the negative wedge is driven by the period of exchange rate floor imposed by the central bank against the Euro from late 2013 to early April 2017, while Figure 3 suggest that mutual funds in our sample have tiny exposure to ILS through both bonds and derivatives.

[31] Such relationships also hold in the general case. See Equation (20) in Appendix B.1.

Figure 11 further explores the cross-currency heterogeneity in the currency wedges and relate them to the primitives in our model. (16) implies that the wedge is widening in the volatility of currency depreciation ($Var(S_0/S_1)$) and the inelastic hedging demand of hedger funds (ω, the portfolio weight associated with local currency bonds). Panel (a) demonstrates a strong positive relationship between the wedges and currency volatility, while Panel (b) show that currencies with large currency wedges are also those that the hedger funds in our sample put more weight on their bond portfolio.

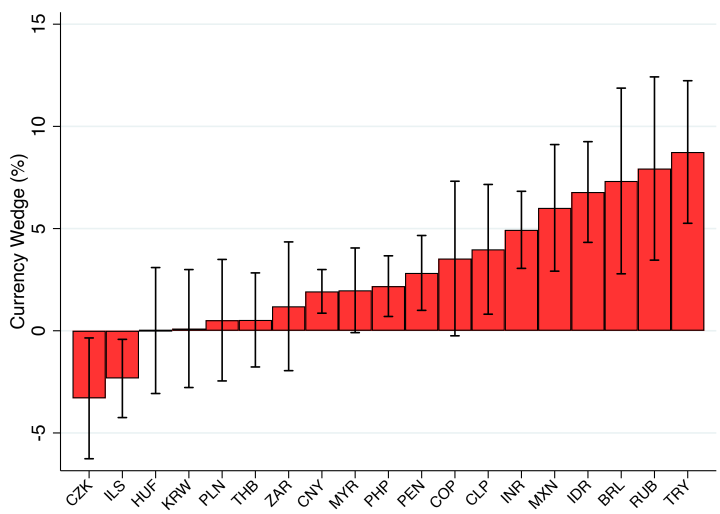
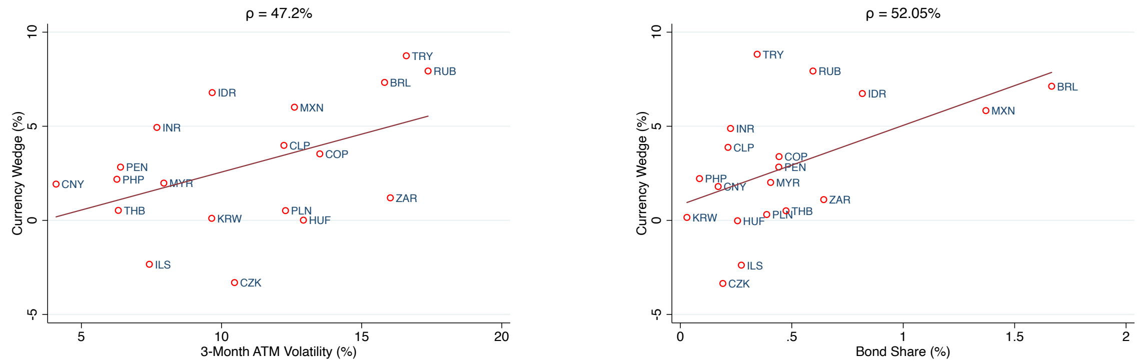


Figure 10: Relative currency wedge at 3-month horizon

Notes: Figure 10 reports the relative currency wedge ($\ln \mathbb{E}\left[\frac{S_0}{S_1}\right] - \ln \frac{S_0}{F}$) at the 3-month horizon. The vertical black line of each bar represents the 10% error band of each currency's wedge using Newey-West standard errors. The estimation is based on the sample period from 2010Q1 to 2023Q4. Our sample currencies include major EM currencies with sufficiently active foreign exchange markets: BRL, CLP, CNY, COP, CZK, HUF, IDR, ILS, INR, KRW, MXN, MYR, PEN, PHP, PLN, RUB, THB, TRY, ZAR.

Portfolio sorting In our model and data, local currency investors effectively use long forward positions to bet on currency appreciation. We use a portfolio approach to quantify the compensation for bearing such risk. Equation (12) shows that these investors' long forward demand is characterized by a "speculative demand" component. As such, we define a currency-level "speculative share" to capture cross-sectional differences in



(a) Currency volatility

(b) Currency weight in bond portfolio

Figure 11: Relative currency wedges, volatility, and currency share in hedger funds' bond portfolio

Notes: Figure 11 reports the cross-sectional correlations between various currency-level characteristics and portfolio patterns. The left panel plots the relative currency wedge $\ln \mathbb{E}\left[\frac{S_0}{S_1}\right] - \ln \frac{S_0}{F}$ (3-month tenor) against 3-month ATM implied volatility. The right panel plots the relative currency wedge against underlying bond share of hedger funds, which is computed by dividing the sum of hedger funds' local currency bond investment by the sum of their total net assets. The estimation is based on the sample period from 2010Q1 to 2023Q3. Our sample currencies include 19 major EM currencies with sufficiently active foreign exchange markets.

our sample funds' currency risk exposure through forward contracts:

$$\text{Speculative Share}_{ct} = \frac{|\sum_i \$NFS_{ict} \times \mathbb{1}\{NFS_{ict} < 0\}|}{|\sum_i \$NFS_{ict} \times \mathbb{1}\{NFS_{ict} > 0\}| + |\sum_i \$NFS_{ict} \times \mathbb{1}\{NFS_{ict} < 0\}|}. \tag{19}$$

where $\$NFS_{ict}$ denotes the dollar amount of net forward sales. We aggregate over funds that long or short currency-c forward on net to calculate the share of long forward positions. (19) is a monotonic transformation of the ratio of the aggregate currency risk exposure through forwards between funds taking a long position versus a short position.

We group the 19 major EM currencies in our sample into three equal-weighted portfolios, rebalanced every quarter based on the speculative share. We calculate the log currency return ($f_t - s_{t+1}$) and the long-short strategy of going long Portfolio 3 (highest speculative share) and shorting Portfolio 1 (lowest speculative share), and report the results in Table 7. The long-short strategy generates an excess return of 2.32% per annum. This finding is consistent with our model prediction, that local currency investors could earn a risk premium from taking a long forward position to take directional risk exposure and engage in hedging service provision.

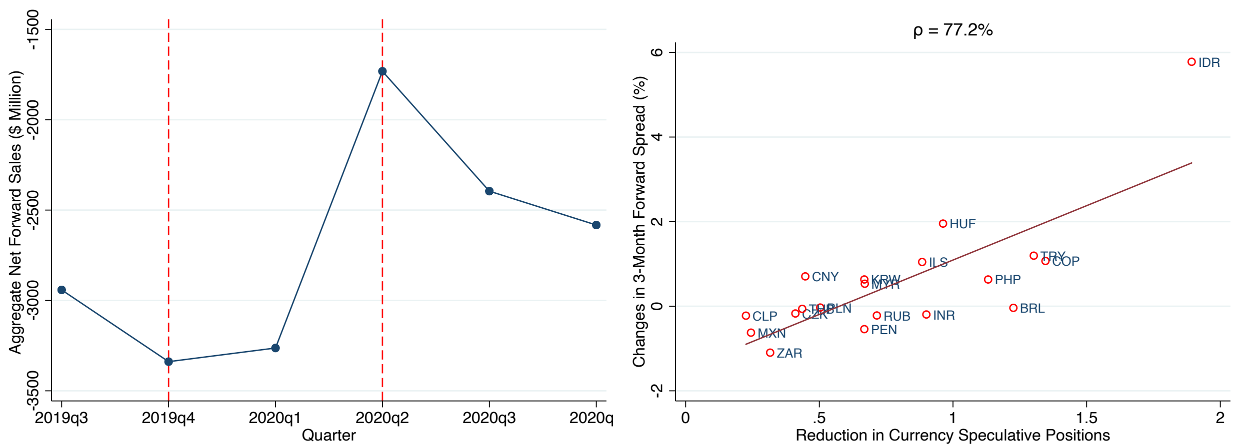
In Table 7, we also report other statistics associated with each portfolio. In particular, we find that portfolios with stronger speculative shares face stronger capital control from the currency issuer, echoing Figure 4(a). In addition, consistent with (16), these portfolios also feature currencies that are expected to depreciate by less in the future.

	Mean	STD	SE	Fwd Disc	Exp Dep	Int Diff	CCI	Sharpe Ratio
Low Speculative Share	-2.06	8.75	2.19	4.08	0.82	3.95	0.47	-0.24
Medium Speculative Share	0.26	8.32	1.99	4.30	1.13	4.05	0.55	0.03
High Speculative Share	0.25	7.50	1.82	2.52	-0.04	2.89	0.59	0.03
High Minus Low	2.32	5.46	1.44	-1.56	-0.86	-1.06	0.13	0.42

Table 7: Summary statistics: Currency portfolios sorted on speculative share

Notes: Table 7 presents the summary statistics of the currency portfolios formed based on currency-level speculative position defined in Equation (19). Portfolios are rebalanced every quarter. STD refers to standard deviation. Newey-West standard errors (SE) with 4 lags are reported. All variables are annualized and in percentage points. "Fwd disc" refers to forward discount. "Exp dep" refers to expected 3-month depreciation of the local currency sourced from Bloomberg. "Int diff" refers to raw interest rate differential, and "CCI" refers to the average capital control index for the issuing countries in each portfolio, with the data coming from Bergant, Fernández, Teoh, and Uribe (2026). The estimation is based on a monthly sample from 2010M1 to 2023M12. Our sample currencies include 19 major EM currencies with sufficiently active foreign exchange markets.

Global downturn: COVID-19 crisis Finally, we use the COVID-19 crisis to evaluate the dependence of hedging cost on the risk-bearing capacity of local currency investors and hedgers. Panel (a) of Figure 12 documents a sharp increase in aggregate net forward sales (short position) by EM-focused mutual funds during the initial phase of the COVID-19 pandemic, from 2019Q4 to 2020Q2. This shrinkage in forward trading activities is significantly correlated with currency hedging costs. For each currency, we trace the changes in the net forward position for each funds with positive net forward purchases in that currency before the shock and compute an aggregate "speculative position change" measure normalized by the absolute value of aggregate net forward position across our sample funds for that currency. Panel (b) confirms a substantial correlation (77%) between the scale of long position unwound and the rise in hedging cost in the cross-section of currencies, measured by the change in the forward premium for each currency in the same period.



(a) Aggregate net forward sales by sample funds

(b) Changes in hedging cost and forward positions across currencies

Figure 12: Changes in forward positions and hedging cost during COVID-19

Notes: Figure 12 presents in Panel (a) the time-series of aggregate net forward sale position across major EM currencies in our sample before and during the initial phase of the COVID-19 crisis (early 2020); and Panel (b), the correlation between the scale of reduction in currency long forward position and rise in hedging cost during the onset of the COVID-19 crisis. The y-axis in Panel (b) refers to change in 3-month forward spread $(f_t - s_t)$ between 2019Q4 and 2020Q2, expressed in percentage points. The x-axis in both panels corresponds to the reduction in currency long forward positions, also called "speculative" positions between 2019Q4 and 2020Q2. To calculate the change in currency speculative positions, we track the forward position changes for funds purchasing a currency forward on net in 2019Q4, aggregate them, and normalized by the absolute value of aggregate net forward position across our sample funds:

$$\Delta\text{Speculative Position}_{c,2019Q4\rightarrow 2020Q2} = \frac{(\sum_i \$NFS_{ic,2020Q2} - \sum_i \$NFS_{ic,2019Q4}) \times \mathbb{1}\{NFS_{ic,2019Q4} < 0\}}{|\$NFS_{c,2019Q4}|}$$

5.3 Hedging cost and capital flow restrictions

We now turn to the data to verify the comparative statics of hedging cost with respect to various types of capital flow restrictions in Proposition 2. As indicated by the model, we show that the empirical relationship crucially depends on whether policy measures target foreign participation in the onshore bond market or the segmentation between onshore and offshore derivative markets.

Onshoring cost We first focus on the capital control measures used in Figure 4 and Table 7. The Bergant et al. (2026) index mostly captures capital flow restrictions through increasing "onshoring" cost (a higher κ_b). Consistent with our theory, Figure 4 shows that a stronger level of onshoring cost corresponds to a higher overall degree of net forward purchase by our sample funds. Table 7 shows that the currency portfolio with the highest degree of speculative share is also the one facing the strongest average degree of capital control and lowest forward discount.

Onshore-offshore segmentation In Section 3, we discuss the enforcement of domestic NDF trading ban by Malaysia. Interpreted through the lens of our model, this policy action would increase the hedging cost through the intermediation cost channel, by making it more difficult for the global intermediary to offload currency risk to local counterparties (higher κ_f). Consistent with this prediction, we find that following the ban, 3-month CIP deviations spike by more than 300 basis points (Figure 13).

6 Conclusion

Using novel data, we analyze currency hedging and speculating by international mutual funds focused on EM fixed income assets, and relate the empirical pattern to equilibrium exchange rate dynamics. Our findings show that the currency risk exposure of an average EM-focused investor are much bigger and wider than previously understood.

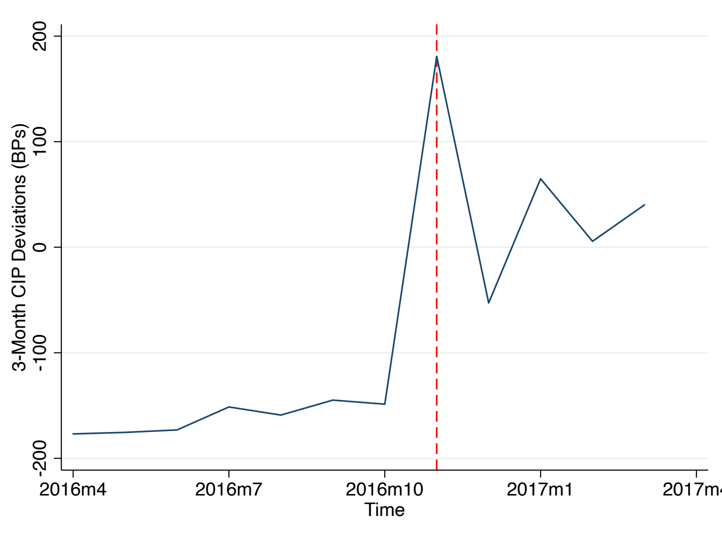


Figure 13: FX hedging cost around 2016Q4 for MYR

Notes: Figure 13 presents time-series of MYR's 3-month CIP deviations around the regulatory event in November 2016 that banned residents from trading in FX NDF markets.

We demonstrate that capital account restrictions could explain the degree of currency forward positions observed in data, underpinned by the incentive for local currency bond funds seeking currency exposure consistent with benchmark indices when facing costs to obtain such exposure directly through bonds. By separating funds into local currency investors and hedgers, we explore the key heterogeneity characterizing different types of players in the offshore forward market. Based on these findings, our model of the offshore forward market featuring heterogeneous market participants and market segmentation sheds light on the dynamics of EM currency wedges and the relationship between hedging cost and various types of policies that manage capital flows and derivative market integration. Our finding of a broader currency risk exposure borne by emerging market investors could help explain why currency indices, rather than bilateral exchange rates, tightly comove with capital flows and CIP deviations (Avdjiev et al., 2019; Jansen et al., 2024).

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Appendix

A Additional Figures and Tables

A.1 Background statistics

JPMorgan Emerging Markets Debt Fund

SCHEDULE OF PORTFOLIO INVESTMENTS
AS OF NOVEMBER 30, 2018 (Unaudited) (continued)

Forward foreign currency exchange contracts outstanding as of November 30, 2018 (amounts in thousands):

Currency Purchased		Currency Sold		Counterparty	Settlement Date	Unrealized Appreciation (Depreciation) ($)
ARS	94,723	USD	2,287	BNP Paribas**	12/4/2018	223
USD	829	ARS	30,673	Barclays Bank plc**	12/4/2018	16
USD	1,738	ARS	64,050	BNP Paribas**	12/4/2018	41
CLP	286,571	USD	424	Goldman Sachs International**	12/19/2018	3
KRW	4,178,659	USD	3,701	Goldman Sachs International**	12/19/2018	32
KRW	518,713	USD	462	Merrill Lynch International**	12/19/2018	1
ARS	84,295	USD	2,120	BNP Paribas**	12/28/2018	39
CLP	6,131,806	USD	9,115	Merrill Lynch International**	12/28/2018	15
EUR	13,547	USD	15,349	HSBC Bank, NA	12/28/2018	26
TRY	58,160	USD	8,782	Merrill Lynch International	12/28/2018	2,215

Figure A1: An example of N-Q filing: JPMorgan Emerging Markets Debt Fund

FX Counterparty	Percent	FX Counterparty	Percent
ABN AMRO	0.00	ING Financial Markets Llc	0.07
ANZ	0.17	Industrial and Commercial Bank of China	0.09
AXA	0.00	JP Morgan	14.58
BBVA	0.00	Macquarie	0.01
BNP Paribas	5.65	Mimlic	0.00
BT Brokerage	0.01	Morgan Stanley	11.04
Banco Santander	0.40	National Australia Bank	0.03
Bank of Georgia	0.00	Natixis	0.00
Bank of America	5.12	Natwest	0.68
Bank of Montreal	1.30	Nomura	0.11
Bank of New York Mellon	0.00	Northern Trust Co	0.01
Bank of Nova Scotia	0.00	Payden	0.00
Barclays	8.57	Raiffeisen	0.00
Baring	0.00	Royal Bank of Canada	0.79
Brown Brothers Harriman	0.16	Scotiabank	0.00
Canadian Imperial Bank of Commerce	0.06	Siam Commercial Bank	0.02
Cantor Fitz & Co.	0.00	Societe Generale	0.02
Citigroup	14.34	Standard Bank	0.63
Commonwealth Bank of Australia	0.03	Standard Chartered	0.07
Credit Agricole	0.30	Standard and Poor's Securities	0.02
Credit Suisse	2.21	State Street	1.96
Danske Bank	6.15	Stifel, Nicolaus & Company	0.01
Den Norske Bank	0.00	Toronto Dominion	5.42
Deutsche Bank	5.34	Truist Securities, Inc.	0.00
Dresdner	0.01	UBS	4.55
Goldman Sachs	9.42	VTB Capital Plc	0.01
HC Istanbul	0.00	Wells Fargo	0.37
HH Clearing Services	0.00	Westpac	0.22
HSBC	0.02		
Hencorp	0.00		
Highland Information Services	0.01		

Table A1: List of FX counterparties

Notes: Table A1 tabulates the list of all FX counterparties (at parent level) in our sample. The second and fourth columns indicate the percentage of observations associated with each counterparty. Some funds may report legacy counterparty names after counterparties were renamed or acquired by other institutions.

A.2 Additional statistics: Fund forward usage and correlates

	Obs	Mean	STD	P25	P50	P75
Hedge Ratio: 19 EM Currencies	3964	-0.16	1.01	-0.27	0.00	0.00
Net Forward Sales scaled by TNA: 19 EM Currencies	4313	-0.08	0.19	-0.11	-0.00	0.00
Portfolio Weight of G9 (non-USD) Currencies	4387	0.02	0.05	0.00	0.00	0.02
Portfolio Currency Concentration	4387	0.29	0.31	0.09	0.14	0.37
Portfolio Weight of Sovereign Securities	4264	0.62	0.25	0.52	0.67	0.80
Portfolio Weight of Cash	4264	0.05	0.14	0.01	0.03	0.07
Maturity (Years)	4231	8.88	3.45	7.05	8.72	11.04
Fund Age	4294	7.14	5.50	2.75	5.79	10.00
Management Fee (%)	4028	0.33	0.79	0.22	0.55	0.71
Expense Ratio (%)	4012	0.87	0.27	0.75	0.90	1.00
Turnover Ratio (%)	3984	92.61	90.80	43.00	71.00	110.00
Institutional Share (%)	4296	77.09	33.73	65.14	95.83	100.00
Flow-Performance Sensitivity (%)	4181	0.67	7.81	-1.72	0.33	3.29
Flow Volatility (%)	4274	26.22	16.64	12.42	20.65	39.35
Observations	4387					

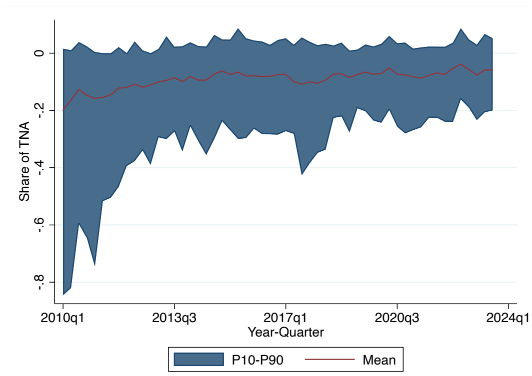
(a) Fund-level characteristics

	P0.1	P0.5	P1.0
Hedge Ratio	-0.15	-0.16	-0.16
Observations	4,021	3,887	3,725

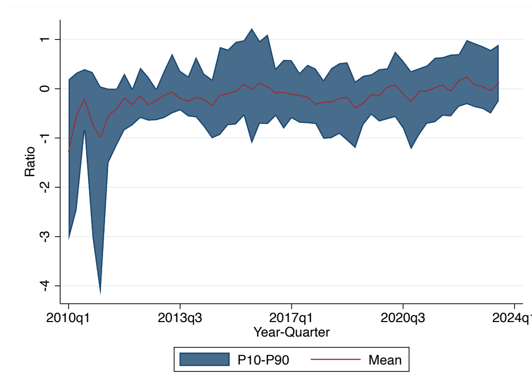
(b) Hedge ratio, with varying portfolio weight thresholds

Table A2: Additional summary statistics: Fund-level

Notes: Table A2 presents additional summary statistics of the fund-quarter level data. Panel (a) reports various fund characteristics. In the first two rows, we report hedge ratio and net forward sales based on fund-quarters with 19 major EM currencies in our analysis. Portfolio currency concentration is computed by taking the sum of squares for a fund's portfolio weight in a local currency as a fraction of all EM currency assets, which is constructed in the same spirit of the Herfindahl-Hirschman Index (HHI). A higher index score implies a more concentrated portfolio. Panel (b) presents our measure of hedge ratio at fund-level with different portfolio weight cutoffs (P, in percentage points), below which the underlying position would be regarded as too small to warrant a hedge ratio calculation. The first column reports the hedge ratio conditional on $\omega_{it} > 0.1\%$; the second column is conditional on $\omega_{it} > 0.5\%$; the third column is conditional on $\omega_{it} > 1\%$. The sample runs from 2010Q1 to 2023Q3.



(a) Net forward sale



(b) Hedge ratio

Figure A2: Time-series of fund-level FX forward usage

Notes: Figure A2 presents the time-series average of fund-level net forward sale position (scaled by total net assets) and hedge ratio from 2010Q1 to 2023Q3. Net forward sales are winsorized at 1%, and for hedge ratio, we remove extreme observations of which the absolute value of hedge ratio exceeds 10. The shaded area indicates the 10th and 90th percentiles of the corresponding variable.

	Benchmark	Ex. index/ETF	Ex. merger/liquidation
Hedge Ratio	-0.15	-0.16	-0.15
Net Forward Sales scaled by TNA	-0.09	-0.08	-0.09

Table A3: Robustness check: excluding ETF/index fund, and liquidated/merged share classes

Notes: Table A3 reports robustness check for hedge ratio and net forward sales under alternative sample selection criteria. Net forward sales are winsorized at 1%, and for hedge ratio, we remove extreme observations of which the absolute value of hedge ratio exceeds 10. Column (1) refers to our baseline sample. Column (2) is based on a sub-sample that excludes ETF and index funds. Column (3) is based on a sub-sample that excludes liquidated and merged share classes.

	$\frac{\Delta \$NFS_t}{TNA_{t-1}}$ (%)		$\frac{\Delta \$Bond_t}{TNA_{t-1}}$ (%)	
	(1)	(2)	(3)	(4)
Fund Flow (%)	-0.028***		0.212***	
	(0.007)		(0.025)	
Inflow (%)		-0.019**		0.184***
		(0.008)		(0.025)
Outflow (%)		0.079***		-0.380***
		(0.020)		(0.049)
Fund Return (%)	-0.125*	-0.114*	0.497***	0.462***
	(0.063)	(0.063)	(0.157)	(0.162)
Lag-1 Fund Return (%)	-0.158*	-0.147*	0.252*	0.213
	(0.085)	(0.085)	(0.129)	(0.130)
Lag-1 Fund Flow (%)	-0.009	-0.009	0.035***	0.034***
	(0.006)	(0.006)	(0.010)	(0.010)
Fund Controls	✓	✓	✓	✓
Time FE	✓	✓	✓	✓
R-squared	0.070	0.074	0.385	0.400
Observations	3674	3674	3674	3674

Table A4: Trading of LC bonds and forwards in response to fund flows

Notes: Table A4 reports regression results in understanding trading of bonds and forwards by U.S. EM-focused mutual funds in response to fund flows. The dependent variable in column (1) and (2) is the quarterly change in net forward sale position of fund i at time t, and the dependent variable in column (3) and (4) is the quarterly change in local currency bond weight of fund i at time t. To compute quarterly change, we divide dollar differences of net forward sale or bond position between t and $t-1$ by total net assets at $t-1$. Fund controls include LC benchmark, portfolio weight in local currency bonds, portfolio concentration, log total net assets, cash holding, expense ratio, turnover ratio, institutional share, flow-performance sensitivity, flow volatility, and fund age. LC benchmark is an indicator variable taking the value of one if a fund tracks a local currency benchmark. All dependent variables and flow variables are winsorized at 1%. Standard errors in parentheses are double-clustered by fund and time. The estimation is based on the sample period from 2010Q1 to 2023Q3.

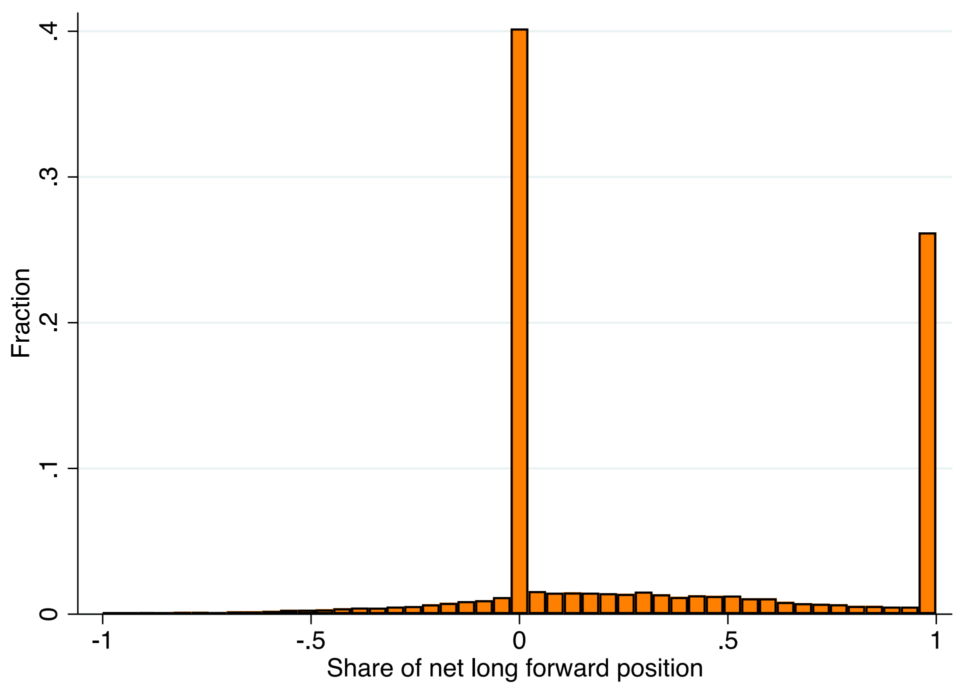
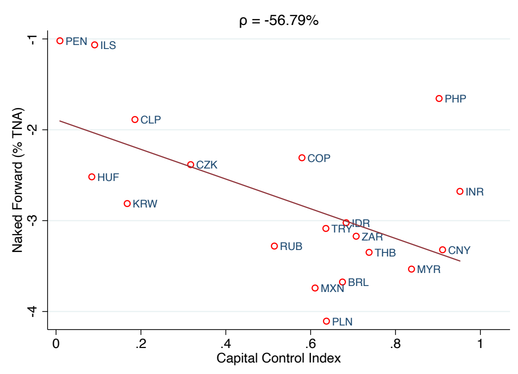
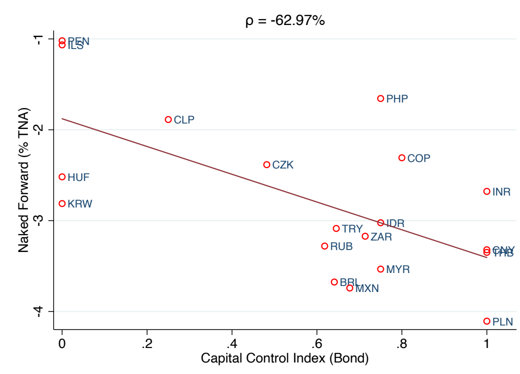


Figure A3: Histogram: share of net long forward position

Notes: Figure A3 presents histograms of share of net long forward position at fund-currency-quarter level, and illustrates the extent to which a fund's currency exposure is gained via net long forward or bond position. We restrict to 59 non-G10 EM currencies, and exclude extreme observations where the share exceeds 1. The sample runs from 2010Q1 to 2023Q3.



(a) Overall capital account restrictions



(b) Capital account restrictions for bonds

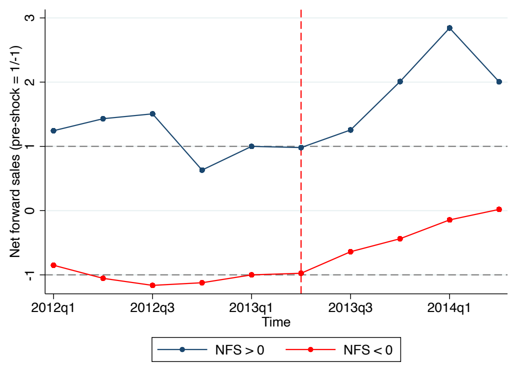
Figure A4: Naked FX net forward sale and capital control

Notes: Figure A4 presents the cross-sectional correlation between naked net forward sale position and capital control. The left panel focuses on the capital control index that captures all asset categories. The right panel focuses on the capital control index that captures restrictions on bond transactions. The capital control index ranges from 0 to 1. Sample averages are taken based on winsorized net forward sales at 1% over 2010Q1 to 2023Q3. A higher capital control index indicates more stringent capital control. Data for capital control index is in annual frequency and comes from Bergant, Fernández, Teoh, and Uribe (2026).

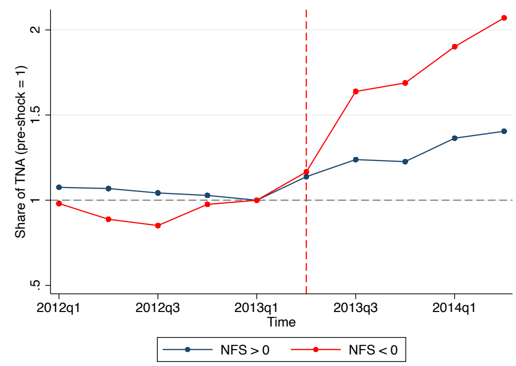
	$\frac{\Delta \$NFS_t}{TNA_{t-1}}$ (%)	NFS (% TNA)	$\frac{\Delta \$NFS_t}{TNA_{t-1}}$ (%)	$\frac{\Delta \$Bond_t}{TNA_{t-1}}$ (%)
Δ Dev. from GBI-EM (%)	0.273***			
	(0.043)			
Dev. from GBI-EM (%)		0.600***		
		(0.065)		
Δ GBI-EM weight (%)			-0.097	0.549***
			(0.077)	(0.069)
Fund Controls	✓	✓	✓	✓
Fund FE	✓	✓	✓	✓
R-squared	0.071	0.443	0.005	0.066
N	9702	9702	9702	9702

Table A5: Deviation from benchmark, net forward sales, and bond weight at fund-level: regressions

Notes: Table A5 tests (1). the relationship between funds' deviation from a local currency benchmark (JPMorgan GBI-EM index) and net forward sales at the time-series dimension; (2). the relationship between change in a local currency benchmark (JPMorgan GBI-EM index) and change in funds' net forward sales or bond weight at the time-series dimension. The dependent variable in column (1) is the quarterly change in net forward sale position of fund i in currency c at time t, and the independent variable is the quarterly change in the fund's benchmark deviation (bond weight−benchmark weight). The dependent variable in column (2) is the level of net forward sales of fund i in currency c at time t, and the independent variable, benchmark deviation, is also in levels. A more negative deviation corresponds to a lower bond weight denominated in currency c relative to the benchmark prescription. The dependent variable in column (3) is the quarterly change in net forward sale position of fund i in currency c at time t. The dependent variable in column (4) is the quarterly change of bond weight of fund i in currency c at time t. The independent variable in both columns is the quarterly change in the local currency benchmark weight. We use holdings from an ETF tracking GBI-EM index (iShares JP Morgan EM Local Currency Bond ETF) as a proxy for index weights. To compute quarterly change, we divide dollar differences of net forward sale or bond position between t and $t-1$ by total net assets at $t-1$. Fund controls include portfolio weight in local currency bonds, portfolio concentration, log total net assets, cash holding, expense ratio, turnover ratio, institutional share, flow-performance sensitivity, flow volatility, and fund age. All dependent variables and independent variables related to benchmark deviation are winsorized at 1%. All columns control for fund fixed effects, and standard errors are double-clustered by fund and time. We restrict to funds tracking only JPMorgan GBI-EM index. The estimation is based on the sample period from 2010Q1 to 2023Q3.



(a) Net forward sales: by fund type



(b) Bond position in BRL: by fund type

Figure A5: FX net forward sale and bond position around 2013Q2 for BRL: by fund type

Notes: Figure A5 presents time-series of fund-level FX net forward sale and bond position in BRL around the regulatory event in June 2013 that removed the IOF on foreign investment. We split funds into two groups based on their average pre-shock net forward sale position in BRL from 2010Q1 to 2013Q1. In particular, the blue line refers to funds whose average pre-shock net forward sale position in BRL is positive ("NFS > 0"), and the red line refers to funds whose average pre-shock net forward sale position in BRL is negative ("NFS < 0"). Net forward sales are winsorized at 1%. For each group, net forward sale and bond position in BRL are normalized by the absolute value of their pre-shock levels in 2013Q1.

A.3 LC investor and hedger funds: Additional results

Year	LC Investor	LC Hedger	Non-FX User	Total
2010	19	15	5	39
2011	39	17	11	67
2012	43	22	13	78
2013	53	29	17	99
2014	56	30	16	102
2015	57	31	16	104
2016	56	32	16	104
2017	54	34	14	102
2018	54	33	13	100
2019	48	30	13	91
2020	43	26	9	78
2021	43	25	10	78
2022	45	25	8	78
2023	41	23	10	74

Table A6: Fund type over time

Table A6 tabulates the number of LC investor and hedger funds over time. A fund is classified as a LC investor fund if the time-series average of its net forward sale position across all currencies is strictly negative, and a LC hedger if the mean of its net forward sale position is positive. The sample runs from 2010Q1 to 2023Q3.

	PIMCO EM LC and Bond Fund	Columbia EM Bond Fund
Period	2014Q3	2014Q3
Total net assets	$10.8 billion	$700 million
Benchmark index	JPM GBI-EM (LC)	JPM EMBI (USD)
Bond investment in EM currencies (% TNA)	69.8%	22.6%
Bond investment in USD (% TNA)	20.7%	73.0%
Net forward sale of EM currencies (% TNA)	-17.2%	1.9%
Net EM currency exposure (%TNA)	87.0%	20.7%

Table A7: A snapshot of two funds

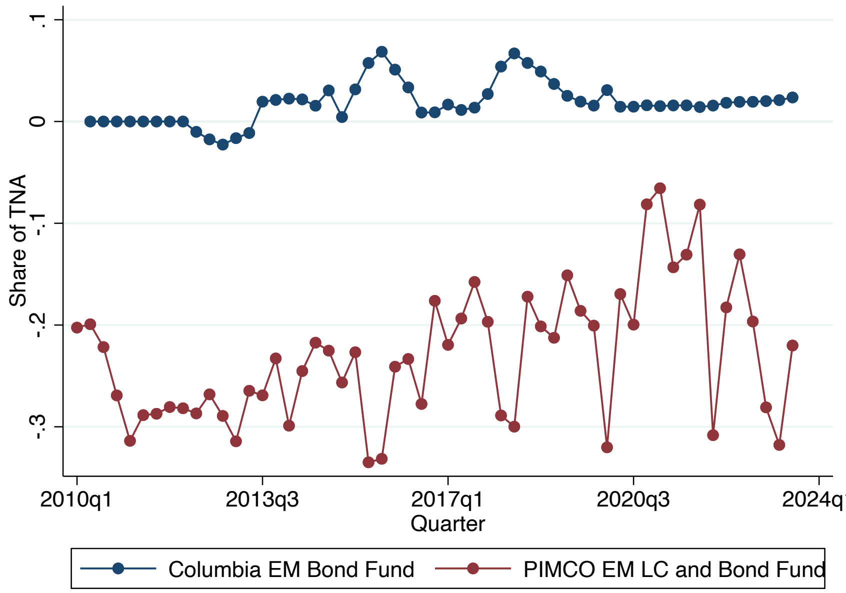


Figure A6: Example: LC investor and hedger funds

Notes: Figure A6 presents the time-series average of net forward sale position of two funds in our sample – PIMCO EM Local Currency and Bond Fund (LC investor) and Columbia EM Bond Fund (LC hedger). A fund is classified as a LC investor fund if the time-series average of its net forward sale position across all currencies is strictly negative, and a LC hedger if the mean of its net forward sale position is positive.

	LC Hedger		**LC Investor**		**Mean Diff.**
	mean	sd	mean	sd	t
Hedge	0.81	(0.39)	0.88	(0.32)	-0.99
Synthetic Exposure	0.81	(0.39)	0.90	(0.31)	-1.25
Return Enhancement	0.42	(0.50)	0.38	(0.49)	0.38
Observations	43		68		111

Table A8: Funds' stated motivation for using derivatives: Information from prospectus

Table A8 summarizes the derivative strategies for our classified group of LC investor and hedger funds based on the verbal description in their prospectuses (SEC filing N-1 or 497K). "Hedge", "Synthetic Exposure", and "Return Enhancement" indicates the proportion of funds that state to be using FX derivatives to hedge, gain synthetic exposure, and enhance return, respectively. A fund is classified as a LC investor if the time-series average of its net forward sale position across all currencies is strictly negative, and a hedger if the mean of its net forward sale position is positive. The sample runs from 2010Q1 to 2023Q3.

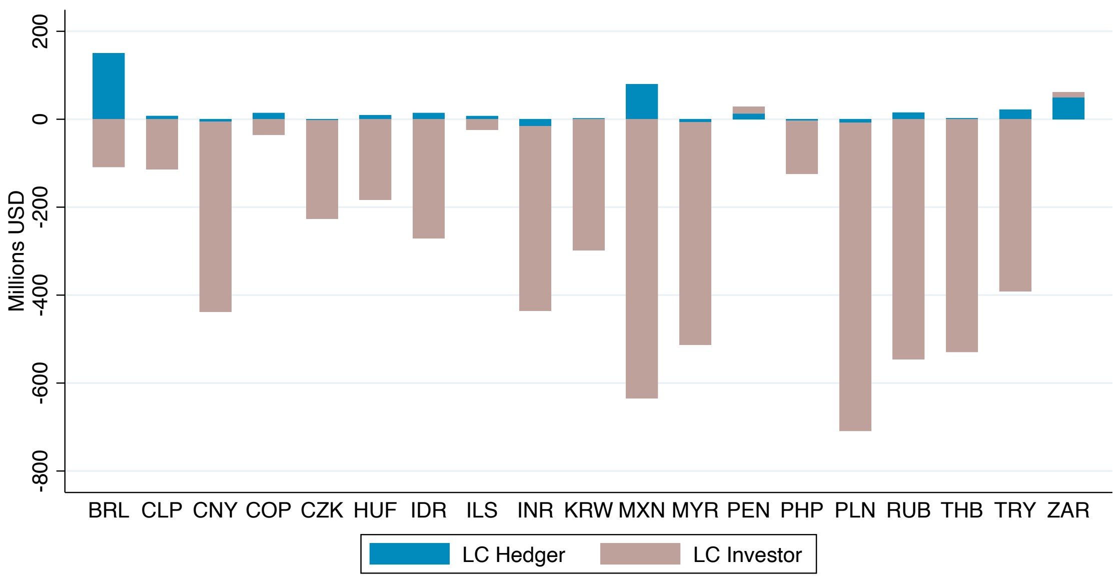


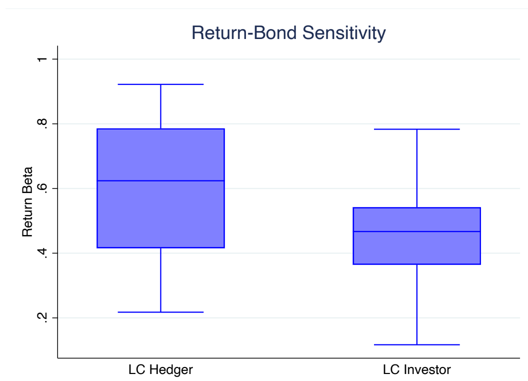
Figure A7: LC investor and hedger fund share of net forward sales in each currency

Notes: Figure A7 plots the net forward sales position of LC investor and hedger funds identified in Section 4, aggregated to the currency level. The sample runs from 2010Q1 to 2023Q3.

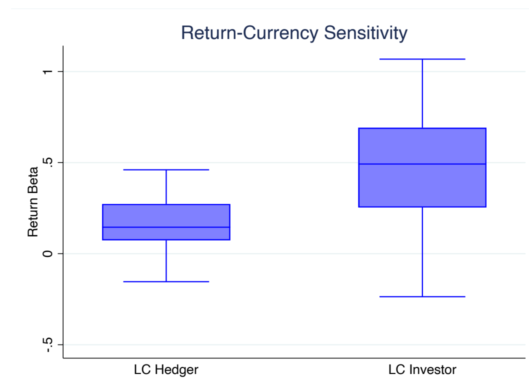
	LC Investor		LC Hedger	
	NFS (% TNA)	NFS (% TNA)	NFS (% TNA)	NFS (% TNA)
Portfolio Weight$_{t-1}$ (%)	0.172***	-0.042	0.408***	0.471***
	(0.024)	(0.054)	(0.062)	(0.094)
3M FX Excess Return$_{t-1}$ (%)	-0.009	-0.034**	0.006	0.004
	(0.010)	(0.014)	(0.008)	(0.010)
3M CIP Deviation$_{t-1}$ (%)	0.081***	0.091***	0.016	0.024*
	(0.017)	(0.019)	(0.012)	(0.013)
3M ATM Implied Volatility$_{t-1}$	-0.091***	-0.120***	-0.007	-0.012
	(0.016)	(0.025)	(0.011)	(0.013)
5Y LC-USD Govt Yield Spread$_{t-1}$ (%)	0.162***	0.130***	0.030	0.013
	(0.022)	(0.028)	(0.028)	(0.027)
5Y-3M LC Govt Yield Spread$_{t-1}$ (%)	0.105***	0.066	0.057**	0.110***
	(0.039)	(0.056)	(0.023)	(0.026)
3M Forward BA Spread$_{t-1}$	0.040***	0.045	-0.010	0.092***
	(0.012)	(0.029)	(0.017)	(0.032)
Capital Control Index$_{t-1}$	-1.928***	-2.076***	-0.632**	-0.356
	(0.217)	(0.236)	(0.238)	(0.257)
3M FX Excess Return × Weight$_{t-1}$		0.006**		0.001
		(0.002)		(0.003)
3M CIP × Weight$_{t-1}$		0.005		-0.003
		(0.004)		(0.012)
3M Vol × Weight$_{t-1}$		0.009***		0.006
		(0.003)		(0.006)
5Y LC-USD Govt Spread × Weight$_{t-1}$		0.011**		0.009
		(0.005)		(0.006)
5Y-3M Govt Spread × Weight$_{t-1}$		0.008		-0.033***
		(0.010)		(0.009)
3M BA Spread × Weight$_{t-1}$		-0.000		-0.070***
		(0.006)		(0.021)
CC Index × Weight$_{t-1}$		0.081		-0.246**
		(0.065)		(0.099)
Fund-by-Quarter FE	✓	✓	✓	✓
R-squared	0.284	0.293	0.359	0.369
N	29498	29498	7754	7754

Table A9: Predicting net forward sales using currency characteristics: By fund type (excluding fund-quarters with zero EM local currency holding)

Notes: Table A9 reports regression results based on Equation (8) in understanding the currency-level determinants of currency forward positions by different types of U.S. EM-focused mutual funds. For robustness check, fund-quarters with zero holding in EM currencies are excluded. A fund is classified as a LC investor fund if the time-series average of its net forward sale position across all currencies is strictly negative, and a LC hedger if the mean of its net forward sale position is positive. The dependent variable is the net forward sale position of fund i in currency c at time t. Net forward sales are winsorized at 1%. Standard errors in parentheses are double-clustered by fund and time. The estimation is based on the sample period from 2010Q1 to 2023Q3.



(a) Return-bond sensitivity



(b) Return-currency sensitivity

Figure A8: Return sensitivity to bond/currency returns: LC investor vs. hedger funds

Notes: Figure A8 presents the box plots of fund-return sensitivity to bond and currency returns for LC investor and hedger funds. The center line of each box represents the median of a variable. The bottom and top of each box represents 25th and 75th percentile of a variable, respectively. Return-bond sensitivity and return-currency sensitivity refer to fund return beta to its benchmark index return (JPMorgan GBI-EM or EMBI index) and a simple average of FX spot return across 19 major EM currencies. Return betas are estimated by the following model: $\text{Ret}_{i,t} = \alpha + \beta_1 \text{GBI-EM}_t + \beta_2 \text{EMBI}_t + \beta_3 \text{FX Ret}_t + \gamma \Delta \text{VIX}_t + \epsilon_t$. We use index ETFs tracking JPMorgan GBI-EM to measure benchmark returns in local currency (iShares JP Morgan EM Local Currency Bond ETF), and for dollar benchmark returns, we use index ETFs tracking the JPMorgan EMBI index (iShares JP Morgan USD Emerging Markets Bond ETF). For funds with blended benchmarks, we take the average of two return betas. The sample runs from 2010Q1 to 2023Q3.

B Proofs

B.1 Proof of Proposition 2

We start with the equation for the equilibrium relative currency wedge after applying the market clearing condition. Note that Equation (15) can be rearranged as:

$$\frac{S_0}{F} - \mathbb{E}\Big[\frac{S_0}{S_1}\Big] = -(1+r)\Big(\frac{1-(1-\theta)\lambda(\kappa_f)}{2(1-\lambda(\kappa_f))c} + \frac{1}{\gamma_s Var(S_0/S_1)} + \frac{1}{\gamma_h Var(S_0/S_1)}\Big)^{-1}\Big[\omega + \kappa_b^{-1}\cdot\Big(\frac{S_0}{F}(1+r)-1\Big)\Big] \tag{20}$$

Therefore, a sufficient condition to ensure a negative gap between forward premium and expected appreciation of the peso is $\frac{S_0}{F}(1+r)-1>0$. This condition also ensures the positivity of global intermediary's supply of hedging services, as well as the local currency investor's optimal weight in onshore bond allocation.

Applying (15), we can express the CIP deviation as:

$$\frac{S_0}{F}(1+r)-1 = \frac{UIP\cdot C(\kappa_f) - \omega(1+r)^2}{C(\kappa_f)+\frac{(1+r)^2}{\kappa_b}}.$$

A positive CIP deviation corresponds to

$$C(\kappa_f) = \alpha(\kappa_f) + \frac{1}{\gamma_s Var(S_0/S_1)} + \frac{1}{\gamma_h Var(S_0/S_1)} > \frac{\omega(1+r)^2}{UIP} \tag{21}$$

and as a result, a sufficient condition for (21) is such that

$$\frac{1}{\gamma_s Var(S_0/S_1)} > \frac{\omega(1+r)^2}{UIP}$$

and we obtain (17).

Comparative statics 1: $\frac{\partial S_0/F}{\partial \kappa_f} < 0$ Taking the partial derivative of (15) with respect to κ_f, we have:

$$\frac{\partial S_0/F}{\partial \kappa_f} = \frac{\alpha'(\kappa_f)\Big[\mathbb{E}[\frac{S_0}{S_1}]\frac{(1+r)^2}{\kappa_b} - \frac{1+r}{\kappa_b} + \omega(1+r)\Big]}{[C(\kappa_f) + \frac{(1+r)^2}{\kappa_b}]^2} \tag{22}$$

Given the definition of $\alpha(\kappa_f) = \frac{1-(1-\theta)\lambda(\kappa_f)}{2(1-\lambda(\kappa_f))c}$, it is straightforward to show that $\alpha'(\kappa_f) = \frac{\theta\lambda'(\kappa_f)}{2c(1-\lambda(\kappa_f))^2} < 0$. Thus, a sufficient condition to ensure $\frac{\partial S_0/F}{\partial \kappa_f} < 0$ is:

$$\mathbb{E}[\frac{S_0}{S_1}]\frac{(1+r)^2}{\kappa_b} - \frac{1+r}{\kappa_b} + \omega(1+r) > 0 \tag{23}$$

Rearranging the inequality, we have:

$$\kappa_b > -\omega^{-1}\Big(\mathbb{E}[\frac{S_0}{S_1}](1+r) - 1\Big) \tag{24}$$

As $\kappa_b > 0$, (24) is satisfied as long as $\mathbb{E}[\frac{S_0}{S_1}](1+r) - 1 > 0$.

Comparative static 2: $\frac{\partial S_0/F}{\partial \kappa_b} > 0$ Taking the partial derivative of (15) with respect to κ_b, we have:

$$\frac{\frac{1+r}{\kappa_b^2}\Big(C(\kappa_f)(\mathbb{E}[\frac{S_0}{S_1}](1+r) - 1) - \omega(1+r)^2\Big)}{[C(\kappa_f) + \frac{(1+r)^2}{\kappa_b}]^2} \tag{25}$$

Given the definition of $C(\kappa_f)$, $\frac{\partial S_0/F}{\partial \kappa_b} > 0$ is equivalent to

$$\alpha(\kappa_f) > \omega(1+r)^2\Big(\mathbb{E}[\frac{S_0}{S_1}](1+r) - 1\Big)^{-1} - \frac{1}{\gamma_s Var(S_0/S_1)} - \frac{1}{\gamma_h Var(S_0/S_1)} \tag{26}$$

Note that this is the same condition as in (21), which leads to (17) as a sufficient condition.

Partial hedge Finally, we have to find sufficient conditions to ensure that the hedger's optimal hedging demand is positive, i.e. $\tilde{h} > 0$. We prove that the sufficient conditions are (17) and (18), and we further show that under these conditions, the hedger only partially hedges.

By market clearing, we have:

$$\tilde{h} = \tilde{h}_s + \tilde{h}_I = \left(\alpha + \frac{1}{\gamma_s \sigma^2}\right) \cdot \frac{(1+r)(\omega + \omega_s(\cdot))}{C(\cdot)} - (1+r)\omega_s(\cdot). \tag{27}$$

To ensure $\tilde{h} > 0$, the right hand side must be larger than zero. We use $C(\cdot)$ and $\omega_s(\cdot)$ to track C's dependence on γ_h. To ease notation, we express $\alpha(\kappa_f)$ as α, and $Var(S_0/S_1)$ as σ^2.

Rearranging the implied inequality: Given (17), we have $\omega_s(\cdot) > 0$, so that the condition is equivalent to

$$\frac{\omega + \omega_s(\cdot)}{\omega_s(\cdot)} > \frac{C(\cdot)}{\alpha + \frac{1}{\gamma_s \sigma^2}}. \tag{28}$$

Observe that using the definition of $C(\cdot)$, we can rewrite this inequality to

$$\frac{\omega}{\omega_s(\cdot)} > \frac{\gamma_s}{\alpha \gamma_s \sigma^2 + 1} \cdot \gamma_h^{-1} \tag{29}$$

or

$$\frac{\gamma_h}{\omega_s(\cdot)} > \frac{\gamma_s}{\omega} \cdot \frac{1}{\alpha \gamma_s \sigma^2 + 1}. \tag{30}$$

Then (18) follows. It is straightforward to show that $\partial \omega_s(\cdot)/\partial \gamma_h < 0$ if $UIP > 0$.

First, by substituting the equilibrium forward premium in (15) into (11), we have:

$$\omega_s = \frac{C(\kappa_f)\Big(\mathbb{E}\Big[\frac{S_0}{S_1}\Big](1+r)-1\Big)-\omega(1+r)^2}{\kappa_b C(\kappa_f)+(1+r)^2} \tag{31}$$

Taking partial derivative with respect to γ_h gives us:

$$\frac{\partial \omega_s}{\gamma_h} = \frac{-\frac{(1+r)^2}{\sigma^2\gamma_h^2}(UIP+\omega\kappa_b)}{(\kappa_b C(\kappa_f)+(1+r)^2)^2} < 0. \tag{32}$$

The intuition is that a less risk-averse hedger would reduce hedging demand through forward, lowering the gain from hedging service provision and leads the local currency investor to substitute to bond investment. As a result, when γ_h is sufficiently large, the inequality would be satisfied.

Simple algebra allows us to express the optimal hedging demand as

$$\begin{aligned}
\tilde{h} &= \omega(1+r) - \frac{(1+r)[C(\kappa_f)]^{-1}(\omega+\omega_s)}{\gamma_h Var(S_0/S_1)} && (33)\\
&= \frac{\omega(1+r)\Big[\gamma_h Var(S_0/S_1)\Big(\alpha(\kappa_f)+\gamma_s^{-1}Var(S_0/S_1)^{-1}\Big)\Big]-\omega_s(1+r)}{1+\gamma_h Var(S_0/S_1)\Big(\alpha(\kappa_f)+\gamma_s^{-1}Var(S_0/S_1)^{-1}\Big)} && (34)\\
&= \omega(1+r)\xi - \omega_s(1+r)(1-\xi), && (35)
\end{aligned}$$

where $\xi = \frac{\gamma_h Var(S_0/S_1)\left(\alpha(\kappa_f)+\gamma_s^{-1}Var(S_0/S_1)^{-1}\right)}{1+\gamma_h Var(S_0/S_1)\left(\alpha(\kappa_f)+\gamma_s^{-1}Var(S_0/S_1)^{-1}\right)} \in (0,1)$.

Since $\omega_s > 0$ in equilibrium, it is straightforward to show that $\tilde{h} \in (0, \omega(1+r))$.

C Model extension: Local currency investor with benchmarks

In this section, we extend the baseline model by incorporating the benchmarking motive into the local currency investor's optimization problem. We model benchmarking by introducing tracking error aversion with respect to a pre-determined benchmark bond weight. The local currency hedger and intermediary's problems are unchanged. For completeness, we re-collect the hedger and intermediary's first-order conditions below.

Local currency hedger The hedger's optimal demand for hedging are

$$\tilde{h} = \omega(1+r) + \frac{\frac{S_0}{F} - \mathbb{E}\left[\frac{S_0}{S_1}\right]}{\gamma_h Var\left(\frac{S_0}{S_1}\right)} \tag{C1}$$

Benchmarked local currency investor Let ω_s denote the share of wealth allocated to the local-currency bond and let h_s denote the notional amount of offshore forward contracts to purchase. Then the local currency investor's period-1 dollar wealth is

$$W_1^s = \omega_s W_0 \frac{1+r}{S_1} + (1-\omega_s)\frac{W_0}{S_0} + h_s\left(S_1^{-1} - F^{-1}\right). \tag{C2}$$

Denote the benchmark local currency bond weight as $\bar{\omega}$. The benchmark wealth is given by

$$W_1^B = \bar{\omega} W_0 \frac{1+r}{S_1} + (1-\bar{\omega})\frac{W_0}{S_0}. \tag{C3}$$

Hence the tracking-error payoff is

$$W_1^s - W_1^B = (\omega_s - \bar{\omega}) W_0 \frac{1+r}{S_1} + h_s\left(S_1^{-1} - F^{-1}\right) + (\bar{\omega} - \omega_s)\frac{W_0}{S_0}. \tag{C4}$$

The benchmarked local currency investor solves

$$\max_{\omega_s, h_s} \mathbb{E}[W_1^s] - \frac{\kappa_b}{2}\left(\omega_s \frac{W_0}{S_0}\right)^2 - \frac{\gamma_s}{2}\text{Var}(W_1^s) - \frac{\tau_s}{2}\text{Var}(W_1^s - W_1^B), \tag{C5}$$

where $\gamma_s > 0$ is the mean-variance risk aversion and a new paramter $\tau_s \geq 0$ measures aversion to tracking error relative to the benchmark.

The first-order conditions are given by:

$$\omega_s = \kappa_b^{-1}\left[\frac{S_0}{F}(1+r) - 1\right]. \tag{C6}$$

$$\tilde{h}_s = \frac{\mathbb{E}[S_0/S_1] - S_0/F}{(\gamma_s + \tau_s)\text{Var}(S_0/S_1)} - (1+r)\omega_s + \frac{\tau_s}{\gamma_s + \tau_s}(1+r)\bar{\omega}. \tag{C7}$$

Global intermediary. As in the baseline model,

$$\tilde{h}_I \equiv \frac{h_I}{W_0} = \alpha(\kappa_f) \cdot \left(\mathbb{E}\left[\frac{S_0}{S_1}\right] - \frac{S_0}{F}\right), \tag{C8}$$

$$\alpha(\kappa_f) \equiv \frac{1 - (1-\theta)\lambda(\kappa_f)}{2(1 - \lambda(\kappa_f))c}, \qquad \alpha'(\kappa_f) < 0. \tag{C9}$$

C.1 Market clearing

Market clearing in the offshore forward market is

$$\tilde{h}_s + \tilde{h}_I = \tilde{h}. \tag{C10}$$

The forward premium is thus given by:

$$\frac{S_0}{F} = \frac{\frac{1+r}{\kappa_b} + \mathbb{E}\left[\frac{S_0}{S_1}\right] C_B(\kappa_f) - (1+r)\left(\omega - \frac{\tau_s}{\gamma_s + \tau_s}\bar{\omega}\right)}{C_B(\kappa_f) + \frac{(1+r)^2}{\kappa_b}}, \tag{C11}$$

where $C_B(\kappa_f) \equiv \alpha(\kappa_f) + \frac{1}{(\gamma_s+\tau_s)\sigma^2} + \frac{1}{\gamma_h \sigma^2}$.

C.2 Equilibrium

Given (C11), the equilibrium bond position of the local currency investor is

$$\omega_s = \frac{C_B(\kappa_f)\, UIP - (1+r)^2 \Omega}{\kappa_b C_B(\kappa_f) + (1+r)^2}, \tag{C12}$$

where $\Omega \equiv \omega - \frac{\tau_s}{\gamma_s+\tau_s}\bar{\omega}$ and $UIP = \mathbb{E}[\frac{S_0}{S_1}](1+r) - 1$.

The equilibrium relative currency wedge is

$$\frac{S_0}{F} - \mathbb{E}\left[\frac{S_0}{S_1}\right] = -\frac{1+r}{C_B(\kappa_f)}(\Omega + \omega_s). \tag{C13}$$

The equilibrium CIP deviation is

$$\frac{S_0}{F}(1+r) - 1 = \frac{UIP \cdot C_B(\kappa_f) - (1+r)^2 \Omega}{C_B(\kappa_f) + \frac{(1+r)^2}{\kappa_b}}. \tag{C14}$$

C.3 Comparison with the baseline model

If $\tau_s = 0$, (C11) collapses exactly to the original equilibrium as in Equation (15). The extension with benchmarking departs from the baseline through two objects:

1. the local currency investor's effective risk-bearing capacity in offshore forwards, which now becomes $\gamma_s + \tau_s$ rather than γ_s;

2. the net inelastic hedging demand becomes

$$\Omega = \omega - \frac{\tau_s}{\gamma_s + \tau_s}\bar{\omega}.$$

as benchmarking motive adds an inelastic long forward demand to local currency investors.

The analogs of Equations (17) and (18) are:

$$\gamma_s < \frac{UIP - \tau_s(1+r)^2 Var(S_0/S_1)(\omega - \bar{\omega})}{\omega(1+r)^2 Var(S_0/S_1)} \tag{C15}$$

$$\gamma_h \omega > \frac{\omega_s - \frac{\tau_s}{\gamma_s + \tau_s}\bar{\omega}}{\alpha(\kappa_f) Var(S_0/S_1) + (\gamma_s + \tau_s)^{-1}}. \tag{C16}$$

To prove the counterpart to Proposition 2, we additionally impose

$$\Omega = \omega - \frac{\tau_s}{\gamma_s + \tau_s}\bar{\omega} > 0, \tag{C17}$$

so that benchmark-induced long forward demand does not completely offset the hedger's inelastic forward sales in aggregate.

C.4 Proof of a modified Proposition 2

Proposition 3. *Assume $UIP = \mathbb{E}[S_0/S_1](1+r) - 1 > 0$ and (C17) hold. Suppose the local currency investor's risk aversion is sufficiently small, and hedger's risk aversion is sufficiently high such that (C15) and (C16) hold. Then there exists an equilibrium with*

- $\frac{S_0}{F} - \mathbb{E}[S_0/S_1] < 0$;

- $\frac{S_0}{F}(1+r) - 1 > 0$;
- $\frac{\partial(S_0/F)}{\partial\kappa_f} < 0$;
- $\frac{\partial(S_0/F)}{\partial\kappa_b} > 0$;
- *The hedger partially hedges.*

Proof. From the previous section, we have:

$$\frac{S_0}{F} - \mathbb{E}\left[\frac{S_0}{S_1}\right] = -\frac{1+r}{C_B(\kappa_f)}(\Omega + \omega_s). \tag{C18}$$

Thus, a sufficient condition for a negative gap between forward premium and expected appreciation is $\Omega + \omega_s > 0$.

From (C14), we have the CIP deviation:

$$\frac{S_0}{F}(1+r) - 1 = \frac{UIP \cdot C_B(\kappa_f) - (1+r)^2\Omega}{C_B(\kappa_f) + \frac{(1+r)^2}{\kappa_b}}. \tag{C19}$$

Hence, a positive CIP deviation is equivalent to

$$C_B(\kappa_f) > \frac{\Omega(1+r)^2}{UIP}. \tag{C20}$$

Since

$$C_B(\kappa_f) = \alpha(\kappa_f) + \frac{1}{(\gamma_s + \tau_s)\sigma^2} + \frac{1}{\gamma_h\sigma^2},$$

a sufficient condition for (C20) is such that $\gamma_s < \frac{UIP - \tau_s(1+r)^2 Var(S_0/S_1)(\omega - \bar{\omega})}{\omega(1+r)^2 Var(S_0/S_1)}$, and thus we obtain (C15).

Comparative statics with respect to κ_f. Differentiate (C11) with respect to κ_f. Only α

and hence C_B depend on κ_f, so

$$\frac{\partial(S_0/F)}{\partial\kappa_f} = \frac{\alpha'(\kappa_f)(1+r)\left(\frac{UIP}{\kappa_b}+\Omega\right)}{\left[C_B(\kappa_f)+\frac{(1+r)^2}{\kappa_b}\right]^2}. \tag{C21}$$

Because $\alpha'(\kappa_f) < 0$, UIP > 0, $\kappa_b > 0$, and $\Omega > 0$, the numerator in (C21) is negative. Therefore

$$\frac{\partial(S_0/F)}{\partial\kappa_f} < 0.$$

Comparative statics with respect to κ_b. Differentiate (C11) with respect to κ_b:

$$\frac{\partial(S_0/F)}{\partial\kappa_b} = \frac{\frac{1+r}{\kappa_b^2}\left[C_B(\kappa_f)\,UIP-(1+r)^2\Omega\right]}{\left[C_B(\kappa_f)+\frac{(1+r)^2}{\kappa_b}\right]^2}. \tag{C22}$$

The bracketed term is the numerator of the CIP deviation in (C19). Hence under (C15), it is positive, so

$$\frac{\partial(S_0/F)}{\partial\kappa_b} > 0.$$

Thus a higher onshoring cost lowers the equilibrium hedging cost.

Finally, we demonstrate that hedgers still partially hedge. Let $\beta = \frac{\tau_s}{\tau_s+\gamma_s}$. Using market clearing,

$$\begin{aligned}\tilde{h} &= \tilde{h}_s + \tilde{h}_I \\ &= \left(\alpha(\kappa_f)+\frac{1}{(\gamma_s+\tau_s)\sigma^2}\right)\frac{(1+r)(\omega+\omega_s-\beta\bar{\omega})}{C_B(\kappa_f)} - (1+r)\omega_s + \beta(1+r)\bar{\omega}.\end{aligned} \tag{C23}$$

Rearranging yields

$$\tilde{h} = \frac{1+r}{C_B(\kappa_f)}\left[\left(\alpha(\kappa_f)+\frac{1}{(\gamma_s+\tau_s)\sigma^2}\right)\omega - \frac{\omega_s-\beta\bar{\omega}}{\gamma_h\sigma^2}\right]. \tag{C24}$$

Therefore, $\tilde{h} > 0$ if and only if

$$\left(\alpha(\kappa_f) + \frac{1}{(\gamma_s + \tau_s)\sigma^2}\right)\omega > \frac{\omega_s - \beta\bar{\omega}}{\gamma_h\sigma^2},$$

which is equivalent to (C16). This is the exact counterpart to (18), with

$$\gamma_s \mapsto \gamma_s + \tau_s \qquad \text{and} \qquad \omega_s \mapsto \omega_s - \frac{\tau_s}{\gamma_s + \tau_s}\bar{\omega}.$$

Finally, partial hedging follows immediately from the hedger's first order condition (C1). Since we have established $\frac{S_0}{F} - \mathbb{E}[\frac{S_0}{S_1}] < 0$,

$$\tilde{h} = \omega(1+r) + \frac{\frac{S_0}{F} - \mathbb{E}\left[\frac{S_0}{S_1}\right]}{\gamma_h Var\left(\frac{S_0}{S_1}\right)} < \omega(1+r).$$

Combined with (C16), this gives

$$0 < \tilde{h} < \omega(1+r).$$

So the hedger partially hedges in equilibrium. □

D A mean-variance model of optimal hedging

We sketch a simple mean-variance framework following Du and Huber (2024) to take the empirical hedge ratio to the data. Consider a representative US investor with mean-variance preference. The investor chooses to invest in the US or a foreign country j, which are denominated in USD and foreign currency, respectively. Within her investment in country j, she can choose to hedge the currency risk in country j or not.

Denote log excess return on USD and foreign currency assets in country j as:

$$rx^{\$}_{t+1} = r^{\$}_{t+1} - rf^{\$}_{t} \tag{D1}$$
$$rx^{j}_{t+1} = r^{j}_{t+1} - rf^{j}_{t} \tag{D2}$$

Define the log spot exchange rate of foreign currency per USD as s_t. Then, log excess return on non-hedged foreign currency asset is:

$$\begin{aligned} rx^{j,NH}_{t+1} &= r^{j}_{t+1} - \Delta s_{t+1} - rf^{\$}_{t} && \text{(D3)} \\ &= (r^{j}_{t+1} - rf^{j}_{t}) + \underbrace{(rf^{j}_{t} - rf^{\$}_{t} - \Delta s_{t+1})}_{:=rx^{FX}_{t+1}} && \text{(D4)} \\ &= rx^{j}_{t+1} + rx^{FX}_{t+1} && \text{(D5)} \end{aligned}$$

If the investor chooses to hedge the foreign currency assets, the log excess return is:

$$\begin{aligned} rx^{j,H}_{t+1} &\approx r^{j}_{t+1} - (f_t - s_t) - rf^{\$}_{t} && \text{(D6)} \\ &= (r^{j}_{t+1} - rf^{j}_{t}) + \underbrace{(rf^{j}_{t} - rf^{\$}_{t} - (f_t - s_t))}_{:=x_t} && \text{(D7)} \\ &= rx^{j}_{t+1} + x_t && \text{(D8)} \end{aligned}$$

Effectively, there are three types of assets for the investor to choose: USD asset, hedged foreign currency asset, non-hedged foreign currency asset. Define w_j as the portfolio weight on the foreign currency asset, and $w_{j,NH}$ as the weight on non-hedged foreign currency asset in country j. By complementarity, the weight on hedged foreign currency asset is $w_j - w_{j,NH}$.

The investor chooses portfolio weights to maximizes her mean-variance utility:

$$\max_{w_j, w_{j,NH}} \mathbb{E}[rx^{P}_{t+1}] - \frac{\gamma}{2}\mathbb{V}[rx^{P}_{t+1}], \tag{D9}$$

where

$$rx^P_{t+1} = (1-w_j)rx^{\$}_{t+1} + w_{j,NH}(rx^j_{t+1} + rx^{FX}_{t+1}) + (w_j - w_{j,NH})(rx^j_{t+1} + x_t) \tag{D10}$$

$$= (1-w_j)rx^{\$}_{t+1} + w_j rx^j_{t+1} + w_{j,NH} rx^{FX}_{t+1} + (w_j - w_{j,NH})x_t \tag{D11}$$

Now, the expected return and variance on the entire portfolio can be computed as:

$$\mathbb{E}[rx^P_{t+1}] = (1-w_j)\overline{rx}^{\$} + w_j\overline{rx}^j + w_{j,NH}\overline{rx}^{FX} + (w_j - w_{j,NH})x \tag{D12}$$

$$\begin{aligned}\mathbb{V}[rx^P_{t+1}] = {} & (1-w_j)^2\sigma^2_{\$} + w_j^2\sigma_j^2 + w^2_{j,NH}\sigma^2_{FX} \\ & + 2w_j(1-w_j)\sigma_{\$,j} + 2w_{j,NH}(1-w_j)\sigma_{\$,FX} + 2w_j w_{j,NH}\sigma_{j,FX}\end{aligned} \tag{D13}$$

The optimal portfolio weights are:

$$w_j = \frac{(\sigma_{j,FX} - \sigma_{\$,FX})(\overline{rx}^{FX} - x - \gamma\sigma_{\$,FX}) - \sigma^2_{FX}(\overline{rx}^j - \overline{rx}^{\$} + x - \gamma\sigma_{\$,j} + \gamma\sigma^2_{\$})}{\gamma[(\sigma_{\$,FX} - \sigma_{j,FX})^2 - \sigma^2_{FX}\sigma^2_{j-\$}]}, \tag{D14}$$

$$w_{j,NH} = \frac{\gamma\sigma_{\$,FX}(\sigma_j^2 - \sigma_{\$,j}) + \gamma\sigma_{j,FX}(\sigma^2_{\$} - \sigma_{\$,j}) + (\sigma_{j,FX} - \sigma_{\$,FX})(\overline{rx}^j - \overline{rx}^{\$} + x) + \sigma^2_{j-\$}(x - \overline{rx}^{FX})}{\gamma[(\sigma_{\$,FX} - \sigma_{j,FX})^2 - \sigma^2_{FX}\sigma^2_{j-\$}]}, \tag{D15}$$

where $\sigma^2_{j-\$} = (\sigma_j - \sigma_{\$})^2$.

The implied hedge ratio is then:

$$\text{HR}_j = \frac{w_j - w_{j,NH}}{w_j} \tag{D16}$$

D.1 Mapping Model Prediction to Data

We use monthly data on bond and currency pricing from 2000m1 to 2021m2 as model input, and then predict hedge ratio for each currency according to equation D16. Then, we compare predicted hedge ratio with observed hedge ratio from 2021Q2 to 2023Q2 in our sample.[32] We focus on one- and three-month horizons.

For bond returns, we compute holding period return based on 10-year government bond pricing data from Du and Schreger (2016) and Du, Im, and Schreger (2018). For currency return and hedging cost, we compute currency excess return and CIP deviation based on data from Cerutti and Zhou (2024). Risk aversion γ in the benchmark calibration is set to 0.1.

In particular, for bonds, (annualized) one-month holding period return can be computed as:

$$rx_{t+1}^{j} = y_{10Y,t} - 119\Delta y_{10Y,t+1} - rf_t^j, \tag{D17}$$

where $y_{10Y,t}$ is the continuously compounded yield of 10-year government bond in country j, and rf_t^j is one-month IBOR of country j.

Next, we compute one-month currency return with one-month IBOR and spot exchange rate:

$$rx_{t+1}^{FX} = rf_t^j - rf_t^{\$} - 12\Delta s_{t+1} \tag{D18}$$

One-month hedging cost (i.e., one-month CIP deviations) is computed as in equation 1 of Section 2.

With overlapping monthly frequency, three-month holding period return of bonds can be computed by:

$$rx_{t+1}^{j} = y_{10Y,t-2} - 39(y_{10Y,t+1} - y_{10Y,t-2}) - rf_{t-2}^j, \tag{D19}$$

where $y_{10Y,t}$ is the continuously compounded yield of 10-year government bond in country j, and rf_t^j is three-month IBOR of country j.

[32] Our results are robust to different input and prediction time ranges.

Similarly, three-month currency return can be computed by:

$$rx_{t+1}^{FX} = rf_{t-2}^{j} - rf_{t-2}^{\$} - 4(s_{t+1} - s_{t-2}) \tag{D20}$$

Based on this portfolio choice framework, we calculate the variance-covariance matrix associated with EM currency and bond returns. We focus on the 1- and 3-month horizons, since these are the main tenors of the contracts in our granular data.[33] Table D1 compares the optimal hedge ratio predicted from the model to the hedge ratio we calculate from the mutual fund data. For most currencies, we are able to match the sign of the ratios, indicating that the pattern of a negative hedge ratio on average, instead of implying a general missed opportunity for EM-focused funds to reduce their currency risk exposure, may be consistent with the risk-return tradeoffs and the cost of hedging these investors are actually facing. Moreover, given the risk-return characteristics in the data, a very low degree of risk aversion is necessary to generate a negative hedge ratio.[34]

D.2 Comparative Statics: A numerical example

Here, we present a numerical example of Thailand baht (THB). In particular, we plot optimal hedge ratio by varying the level of currency return, hedging cost, and risk aversion, holding all else equal. In this exercise, we focus on one-month holding period.

Figure D1 shows that higher FX return and higher hedging cost could lead a mean-variance investor to amplify her currency risk exposure by taking negative hedge ratio. Figure D2 highlights the role of risk aversion in optimal hedging decision. In particular, given the risk-return characteristics of THB bond and currency returns, as well as hedging cost, a low level of risk aversion is essential to generate a negative hedge ratio.

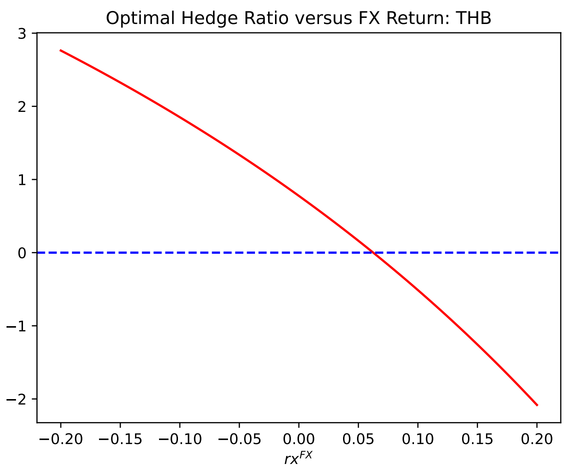
[33] Our benchmark estimation focuses on 1-month horizon, and in unreported tables, we test the robustness of our benchmark results under 3-month horizon.

[34] In our benchmark calibration, we set risk aversion γ to 0.1. In Appendix D.2, we provide additional results on comparative statistics, by plotting optimal hedge ratios against the risk aversion parameter.

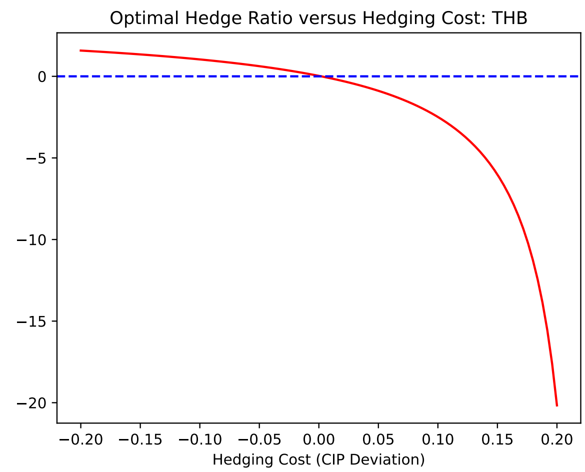
Currency	Predicted Hedge Ratio	Observed Hedge Ratio
BRL	-	-
CNY	-	-
COP	+	+
HUF	+	-
IDR*	-	-
ILS	+	+
INR	-	-
KRW	+	-
MXN	+	-
MYR	+	-
PEN	+	+
PHP	-	+
PLN	+	-
RUB*	-	-
THB	-	-
TRY	+	-
ZAR	+	+

Table D1: Signs of model-predicted versus observed hedge ratio

Notes: Table D1 compares the predicted hedge ratio from the optimal portfolio choice model versus observed hedge ratios in our sample. We use data on monthly bond and currency returns from 2000M1 to 2021M2 as model input, and then predict hedge ratio for each currency. Then, we compare predicted hedge ratio with average observed hedge ratio from 2021Q2 to 2023Q3 in our sample. For bond returns, we compute one-month holding period return based on 10-year government bond pricing data from Du and Schreger (2016) and Du, Im, and Schreger (2018). For currency return and hedging cost, we compute one-month currency return and 1-month CIP deviation based on data from Cerutti and Zhou (2024). We also test robustness of our results using 3-month holding period return and 3-month CIP deviation as an alternative measure for hedging cost. Risk aversion γ in this benchmark calibration is set to 0.1. For currencies denoted with $*$, we compare their predicted and observed net forward sale position scaled by total net assets, because we impose non-negative constraint on the underlying risky assets and these currencies have binding constraints (i.e., negative predicted weights). Model details can be found in Appendix D.



(a) FX return



(b) Hedging cost

Figure D1: Optimal hedge ratio, FX return, and hedging cost: The case of THB

Notes: Figure D1 shows the relationship between the model-implied optimal hedge ratio and FX return and hedging cost, given returns of Thai local-currency government bonds and U.S. Treasuries (in dollars), as well as variance-covariance matrix of bond and FX returns. Left panel plots optimal hedge ratio against FX return and right panel plots optimal hedge ratio against hedging cost. The following parameters (expressed in monthly percentage terms) are estimated based on a monthly sample from 2000m1 to 2021m2: $\sigma_j^2 = 7.47$, $\sigma_\$^2 = 6.4$, $\sigma_{FX}^2 = 2.84$, $\sigma_{\$,j} = 3.13$, $\sigma_{j,FX} = 0.89$, $\sigma_{\$,FX} = 0.30$, $\overline{rx}^j = 0.28$, $\overline{rx}^\$ = 0.30$, $\overline{rx}^{FX} = 0.16$, $x = -0.07$, $\gamma = 0.1$. Each plot is generated by varying the variable of interest and holding all others fixed.

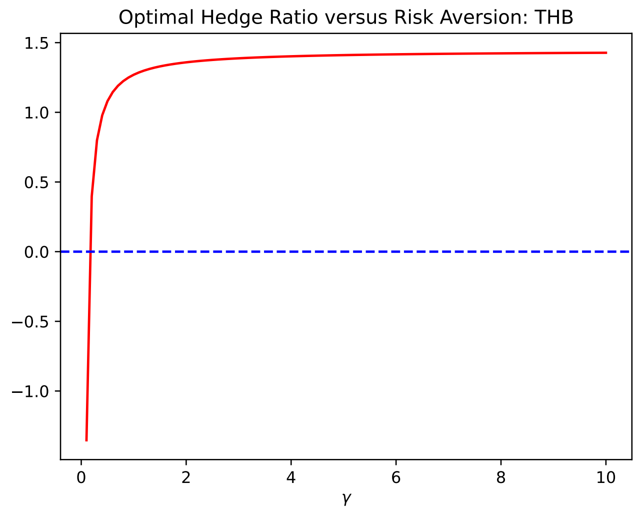


Figure D2: Optimal hedge ratio and risk aversion: The case of THB

Notes: Figure D2 presents how optimal hedge ratio of THB responds to risk appetite, given returns of Thai local-currency government bonds and U.S. Treasuries (in dollars), as well as variance-covariance matrix of bond and FX returns. The following parameters (expressed in monthly percentage terms) are estimated based on a monthly sample from 2000m1 to 2021m2: $\sigma_j^2 = 7.47$, $\sigma_\$^2 = 6.4$, $\sigma_{FX}^2 = 2.84$, $\sigma_{\$,j} = 3.13$, $\sigma_{j,FX} = 0.89$, $\sigma_{\$,FX} = 0.30$, $\overline{rx}^j = 0.28$, $\overline{rx}^\$ = 0.30$, $\overline{rx}^{FX} = 0.16$, $x = -0.07$. The plot is generated by varying the variable of interest and holding all others fixed.